BOOK OF ABSTRACTS

Edited by

Eva Debinski, Martin Diekmann, Javier Loidi, Susan Wiser & David Zelený

IAVS

DOI 10.21570/ABS-2021-63

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Plenary

A hotter and drier future: consequences for Rocky Mountain aspen forests

Blonder, Benjamin*[1]

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Extreme droughts are becoming increasingly common. In semi-arid or snowmelt-dominated regions, these climate extremes may have major effects on plant genetics, demography, and ultimately geographic distribution. Critically, these may be genetically variable, such that impacts are more severe for some populations than others, and may also be temporally lagged, so that the consequences of a given perturbation may not be apparent until several years later.

I will illustrate some of these impacts and concepts through a case study of quaking aspen (Populus tremuloides). Aspen is a foundation tree species that occurs widely from Alaska (northern USA) to Jalisco (central MX), often in monodominant stands. It has high genetic variation, can grow in spatially extensive clones, and occurs in both diploid and triploid cytotypes. The species is experiencing large mortality events in many parts of its range, and is a high priority for land management and conservation.

I will first highlight the importance of considering genetic variation in predicting species' demographic responses to changing environments. Using a combination of hyperspectral remote sensing, genomic, and field census data, I will show that the demographic consequences of heat and drought differ strongly among diploid and triploid individuals, and that allelic genetic variation is as important to predicting demography as topographic factors. Thus, mapping the geographic mosaic of genetic variation is necessary for accurate predictions of demographic responses to environmental change – and remote sensing will soon make this mapping possible.

I will second highlight the role of temporal lags in demographic responses to climate extremes. The consequences of stressors may not become apparent for months or years after a stressor, due to interactions among carbon starvation and hydraulic failure mechanisms. Using spatially and temporally extensive datasets for drought, temperature, phenology, and mortality, I will show that climate events occurring several years prior can predict phenological and demographic variation in future years, and again that genetic variation strongly influences the magnitude of these lags.

These case studies highlight the utility of integrating genomics and remote sensing with field-based measurements of vegetation, and help move us towards better prediction of the spatial and temporal heterogeneity of vegetation responses to climate extremes.

Plenary

Southern African grasslands: diverse, essential but undervalued

Greve, Michelle*[1]

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Temperate grasslands are the most transformed and least protected biome in the world. South Africa is home to an extensive area of temperate grasslands. Traditionally, low biodiversity value was placed on South African grasslands: early ecologists considered them to be forests degraded by long-term anthropogenic burning practices. We now know that they are ancient and diverse systems that originated before humans. Despite the fact that the grasslands of South Africa are the second-most diverse biome in South Africa, and that grasslands provide valuable ecosystem services, fairly little is known about the diversity of the grassland flora. I summarise what we know about patterns and drivers of grassland diversity and highlight some interesting aspects of the natural history of the biome. Grasslands harbour high alpha and beta diversity patterns at species, genus and family level. Recent work has shown that alpha diversity for the biome is higher than previously thought. Also, forbs, which, compared to grasses are rarely studied, show considerably higher beta, and often higher alpha diversity than grasses, indicating that they contribute most to the overall diversity of the grassland biome. Climatic factors are poor predictors of diversity patterns within the biome. Also, while it has been suggested that fire and frost may be important in distinguishing grasslands from the similar savanna biome by suppressing the recruitment of woody seedlings, several lines of evidence suggest that many tree species can withstand fire and frost events. Therefore, much remains to be determined in understanding the diversity and distribution of South African grasslands.

Plenary

Ecologist in the enchanted belowground world of plant communities

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Vegetation scientists generally assume that the belowground parts of plant communities mirror the aboveground parts and thus all important community responses and functions can be assessed solely by the examination of a community from above. However, this concept is not viable when we also look at a plant community from below. First, we can see that in herbaceous communities, green shoots are annual, while the longevity of roots, rhizomes, and bulbs can range from one season to decades. The relative dominance of species assessed according to the area of cover of green shoots may not be equal to dominance according to the area or biomass of belowground organs. Aboveground plant traits can be easy to measure but belowground traits are often better at responding to environmental gradients. This leads us to question whether we can ignore the belowground plant parts of our communities. I will try to answer this question showing examples of the different functions belowground plant parts provide, namely clonal multiplication and mobility, as well as the response to disturbance and productivity gradients.

Plenary

Tropical grassy biomes: A South Asian Perspective

Sankaran, Mahesh*[1]

National Centre for Biological Sciences, India[1]

Tropical grassy biomes (TGBs), which include both savannas and grasslands, are ancient biomes that harbor unique biodiverse and support the livelihoods of a large fraction of the world's human population. Although ecologists have long recognized the importance of the savannas of Africa, Australia and South America, the TGBs of Asia have been largely ignored or misclassified. Here, I first address the historical legacies that underlie this lack of appreciation of South Asian TGBs, discuss the challenges with mapping and conserving these biomes in S. Asia, and explore the potential responses of these biomes to select global change drivers. I then focus on a unique TGB – the montane forest-grassland mosaics of the southern Western Ghats biodiversity hotspot – and discuss the factors that structure these bi-phasic ecosystems and their potential responses to future climate change, and the threats and challenges facing the conservation and restoration of these ecosystems.

ID 101

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Format Poster Presentation with lightening Talk

Phytoecological study of dry vegetation in Moheli island, the only biosphere reserve of Comoros Archipelago

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The dry vegetation of Moheli island, Moheli national park, the only biosphere reserve of Comoros archipelago, is very rich in biological diversity. However, it is the most threatened and the least known. The aim of this study is to provide ecological information on the dry vegetation of this island and to develop proposals for its conservation. Two approaches were adopted for data collection: Braun-Blanquet's method and Rothe's method of regeneration. Several floristic, structural and pedological parameters were processed and analyzed to characterize the sites. Five dry plant formations of this island are identified in five sites: the dry forests of Bunduni and Rocher Hamada Ali on Istamia, the dry forest of Hagnamoida, the dry forest of Méa Island and the dry forest of Wenefu Island. Seven (7) transects were undertaken in all sites. All these forests are well stratified and the trees do not exceed 15 m in height and are deciduous. The density varies from 450 to 781 individuals per hectare. Eighty (80) species, belonging to sixty-six (66) genera and forty (40) families were identified in the four formations, including 62 trees and shrubs. The biogeography of the flora shows that 25 % of the species are endemic to the Comoros, 68 % common to Madagascar and only 7 % to Africa. Natural regeneration is high for all the plant formations studied with a rate varying from 867.64 to 967.64 %; but it is low for the Bunduni dry forest (53.96 %). Mesophanerophytes, nanophanerophytes and lianas are the predominant biological types. The most common biological traits are deciduous leaves, pachycaulia and aphylia. The most important threats are of anthropogenic origin.

ID 151

Format Oral Presentation

Theme Special session: River vegetation

How regulated flows affect the provision of riparian ecosystem services?

Aguiar, Francisca C.*[1]; Martins, Maria João[1]; Rivaes, Rui[1]; Lozanovska, Ivana[1]; Ferreira, Maria Teresa[1]; Silva, Pedro Cristiano[1]; Fernandes, Maria Rosário[1]

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Regulation of flows by dams is a continuous and heavy stress for the fluvial environment and the riparian ecosystems. We aim to assess how dam-induced alterations affect the riparian vegetation (abundance, function, composition, location), which can be further reflected in the supply and flow of ecosystem services. First, we used high-resolution airborne imagery to analyse the differences in riparian woody cover on two case studies in Portugal with different hydrological alterations by dams, namely the Touvedo dam (run-of-river) and Fronhas dam (storage reservoir). We performed a temporal comparison using pre-dam (1965) and post-dam (2013) data. For this, we digitalized the riparian patches observed in ~ 82 km on both margins of these hydropower rivers, River Lima and River Alva, respectively. We also mapped the diverse land-use and land-cover (LULC) patches in a 200 m-buffer for both dates. We computed landscape metrics for riparian patches, such as Mean Patch Size and calculated the differences between pre-dam and post-dam periods for riparian patches and LULC classes. We used paired t-tests to analyse whether the means of these differences were significantly different. Redundancy analysis was used to assess the relevance of hydrology and LULC changes on the riparian cover. Then, we complemented this study with field cover data of all woody species For this, we surveyed 31 sites in spring-summer 2019 along regulated stretches of Alva and Lima and free-flowing rivers and free-flowing rivers upstream of dams or in nearby similar rivers. We used a functional trait-based approach and devised plant guilds, which are groups of species with similar functional traits (e.g., duration of seed buoyancy), and thus potentially similar responses to disturbances. Differences of guilds' cover between regulated and free-flowing sites were assessed through Wilcoxon-Mann-Whitney tests. Riparian areas are mostly composed of alders (*Alnus glutinosa*), ashes (*Fraxinus angustifolia*), and willows (*Salix atrocinerea, S. salviifolia*). *Acacia* sp. invades some regulated reaches of River Alva. Diverse trajectories of the riparian vegetation were observed for the rivers impaired by the different dams. Riparian patches encroach into the river channel, occupy more area and are larger at the storage reservoirs than at the run-of-river setting. Riparian growth trajectory at the latter is mainly outwards from the active channel. Redundancy analyses indicated that riparian change was driven by both LULC change (e.g., agricultural land abandonment) and hydrological alterations that jointly contribute to the structure and spatial trajectories of riparian expansion. We obtained five distinct riparian guilds that had diverse responses on the diverse impaired rivers. Differences are expressed in the cover and location on the riparian zone, which affects the provision of ecosystem services, such as carbon stock, intermediate services (biodiversity) and cultural services.

ID 135

Format Oral Presentation

Theme Conservation and restoration

Make Grasslands Great Again (for insects) – Using an experiment along a soil moisture gradient to facilitate insects in a grassland-dominated agricultural landscape.

Ahlborn, Julian*[1]; Scharschmidt, Phillipp[1]; Eulenstein, Frank[1]; Lampei-Bucharova, Anna[1]; Lampei, Christian[2]; Kaiser, Thomas[1]

Leibniz Centre for Agricultural Landscape Research[1]; Philipps-University of Marburg[2]

The intensification of grassland management during the last decades has resulted in a significant loss of plant diversity, and therewith contributed to the decline of insect diversity in agricultural landscapes. In the FInAL-project, we established landscape laboratories in Germany where we try to integrate insect-friendly measures into agricultural practices. Resupplying insects with essential resources for living and reproduction on a landscape level often requires the reseeding of previously lost species in order to fill gaps in time and space. Problems in the application of such measures on the landscape level are the heterogeneity of conditions (e.g., soil moisture), which can lower the success of the measures, and the trade-offs between increase in biodiversity and the economic value. In order to overcome these obstacles in our landscape laboratory in Brandenburg, we set up an experiment on a fen grassland that mirrors the environmental and economic constrains in the landscape laboratory. We sow different mixtures of wildflowers and clover along a moisture gradient and studied the establishment success, functional properties, biomass production, forage quality and biogas potential of the treatments. Results of the first year showed the importance of soil moisture for establishment success, species diversity and biomass production. The data on the biogas potential suggests that the time of harvest is more important than the species composition of the grassland. In this talk, I will present the results of the first two years of the experiment and explore how a sowing experiment along a moisture gradient can help to improve grasslands for insects on a landscape level.

ID 122

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Growth response of plantation species (*Cedrela odorata* and *Terminalia superba*) to variability in site and climatic conditions

Akowuah, David*[1]; Guuroh, Reginald Tang[1]; Appiah, Mark[2]

Council for Scientific and Industrial Research[1]; CSIR College of Science and Technology[2]

Forest plantations serve as a sustainable resource base that will satisfy the future demand for industrial timber and enhance environmental quality. Environmental conditions such as climate affect growth rates of these plantation trees. Growth performance in forest plantations can therefore be greatly improved with research-based site-species matching and implementation of proper management regimes. The study compared the effect of site and climatic variables on growth rate of *Cedrela odorata* and *Terminalia superba* plantations that were established at three ecological zones (moist semi-deciduous zone, North West sub-type & South East sub-type, and dry semi-deciduous zone). Plots were selected from existing Permanent Sampling Plots (PSPs) each of 30 m x 30 m. Diameter at breast height and height of trees were measured in total and the mean annual increment of each tree was then determined. Soil samples were taken from study plots and analyzed while climatic variables were also obtained from WorldClim database online. Linear Mixed-effect Models were used to analyze the relationship between growth rate of trees and the environmental variables. Trends in growth rate differed across ecological zones for both *C. odorata* and *T. superba*. Soil properties within each study site varied significantly across the three ecological zones. Annual precipitation was observed to be the main environmental predictor. For *C. odorata*, annual precipitation predicted both diameter at breast height increment ($p < 0.001$) and height increment ($p < 0.01$). For *T. superba*, annual precipitation predicted DBH increment ($p < 0.001$) while precipitation of the coldest quarter also predicted height increment ($p < 0.01$). The relatively high percentage of unexplained variations in growth for both species suggest that other variables may also predict the growth rate of trees.

ID 167

Format Poster Presentation

Theme Invasive species

Plant-soil interactions of an invasive plant species in its native range help to explain its invasion success elsewhere

Aldorfová, Anna*[1]; Hanzelková, Věra[1]; Münzbergová, Zuzana[1]

Institute of Botany, Czech Academy of Sciences[1]

Plant-soil feedback (PSF) is recognized as one of the drivers of plant invasions as the loss of specialized soil enemies in the secondary range allows alien species to develop less negative PSF than the native species and gain dominance. Species most likely to benefit from enemy release and become invasive are hypothetically those more limited by specialized pathogens in the native range and able to benefit from generalistic mutualists, but evidence for this is so far scarce. We compared PSF of invasive *Cirsium vulgare* in its native range in Europe with *C. oleraceum*, native to Europe but not invading elsewhere. We grew the plants in a two-phase greenhouse experiment. First, we conditioned the soil by each of the species separately and assessed the changes in soil chemistry, soil microbial communities, and activity of arbuscular-mycorrhizal fungi (AMF). Second, we assessed abiotic, microbial, and biotic PSF by comparing the growth of the plants in self-conditioned and unplanted control soil from which all, some or no biota was excluded. Conditioning by the invasive species caused a greater increase in AMF and a greater decrease in soil nutrients than conditioning by the non-invasive species, pointing to its more efficient nutrient utilization. Its abiotic PSF was, however, not more negative, showing its plastic response to nutrients, a useful trait for an invader. Both species performed the worse the more soil biota was added to the soil, but the invasive species was more negatively affected by growth with its own specialized biota, compared to the control biota, suggesting it may benefit more from enemy release when introduced to a secondary range. Our study showed that comparing PSF of an invasive species in its native range to that of its non-invading congener may provide valuable insight into the invasive potential of the species. However, studies on more species are needed to test the generality of the results.

ID 137

Format Oral Presentation

Theme Special session: Big data and big classifications

Aquatic and semi-aquatic vegetation in the Ethiopian Rift-Valley: Combining vegetation surveys and database assessment for a consolidated syntaxonomy

Alvarez, Miguel*[1]; Wosnie, Assefa[2]; Landucci, Flavia[3]; Steinbach, Stefanie[4]; Wagaw, Solomon[5]; Mengistou, Seyoum[5]; GebreMariam, Zinabu[6]; Lansdown, Richard[7]; Hentze, Konrad[1]

University of Bonn[1], Dilla University[2], Masaryk University Brno[3], Ruhr-University Bochum[4], Addis Ababa University[5], Hawassa University[6], Ardeola Environmental Services[7]

Freshwater vegetation in Eastern Africa and elsewhere is important for the maintenance of ecosystem integrity, offering habitat to diverse organisms as well as regulating siltation, hydrological fluxes and nutrient exchange. Furthermore, a lot of ecosystem services are provided by macrophytes, including medicinal and edible plants, and material for crafts and construction. Nevertheless, human activities in nearby urban centers, agriculture, fishery and touristic activities may have negative impact on such ecosystems. Despite this relevance, little is known about the floristic composition, biogeography and ecology of plant communities growing in the transition of aquatic and terrestrial habitats. With the aim of getting a consolidated syntaxonomy for aquatic and semi-aquatic vegetation, a database has been designed as a repository for vegetation-plot records done in closed and active research projects. We combined in this work two small surveys carried out in the Central Rift-Valley of Ethiopia, in the transect between Mojo and Hawassa, with the assessment of a large vegetation-plot database to arrange recorded vegetation units within a syntaxonomic scheme using the Braun-Blanquet approach. We recognized a total of 18 plant communities, most of them assigned to the classes Phragmito-Magnocaricetea, Potametea and Lemnetea. We also collected few samples from vegetation in sodic lakes dominated by *Cyperus laevigatus* stands, which are heavily affected by livestock grazing. The later communities have some floristic relationships to ephemeral wetland vegetation described in previous studies. The resulting data set is distributed in nine countries including the East African low and highlands, the Congo basin and even far at the west African littoral. This wide range distribution is explained by the azonal character of wetland-dependent vegetation. This approach enhances a proper classification of plant communities that may be rare in the field surveys, while it supports the construction of a syntaxonomic scheme at the continental level.

ID 50

Format Oral Presentation

Theme Disturbance ecology

Grassland plant community response to interacting disturbances and temporal variability

Andrade, Bianca**[*1]; Dallmann, Josiah[2]; Volesky, Jerry[2]; Schacht, Walter[2]; Guretzky, John[2]

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Climate change is expected to affect the frequency, intensity, and extent of disturbances. Improved knowledge of disturbance interactions is fundamental to adequately predict plant community response and foster management practices for resilience. Based on that, we experimentally assessed the short-term plant community response to multiple disturbances, weather and other time-dependent conditions. We set up a randomized complete block design experiment in 2016 and repeated the same experiment in 2017, both in a Nebraska Sandhills mixed-grass prairie. Each experiment featured a 5-block design with a 3x2x2 factorial arrangement of soil disking, water addition, and fire treatments, and we monitored them over two years. With this design, we measured plant community response to disturbance and monthly rainfall change. We used mixed-effect models and ordination analysis to analyze the data. Consistent patterns between experiments were: (i) fire had the most prominent impact on plant community composition and biomass compared to other disturbance events, (ii) a positive effect of fire on bare ground cover, (iii) a negative effect of fire on plant annual cover in the first year followed by a positive effect in the following year, and (iv) forb frequency was significantly affected by fire and responsive to change in weather. Warm- and cool-season grasses cover and biomass, as well as forb seed establishment, were most affected by the temporal replication of the experiment. Differences in plant community response between experiments are likely due to a sudden and intense drought event (i.e., flash drought) in the middle of the growing season in 2017. Overall, the studied plant community was resistant to multiple disturbance interactions, and we did not see evidence of large or non-linear changes in the community structure over the short term.

ID 66

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Combating Desertification in Northern Nigeria: Lessons learned so far

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Northern Nigeria has faced the global environmental problem of desertification, with the rate of desert encroachment of about 0.6-0.7 km annually and 63.83 % of the total area impacted. Climatic factors, such as increased mean annual temperature and decreased mean annual precipitation have been identified as the causes of desertification. Other causes include anthropogenic factors, e.g., deforestation, cultivation on marginal land, and overgrazing. Desertification has impacted negatively on biodiversity and livelihood. Here we show a historical perspective on desertification in Northern Nigeria and government interventions aimed at combating the menace. Despite these interventions, the problem persists due to inconsistent poor implementation and management of these targeted interventions. We also discussed the challenges in tackling desertification, such as the erratic nature of afforestation design, improper plant species mix that is made up of non-native trees that could reduce stream flow, increase fire risk, support less biodiversity, and further degrade the land. We highlighted the possible solutions in mitigating desert encroachment and how Nigeria can localize the Chinese model of desertification control. Models such as mechanical and biological measures have been practically implemented to restore desert-prone areas in China. Besides, such recommendations will assist not only Nigeria, but other desert-prone regions in sub-Sahara Africa towards combating the threat of desert encroachment to biodiversity and livelihood.

ID 69

Format Virtual Excursion

Theme Virtual Excursion

Vegetation succession gradients on post-mining spoil heaps

Anibaba, Quadri*[1]; Dyderski, Marcin[2]; Jagodziński, Andrzej[2]

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Globally, the mining industry occurs in all climatic zones and continents. Activities of these mining industries have led to land degradation of post-mine areas with a strong need for the restoration of these degraded ecosystems. Besides technical reclamation of post-mining sites, spontaneous succession is another useful tool for their restoration. A large proportion of post-mining sites consists of overburdened materials dumped on spoil heaps. Such spoil heaps if left to spontaneous succession, represent a very suitable model to study the mechanism of succession. In this video, we aim to showcase successional gradients on post-mining spoil heaps of hard coal mines in Silesian Upland, Poland. Specifically, we will highlight how spoil heaps may provide sites valuable for nature conservation.

ID 105

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Assessment of the carbon sequestration potentials of three different landuse types in Ghana

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In the wake of climate change, insight into the potentials of land management systems in sequestering atmospheric carbon to reduce greenhouse gas concentrations remains vital. Different land use systems possess different potentials for sequestering atmospheric carbon dioxide. In this regard, this study was conducted in the Dry Semi-deciduous Agro-ecological Zone of Ghana to assess the carbon sequestration potentials of different land use types. The study compared three land use types – cashew farms, farmlands and near-natural ecosystems. For cashew farms, two age categories were differentiated – cashew farms less than 10 years old and those more than 10 years old. Height and diameter of all trees were measured in sample plots of 50 m x 20 m for all the land use types. A total of fourteen (14) temporary sample plots were inventoried in each of the land use types; hence a total of 56 plots in total. Also, the aboveground and belowground biomass was estimated for the trees in each of the three land use types by using previously developed allometric equations. It was revealed that the largest average carbon stock was recorded in the natural forests (120.53 Mg ha^{-1}) and followed in a decreasing trend by farmlands (30.42 Mg ha^{-1}) and cashew trees (above 10 years [23.11 Mg ha^{-1}] and below 10 years [8.55 Mg ha^{-1}]). By performing Tukey multiple comparisons of means test, it was revealed that there was no significant difference between the cashew trees less than 10 years old and those more than 10 years old in terms of carbon storage ($p = 0.88$). However, there was a strong significant difference in carbon storage between cashew trees less than 10 years old and trees on farmlands ($p = 0.006$). On the other hand, there was no significant difference in carbon storage between cashew trees more than 10 years old and trees on farmlands ($p = 0.98$). None of the other selected land use types were comparable in carbon storage to natural forests. This study reveals the relevance of assessing the potentials of different land use types in sequestering atmospheric carbon for proper and better selection during the processes of making decisions on land use. These findings are useful for proper land use planning while balancing cashew production and carbon sequestration.

ID 29

Format Oral Presentation

Theme Invasive species

Neophyte invasions in European grasslands

Axmanová, Irena*[1]; Kalusová, Veronika[1]; Danihelka, Jiří[12]; Dengler, Jürgen[3,4,10] ; Pergl, Jan[5]; Pyšek, Petr[46]; Večeřa, Martin[1]; Attorre, Fabio[7]; Biurrun, Idoia[8]; Boch, Steffen[9]; Conradi, Timo[10]; Gavilán, Rosario G.[11]; Jiménez-Alfaro, Borja[12]; Knollová, Ilona[1]; Kuzemko, Anna[13,14]; Lenoir, Jonathan[15]; Leostrin, Artem[16]; Medvecká, Jana[17]; Moeslund, Jesper Erenskjold[18]; Obratov-Petkovic, Dragica[19]; Svenning, Jens-Christian[20]; Tsiripidis, Ioannis[21]; Vassilev, Kiril[22]; Chytrý, Milan[1]

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The human-related spread of alien plants has severe environmental and socioeconomic consequences. However, the numbers of alien plants and their impact differ among regions and habitats. Therefore, it is essential to know which habitats are the most threatened by invasion and why. We studied a wide range of European grasslands to assess: (i) which alien species are the most successful invaders in grasslands; (ii) how invasion levels differ across European regions (countries or their parts) and biogeographical regions; and (iii) which habitat types are the most invaded. We selected 97,411 grassland vegetation plots from the European Vegetation Archive (EVA) and assigned a native or alien status to each of the 8,212 vascular plant species recorded in the plots. We considered only neophytes (alien species introduced after 1500 AD), which we further divided according to their biogeographic origin. We compared the levels of invasion by focusing on relative neophyte richness in the species pool, relative neophyte richness and cover-

abundance per vegetation plot as well as the percentages of invaded plots among regions and habitats. We found that only 6.5 % (536 species) of all vascular plants were neophytes, mostly therophytes or hemicryptophytes with broad ecological niches. The majority of neophytes were present in very few plots, while only three species were recorded in more than 1% of all plots (*Onobrychis viciifolia, Erigeron annuus* and *E. canadensis*). Although invasion levels were generally low, we found more invaded plots in the northern part of Europe (Fennoscandia, the Baltic countries, and Poland), where there were relatively higher numbers of neophytes from other continents, as well as from southern Europe. When considering non-European neophytes, the most invaded was the Pannonian region, with a high abundance of open habitats and summer-warm climate, supporting the establishment and persistence of many neophytes. European grasslands in general have lower invasion levels than lowland forests, riparian or human-made habitats (fields, vegetation in the cities, and their surroundings). However, some grassland types are more vulnerable and more easily invaded by neophytes than others, namely sandy grasslands or wet lowland grasslands. In contrast, grasslands at high elevations, where the environment is harsh and human impact low, are almost free of aliens. Some grassland types are probably more prone to invasions only when grazing or mowing is not maintained.

ID 59

Format Oral Presentation

Theme Special session: River vegetation

How can functional traits make plants tolerant to hydropeaking?

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Hydropeaking (HP), which refers to rising or falling discharges caused by the turning on or off of hydro-turbines to generate electricity, is a topic of growing interest for river scientists and restoration practitioners due to the severe impact that this hydropower production technique has on fluvial ecosystems. To date, most studies have focused on the impact of HP on invertebrate and fish communities, but little attention has been paid to the role of functional traits in making plants resistant to it. Morphological and physiological traits potentially enabling plants to cope with the stress imposed by peaking operations include plant leaf cuticle thickness, rooting depth and morphology, resprouting ability, stomata control, shoot growth inhibition and elongation, leaf hyponasty, rhizosphere oxygenation, seed dormancy, and CO_2 concentrating mechanisms, among many others. This review discusses the potential capacity of species commonly found along riparian areas of European rivers (e.g., *Calamagrostis purpurea, Carex acuta, C. vesicaria, Galium palustre, Viola palustris, Comarum palustre, Ledum palustre, Rosa majalis, Agrostis capillaris, Pinus sylvestris, Betula pubescens, Salix alba, S. atrocinerea, Filipendula ulmaria, Fraxinus angustifolia, Alnus glutinosa, A. incana*) and how the expression of a set of 51 traits allows them coping with three HP sources of disturbance: 1) inundation, which implies rapid light attenuation, slow gas diffusion, soil oxygen deficiency and accumulation of toxic compounds in plant tissues; 2) fast drawdown, which may lead to plant water stress; and 3) and rapid water fluctuations linked to up-ramping and down-ramping HP stages, which result in mechanical forces and local geomorphology processes with severe effects in riparian plants. The results from this review allowed detecting “hydropeaking-tolerant” traits and their capacity to define the boundaries beyond which riparian species may not germinate, grow and successfully complete their life cycle under HP disturbance. Information on traits conferring resistance to HP is critical to improve the ability to predict the future composition of ecological communities along HP rivers, as well as to identify the most suitable species to restore rivers affected by hydropower production.

ID 51

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Impact of key climate variables on the phenology of selected woody plant resources in southern Africa

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In temperate environments, temperature, rainfall, and photoperiod influence the availability animal food resources associated with woody plants including new leaves, flowers, and new fruits/pods. Declining resources can in turn negatively impact animal species that depend on these resources for survival. Understanding how dynamics of different aspects of climate relates to woody plant resources can provide managers of natural areas with valuable information that will assist them in their planning for times when resources will be scarce. This study investigates the impact that key climate variables have on phenology and production of resources associated with 113 tagged trees of 26 different woody plant species. A series of General Linear Models were run to determine which environmental variables or combinations of variables had the greatest influence on resource availability. Leads, lags and coincidental relationships between environmental predictor variables and phenological response variables were also explored using time-series cross-correlations and correlograms. Model results indicated that temperature, photoperiod, and their interaction had a noticeable effect on the number of species with new leaves. Peaks in the number of species with new leaves coincided with peaks in rainfall, temperature, and photoperiod. No leading or lagging indicators were observed between new leaves and the environmental variables investigated. Temperature was the strongest influence on flowering, with initial flowering starting when temperatures began to increase in spring (September). A significant lead between flowering and rainfall suggested that flower numbers increased approximately one month before rainfall increased. Temperature also had the most noticeable impact on the numbers of woody plant species with new fruits and pods. Significant lags were observed between new fruits and pods and all environmental variables investigated, indicating that rainfall, temperature, and photoperiod are required for these resources to reach their highest availability. Photoperiod had less of an effect than temperature and rainfall on the resources investigated but did affect the onset of resource pulses. In areas containing wildlife populations, it is recommended that wildlife managers do regular monitoring of resource availability, rainfall, temperature, and day length shifts so that changes can be identified, and consequences mitigated before ecosystems are detrimentally affected.

ID 138

Format Poster Presentation

Theme Theory and methods in vegetation science

Testing stochastic community models with long-term spatiotemporal data in grasslands

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Models of plant community assembly have specific assumptions (e.g., local saturation of species richness, functional equivalence or assumption of equilibrium dynamics) that hard to test in the field. In our study, we developed and applied a specific field sampling protocol for observing spatiotemporal patterns in different grasslands and old fields and for testing contrasting community models. Long-term observations of grassland community patterns were performed in Hungary, in steppe meadows and in open sand grasslands (at five sites in protected areas and in slightly degraded stands). Spontaneously regenerating old fields (adjacent to the grasslands) were also monitored at three sites. At two sites we had manipulative field experiments that were also monitored for spatiotemporal patterns. Spatial patterns of species were detected annually with a specific sampling protocol (combining high spatial resolution with reasonably high spatial extent). The resolution (5 cm x 5 cm) was fitted to the size of the individuals (or ramets). The spatial extent was up to 25 m while the temporal extent varied between 9 and 25 years. We mapped the presence of plant individuals (ramets) in transects and grids. Data were analyzed by variography and information theory models. The base-line spatial data were re-sampled with different resolutions (computerized sampling) that enable us to fit our analyses to the changing natural characteristics scales of field patterns. We used spatially explicit individual-based simulations (with contrasting parameters) for representing types of community models and fitting field data to modeled patterns. Spatiotemporal dynamics of species in steppe meadow fitted well to the core-satellite model. Matrix species showed low spatiotemporal variability. Subordinate and rare species were highly dynamic with some autocorrelations but independent of frequent species. In open sand grasslands, dominant species replaced each other randomly according to a neutral model while subordinate species increased temporally in gaps after the death of dominants (cf. gap dynamic model). The inter-annual variability of weather seems to be the main driver of dynamics in these natural grasslands. Type of patterns and the range of spatiotemporal variability did not differ significantly between long-term observations and field experiments (manipulating rainfall). Replacements of species were faster and more predictable (with some directionality) in slightly degraded grasslands. The largest heterogeneity and consistent spatial associations (due to strong biotic interactions) were found in old fields. We conclude that long-term (minimum 8-10 years) high-resolution monitoring data are required for testing stochastic community models in grasslands. The largest spatial variability and dependence appeared at fine spatial grain sizes, below 1 m^2. The study was supported by the NKFI K 129068 project.

ID 14

Format Poster Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Assessing the impact of anthropogenic activities on the Mediterranean endemics in Egypt

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The Mediterranean Basin is a biodiversity hotspot and one of the most important areas on earth for endemic plants. However, it is now subject to rapid anthropogenic changes. Indeed, precise data on the distribution and conservation status of plants and habitats within many Mediterranean countries - including Egypt - are frequently insufficient, out of date or absent. Consequently, the present study aims to provide a documented database of the Mediterranean endemics in Egypt, their floristic characteristics and conservation status, and to assess the changes in the distribution of the habitats of these species using remote sensing and GIS techniques. Data were collected from different herbaria, field visits and literature. The checklist was arranged alphabetically according to the Angiosperm Phylogeny Group (APG) IV system. The evaluation process was based on IUCN Red List Categories and Criteria Version 3.1. In the present study, we depend on the criterion B which is concerned with geographic range in the form of both B1 (extent of occurrence: EOO) and B2 (area of occupancy: AOO). Calculations of both AOO and EOO and assessment process were carried out using the GeoCAT software. In the present study, 102 plant taxa belonging to 26 families were recorded, including 57 confined to the western Mediterranean, 12 to the eastern Mediterranean and only one to the Deltaic Mediterranean (*Echinops taeckholmianus*) region of Egypt. The most represented families were Asteraceae, Fabaceae and Asparagaceae. Therophytes (47 taxa) were the most frequent life form, while ballochores (36 taxa) were the most common dispersal type. March to April was the peak time for the flourishing and flowering of the majority of the species. Small geographic range - limited habitat - non-abundant plants were the most represented rarity forms (98 taxa). Habitat loss due to land use changes, particularly the establishment of tourist villages, especially along the Western Mediterranean coast, was revealed as the crucial threat to the Mediterranean endemics in Egypt. Five taxa were evaluated as being extinct, 60 taxa as threatened by extinction, 32 taxa as critically endangered, 18 taxa as endangered and 10 taxa as vulnerable. In addition, one taxon was recognized as near-threatened and 35 taxa were recorded as data deficient. The outcomes of the current study can help to guide efforts towards prioritizing Mediterranean endemics in Egypt in future conservation actions. Keywords: Mediterranean, Endemic species, IUCN, Remote sensing, GIS.

ID 114

Format Poster Presentation with lightening Talk

Theme Invasive species

Two-year management does not compensate for the vegetation and soil difference between invaded and non-invaded areas

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Invasion of alien plant species threaten the natural habitats worldwide, as they impede the establishment of native species and affect plant community composition through several mechanisms, such as changing the abiotic environment or competition. Common milkweed (*Asclepias syriaca* L.) is a major and expanding perennial invasive species in Hungary. Its invasion is significant in degraded secondary habitats, but it also threatens open native habitats. The aim of our research was to experimentally study the effects of common milkweed on the development of native plant communities in old-fields. We compared invaded and non-invaded plots on old-fields in Central Hungary, and we managed the milkweed density in invaded plots to study the effect of management. Our main question was: Are there differences in soil properties and plant composition between the invaded and non-invaded sites before and after the management of milkweed? We assigned three plots invaded by common milkweed and one non-invaded plot (each 4 m x 4 m) with a minimum distance of four meters from each other on ten old-fields (40 plots together). We determined initial soil and vegetation conditions in each plot before the start of the management in June 2019. We collected soil samples from the topsoil (upper 0-10 cm, and 10-20 cm) and measured the following soil properties: pH, humus, $CaCO_3$, K_2O, P_4O_{10}, C and NO_3-content. We estimated the cover of vascular plant species in three 1 m x 1 m quadrats/plots. As management, we removed all or half of the aboveground shoots of common milkweed twice a year (end of June and end of July) in 2019 and in 2020. One invaded plot remained unmanaged, and the non-invaded plot was used as control. We monitored the cover of vascular plants after management in 2019 September and in 2020. We monitored the vascular plant species with the same method. We did not find significant differences in the studied soil attributes (pH, $CaCO_3$, K_2O, P_4O_{10}, C and NO_3-content) between the invaded and non-invaded plots prior the management, except in humus content in the upper (0-10 cm) soil layers. This difference is probably due to the higher leaf biomass of common milkweed resulting in higher humus content. We found a significant difference in plant species composition prior management, the cover of sand grassland specialist species was lower in the invaded plots compared to non-invaded plots. The two years of management did not affect the number of milkweed shoots. The milkweed cover decreased in 2020 in managed plots. The management of milkweed had no effect on the cover of sand specialist plants either after the first two years of the study. We have found a decrease in the cover of generalist plant species in the invaded plots by 2020, irrespective of management. We conclude that milkweed has an important effect on vegetation composition, but not by changing the studied soil properties. Two years of suppressing milkweed density was insufficient to change these relationships.

ID 102

Format Poster Presentation

Theme Functional traits

Belowground organs diversity in species from the herbaceous layer in tropical open savannas

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Clonal growth, vegetative regeneration from a bud bank, and storage of reserves are the main persistence traits associated with the plants with belowground organs. Surviving and persisting under frequent disturbances are the main challenges that plants from the herbaceous layer must deal with in fire-prone systems. Therefore, the presence of underground storage organs (USO) bearing buds might be an advantage for plants in these ecosystems. Thus, we ask the following questions: would USO in these ecosystems be morphologically similar? Would they accumulate the same type of storage compounds? We evaluated the USO type and type of reserve occurring in the most abundant species of the herbaceous layer of open savannas in different regions of the Cerrado. Two sites were open savannas (RNST, Central Brazil, high fire frequency; EESB, Southeastern Brazil, low fire frequency) and one site at campo rupestre (PNSC, Southeastern Brazil, high-medium fire frequency). Belowground organ type determination was based on morphological aspects, and a qualitative histochemical screening was performed to raise the main classes of stored compounds. A total of 28 species distributed in 15 families were sampled across the three sites (RNST: 8; EESB and PNSC; 10 species each, 19 forbs and 9 shrubs). 82 % of the species had a xylopodium, which was globular with fine roots (17 %), or a short a bud-bearing stem associated with tuberous roots, which could be a tuberous taproot (52 %) or adventitious roots with some sort of tuberization (31 %). Root crowns associated with a tap root accounted for 18 % of the species and were more frequent at the site with a lower fire frequency (EESB). Root crowns have buds more exposed, located at the soil surface, differently from the xylopodia, that have buds on the belowground, protected from fire by the soil. Also, root crowns have a lower storage capacity due to the absence of additional tuberous roots, and species with this type of structure may not persist under frequent fires. Starch was the most abundant compound found, and they were stored in the parenchymatic cells from the rays and cortical regions of the xylopodium (globular type) and tuberous roots. Phenols, mucilage, lipids, and proteins were also observed in specialized structures, such as idioblasts, laticifers, and cavities. Our results revealed that the herbaceous layer in these fire-prone communities is dominated by two types of structures, which are highly adapted to resprout after fire, due to the high bud number and storage reserve. Thus, despite the botanical family, growth form, sampling site, they exhibited the same type of organ and similar storage compounds, suggesting that fire is the driver selecting species that have these highly adapted belowground bud-bearing organs. Expanding the knowledge about belowground plant organs, associating morphological and anatomical approaches is crucial to broaden our understanding of the belowground plant community and functioning.

ID 158

Format Poster Presentation

Theme Special session: Big data and big classifications

Classification of *Pinus nigra* forest vegetation

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Pine forest vegetation types dominated by *Pinus nigra* are naturally distributed in mountain regions of (sub-)Mediterranean Europe and Anatolia, with a large presence of afforestations in central and northern Europe. Past classifications of Pinus nigra forests lack a formal, broad-scale approach hindering progress in developing a better understanding of these communities. Our study, as part of the the European Vegetation Archive (EVA) project no. 57 entitled Formalized classification of European Mediterranean and temperate pine forests, investigates *Pinus nigra* forest vegetation of Temperate and (sub-)Mediterranean Europe. The aim is to provide the first large-scale classification of these forests based on a comprehensive data set of vegetation plots and of a formalised classification system of these types. Upon requesting *Pinus nigra* dominated vegetation plots from EVA, we obtained 13,689 vegetation plots from 38 participating databases. To study the species composition of these forests and ascertain the main ecological patterns, we performed an unsupervised divisive classification by TWINSPAN. The preliminary results of TWINSPAN analysis showed a clear distinction between planted and natural forests in the first division. Specifically, *Pinus nigra* afforestations of temperate European lowlands outside the native distribution range of the species showed a different species composition than the natural forests within the native distribution range of *Pinus nigra*. This study will provide vegetation classification at the alliance level for *Pinus nigra* forests, enabling automatic classification of relevés from Temperate and (sub-) Mediterranean Europe and Anatolia. The standardisation of the content of classifications will aid future vegetation and ecological studies, ensuring comparability and synthesis of findings across the geographical scope of this study. Moreover, the preservation of natural *Pinus nigra*-dominated relict communities has wider conservation significance as these communities are a target focus of EUNIS framework and 92/43/EEC Directive, and therefore a topic of European interest. Accordingly, this comprehensive analysis will offer relevant insights for the prioritisation of habitats in the field of nature conservation.

ID 150

Format Oral Presentation

Theme Conservation and restoration

Ecosystem state assessment after more than 100 years since rehabilitation

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The assessment of the ecosystem state is fundamental to understand the success of ecological rehabilitation, especially in the long term. In this study, we aim to evaluate the rehabilitation success of a unique Mediterranean dune system site along the Tyrrhenian coast of Italy, which underwent a dune consolidation intervention and species planting at the beginning of the 20th century after the destruction of the natural ecosystem. We used three nearby non-rehabilitated protected coastal sites with different degrees of disturbance as reference sites encompassing different potential rehabilitation outcomes of the target site. To assess the overall result of the intervention, we used several plant characteristics and measured taxonomic and functional beta-diversity between all sites. We compared the proportions of typical and ruderal species of dune habitat types across sites. We further used the species-area relationship to examine if the number of observed species in our sites differed from the expected. Our analyses revealed that the rehabilitated site was taxonomically and functionally more similar to the least disturbed site. We suggest that plant characteristics arising from botanical inventories can be fruitfully used in rehabilitation assessment as they value the taxonomic and functional species diversity at the community scale. We conclude that plant characteristics compared across sites are useful tools in ecosystem state assessment if they reflect the ecological functions and conservation values of the natural ecosystems.

ID 38

Format Poster Presentation with lightening Talk

Theme Vegetation dynamics and succession

Carbon dynamics and biodiversity conservation in the Southern Brazilian Atlantic Forest

Bordin, Kauane*[1]; Esquivel-Muelbert, Adriane[2]; Souza, Alexandre Fadigas de[3]; Silva, Ana Carolina da[4]; Capellesso, Elivane Salete[5]; Klipel, Joice[1]; Marques, Márcia Cristina Mendes[5]; Higuchi, Pedro[4]; Picolotto, Rayana Caroline[1]; Bergamin, Rodrigo Scarton[1]; Müller, Sandra Cristina[1]

Federal University of Rio Grande do Sul[1]; University of Birmingham[2]; Universidade Federal do Rio Grande do Norte[3]; Universidade do Estado de Santa Catarina[4]; Universidade Federal do Paraná[5]

The Southern Brazilian Atlantic Forest (BAF) has suffered from historical deforestation, and current threats related to climatic and anthropogenic changes still impact biodiversity conservation and carbon cycling. Relationships among biodiversity and carbon gains, losses, and overall productivity in BAF are poorly understood. By analysing 62 permanent plots, with at least two census intervals, we evaluated those relationships. Carbon estimate was obtained through individual biomass*0.5. Carbon increment (AGWP) was obtained by summing up tree growth and recruitment across time, tree mortality allowed carbon loss estimates, and forest productivity was accessed by combining AGWP minus carbon losses. Biodiversity measures were described by taxonomic (Shannon Index), functional (RaoQ, based on leaf and wood traits), and phylogenetic (Mean Pairwise Distance) diversities, all based on species basal area. Forest plots correspond to 27 old-growth and 35 successional forests, varying from seven to 150 years. We fitted linear models to assess the effect of biodiversity measures on AGWP, carbon loss and productivity, considering forest stage as a covariate. Overall results indicated a mean annual increment in carbon of 1.1 Mg C ha^{-1} yr^{-1}, and carbon losses of 0.4 Mg C ha^{-1} yr^{-1}. Southern BAF is acting as a carbon sink, with a positive net productivity of 0.7 Mg C ha^{-1} yr^{-1}. AGWP and productivity were positively explained by functional diversity, without differences across forest stages. On the other hand, carbon loss was best and positively explained by taxonomic diversity, and it was higher at old-growth forests. Therefore, both taxonomic and functional diversity are good predictors of carbon dynamics in Southern BAF. The positive effect of functional diversity on AGWP and net productivity may be linked to niche complementarity in terms of resource use in forest communities. The higher the functional diversity, the greater the ranges of trait values in communities, which provides a more efficient resource use, and thus higher carbon assimilation across time. On the other hand, the positive relationship between taxonomic diversity and forest carbon loss may be linked to the death of long-lived pioneers, as they often present higher diversity and account for the largest contribution to carbon storage in forests. Also, the higher losses of carbon in old-growth forests may be related to the mortality of large trees, usually represented by old-senescent trees, strongly impacting the overall carbon accumulation in forests. Our results reinforce the urgent needs of improving efforts in forest protection of the endangered Brazilian Atlantic Forest, in both secondary and old-growth forests, allowing to conserve biodiversity and correlated carbon cycling processes. By increasing protection across BAF, besides reducing threats to biodiversity, it will avoid reduction in forest carbon sink, especially in a scenario of global changes and habitat fragmentation.

ID 139

Format Oral Presentation

Theme Informatics, databases, tools and new technologies

Collaboration networks in vegetation sciences: the case of Latin America and the Caribbean in JVS and AVS

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Collaboration networks are the backbone of modern science. Socio-economic differences between the global south and the global north may be reflected in the structure of these networks. Latin America and the Caribbean (LAC) region of the global south is an important scientific contributor. Bibliometry, beyond its classical use for monitoring the productivity of researchers, may also allow fine analysis of scientific literature. We used it, associated with tools from graph theory, to describe the global vegetation science collaboration network from co-authored publications in the journals of the IAVS: Journal of Vegetation Science and Applied Vegetation Science. Our objective was to describe the specificity of the LAC region within the global collaboration network. LAC institutions are well integrated in the global network and there are clear relationships between institutions at the national level. However, analysis of shortest paths between pairs of institutions showed that the regional connectivity between countries is much weaker than in other regions such as North America or Europe. We will discuss the potential strategies to help developing vegetation science in LAC, in light of these results and the perspective of the new regional section of the IAVS in LAC (IAVS-LAC).

ID 110

Format Oral Presentation

Theme Vegetation dynamics and succession

How accidental are epiphytes? Using community assembly theory to identify adaptation of terrestrial woody plants to the epiphytic habit

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What is it to be epiphytic or terrestrial as a plant? Many taxa are observed on both surfaces, but how do we establish which species are adapted specifically to include epiphytism as a key part of their life histories, and which are just accidentally fortuitous in epiphytic establishment? To identify patterns in epiphytic establishment and development we surveyed the woody epiphytes of 700 tree ferns (350 × *Cyathea smithii*; 350 × *Dicksonia squarrosa*) across New Zealand and recorded their vertical position on the trunk, their stem length, and whether they were reproductive or not, as well as meta-data (height, diameter, light levels up trunk) on the structure of their host tree fern. Tree ferns are ideal for a study into the adaptations of woody epiphytes as although the surface areas of tree fern trunks are generally large, the densities of woody epiphytes are quite low – rarely more than one mature woody epiphyte per fern; this removes any potential competition between epiphytes from our analysis. By standardising epiphyte heights relative to tree fern trunk heights, woody epiphytes of tree ferns separate out by species along a vertical environmental gradient that, by inference from epiphyte taxa traits, appears to be hydrological. Using community assembly theory and accounting for dispersal, abiotic and biotic filters, we identified which taxa established more successfully than expected assuming a proportional relationship of survivorship to successfully colonised space on tree fern trunks (niche). As we did not follow plants over time, we used seedling, sapling and mature tree epiphyte distribution up the stems of the 700 tree ferns as a space-for-time proxy. Of 8 common woody epiphyte species, only 1 established epiphytically more than expected suggesting specific adaptations to this life history strategy. We highlight the likely adaptation of *Pseudopanax arboreus* to the epiphytic habit (higher than expected survivorship:niche size), whilst showing that *Weinmannia racemosa* appears to be less successful (lower than expected survivorship:niche size) than generally assumed in the epiphytic niche. Our results suggest that species vary hugely in adaptations to epiphytism, which is reflected in their adoption of this habit, particularly as larger individuals. Patterns of epiphytism have also highlighted some potentially intriguing patterns around tree fern water relations.

ID 62

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

An ecological description of the vegetation of the Jurisdam-Seekoegat sections of the Mountain Zebra National Park, South Africa

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University of South Africa[1]; South African National Parks[2]

The Mountain Zebra National Park is located in a semi-arid area known as the Nama-karoo in South Africa. The Park has been expanding in size since the early 2000ies by incorporating various newly acquired farms. As part of a vegetation survey programme for the newly acquired farms incorporated into the Park, the vegetation of the Jurisdam-Seekoegat sections were surveyed and classified following the Braun-Blanquet approach. This study was aimed at describing the different plant ecosystems present, their diversity and the changes in veld condition since being incorporated into the park. Veld condition was determined using the Ecological Index Method, while the diversity of the different plant communities identified was determined using the Shannon-Wiener and Gini-Simpson Indices. A TWINSPAN analysis resulted in the identification of eight plant communities that can be grouped into six major communities that are strongly associated with topography and previous land use. Woody species were prominent along the rocky midslope areas and cliffs while grasses and dwarf shrubs were dominant within the lower-lying and plateaus areas. The vegetation of the rocky midslope areas that were least affected by past land use practices, achieved the highest species richness and diversity as well as veld condition score. The results of this study also emphasizes the importance of resting overgrazed veld.

ID 112

Format Oral Presentation

Theme Special session: Big data and big classifications

Using the global vegetation plot database sPlot to derive formal definitions of the world's formation types

Bruelheide, Helge*[1]; Sabatini, Francesco[2]; Chytrý, Milan[3]; Jandt, Ute[1]; Jansen, Florian[4]; Jiménez-Alfaro, Borja[5]; Tichý, Lubomír[3]; sPlot Consortium

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Vegetation formation types are normally defined either purely descriptively or with a combination of physiognomic and structural attributes. Community-level vegetation types, instead, are mainly defined based on floristic criteria. As a result, there is a conceptual break, which prevents to translate floristic types into formations. Here, we present work in progress of how to bridge the gap between these two approaches when defining formations for big data of vegetation plot records. Our procedure involves several steps, starting with training datasets from the global vegetation plot database sPlot for which the formation is known. We here use the formation system of Faber-Langendoen et al. (2016) as the most recent and updated system that is based on operational floristic and functional criteria and contains both natural and cultural vegetation formations. The formal description of these formations is done with the ESy expert system, which employs machine readable coding of assignment rules, based on set-theoretic concepts and formal logical operators. To characterize formations within floristic realms, we use the concept of diagnostic species groups. These groups are initially compiled from the literature but then optimized using the Cocktail and the GRIMP algorithms, either adding further diagnostic species or removing less suitable species. As a result we obtain formal membership expressions for each formation based on one or several diagnostic species groups. In addition, we make use of structural (e.g., cover of the different life forms in the plots) or functional attributes (e.g., small-leaved plants) and combine them with the floristic membership expressions in membership formulas. Using the training datasets as benchmarks, we use brute force approaches and the kappa statistics to find optimal threshold criteria for membership expressions, with respect to the number of species required from a diagnostic species group or for structural attributes. Simultaneously, different combinations of membership formulas are tested. As these membership formulas, which are based on floristic criteria, are only applicable within floristic realms, we repeat this process by realm and then combine the realm-specific formulas into global assignment rules. Finally, these rules are applied to the whole sPlot database to predict formations for records for which the formation is unknown, and comparing the formations' predicted distribution across continents, climate zones and floristic realms. As formations show a strong dependency on climate, we model their continuous potential distribution using boosted regression trees with the different principal components summarizing climate, soil and topographic heterogeneity as predictors. The final maps are then compared to existing coarse-scale maps of the world's formations. We discuss the current outcomes of the approach and limitations and give an outlook on the applications of so-defined global formation types.

ID 31

Format Oral Presentation

Theme Invasive species

Plant invasion in Mediterranean Europe, current hotspots and future scenarios

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Alien species and climate change are among the major causes of ecosystem alterations and biodiversity loss. This is particularly true in Mediterranean Europe, a biodiversity hotspot in terms of species, endemism and ecological functions, which has been historically subject to biological invasions and is expected to be particularly threatened by climate change. After the introduction, alien species can locally adapt to the new environmental conditions, supported by human-mediated continuous introduction, and limited by environmental suitability and their natural dispersal capacity. Therefore, we expect that few alien plants will fill their potential niche in the invaded range and reach equilibrium. However, to date, we have a limited understanding of the fate of alien species under climate change, and we still do not know whether these plants will spread or be hampered by climate change. Therefore, understanding alien species invasion in Mediterranean Europe under climate change is a pressing conservation goal. To address this goal, we analyzed 325,000 georeferenced vegetation plots from the European Vegetation Archive (EVA) and identified 93 naturalized alien plants in Mediterranean Europe. Since alien species may not be at ecological equilibrium in the invaded range, we also estimated the potential niche of these species. We collected 3.5 million presences worldwide from GBIF. To capture potential invasion scenarios, we fitted species distribution models and projected them in the current and future environmental conditions (2050). Moreover, we elaborated a limited dispersal scenario estimating a maximum dispersal distance for each species. Finally, we tested if changes in the invaded area are predicted by traits, niche unfilling and exposure to climate change. Results demonstrate that for 42 % of species, the potential and realized niches were more different than expected by chance due to unfilling in the realized niche. Overall, we found that for the analyzed alien species, the invasion will decrease in 2050 even though few aliens are predicted to greatly enlarge their range. For example, Poaceae will spread more than other families according to the potential niche model. However, invasion hotspot maps show a similar pattern for both potential and realized niche scenarios, also predicting that the highly invaded areas will remain stable. We also found that species with larger niche unfilling will expand more and that exposure to climate change is a significant driver of range loss in all models. In a nutshell, few aliens will greatly enlarge their range but most of them are going to reduce it due to the adverse effects of climate.

ID 55

Format Oral Presentation

Theme Special session: Big data and big classifications

The concept of geobotanical Synequivalence including Synvicariance and Synconvergence: formulation and implications to vegetation classification and biogeography

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Plant communities in distinct biogeographical territories may exhibit similarity in their composition, physiognomy and habitat, i.e., being composed of the same – or taxonomically close – taxa, often in the same infrageneric category; by plants exhibiting analogue traits and; similar environmental envelopes (habitat). Such evolutionary and ecological equivalence may arise either by communities being composed by taxa issuing from vicariant speciation from a recent common ancestor; or either by 'true' trait convergence or by traits' habitat filtering from a previous local species pool. We propose that, for plant communities, the former case is Synvicariance and the latter is Synconvergence s.l. (synconvergence may be split in synapoconvergence - 'true trait convergence - and synplesioconvergence, i.e., trait filtering by habitat). Synvicariance and synconvergence may, in general, be called cases of 'geobotanical synequivalence'. I propose an approach to include phylogenetic relationships, together with species composition and abundance, in the calculation of similarity among phytosociological relevés. Therefore, geobotanical synequivalence may be expressed in the classification, if found useful. As a case-study, we tackle the problem of Macaronesia being a coherent unit. This a classical biogeographical conundrum, as there is an obvious great geobotanical synequivalence among the vegetation of composing archipelagos (Azores, Madeira, Salvages, Canaries and Cape Verde). On the other hand, very few, or no shared species are found so to base a syntaxonomical and biogeographical system uniting archipelagos. My analysis will contribute to solving such apparent paradox and to envisage alternative solutions to approach Macaronesia´s syntaxonomy and biogeography and eventually may be applied elsewhere wherever synequivalence is relevant.

ID 176

Format Poster Presentation with lightening Talk

Theme Ecosystem function

Successional stages in dolines (sinkholes) as soil organic carbon reservoirs in karst areas, SW Slovenia

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Research Centre of the Slovenian Academy of Sciences and Arts[1]; Slovenian Forestry Institute[2]

The research took place on Kras Plateau, a limestone karst plateau located above the Bay of Trieste in the northernmost part of the Adriatic Sea at an altitude of 300-500 meters (Slovenia). The climate is transitional between Mediterranean and continental, with rainy cool winters and hot summers. The rainfall is about 1,400 mm and the average annual temperature is about 11 °C. Soil represents the largest terrestrial reservoir of soil organic carbon (SOC). SOC depends on geological substratum, climate, topography, soil depth, and vegetation. Karst landscapes hold significant potential for carbon sequestration, as the maximum SOC content in karst areas is up to 1.6 times higher than in non-karst areas. In this study, we focus on the doline (sinkhole) - pedosediment complex (thick layer of clay-silt soil at the bottom) and its role in sequestering soil organic carbon (SOC) in the mineral part of the soil. Many studies have calculated the SOC concentration in the karst landscape, but much less research has been done on the SOC inventory. We hypothesized that the SOC sequestration potential in mineral soil is higher in dolines than in areas outside doline and that the SOC stock is higher in dolines where the current land use is forest, followed by successional and grassland dolines. The soil survey was conducted in the centre of the dolines (bottom) at a radius of 1 m at three depths of 10 cm, 10-20 cm, and 20-40 cm. The vegetation survey was conducted in each doline in parallel with the soil sampling. A measurable difference was found between sinkholes with different land use. The highest SOC stock is in succession areas (130 t/ha, 35g/kg) and shows a decreasing trend of SOC st content towards forest (118 t/ha) and grassland (106). Thus, our prediction that the highest levels of SOC stock would be found in forests (due to high litterfall input) turned out to be wrong. The lowest SOC stock is found in grasslands; today's grasslands likely have the legacy of centuries of cultivated land, which influences the lowest SOC storage capacity. The highest SOC storage capacity in successional dolines is supported by recent and past land use. In forests that are sustainably managed, the SOC stock is generally higher than in fields and grasslands. In the case of dolines, we found that the successional stages have the highest SOC pool.

ID 63

Format Poster Presentation with lightening Talk

Theme Climate change

Chronic drought effects on above- and belowground production in a temperate grassland ecosystem

Castillioni, Karen*[1]; Souza, Lara[1]; Newman, Gregory[1]

University of Oklahoma[1]

The intensity and frequency of extreme precipitation events, including the severity and duration of drought, is expected to increase with climate change. This forecast is especially concerning for temperate grasslands, where seasonal variation in timing and amount of precipitation governs productivity due to the water-limited nature of this ecosystem. Much attention has been paid to understanding the effect of climate variation, including drought on aboveground production (ANPP). Yet, fewer experiments have explored the impact of drought on total net plant production (NPP), including belowground productivity (BNPP). We have been experimentally testing ecosystem- and community-level responses to drought in a mixed-grass prairie ecosystem in Oklahoma, USA, since 2016. Our experimental design manipulates a precipitation gradient with seven treatment levels: +50 %, 0 %, -20 %, -40 %, -60 %, -80 %, and -100 % change from ambient precipitation, replicated three times for a total of 21 2 m x 2 m plots. In each year from 2016-2018, ANPP was determined by harvesting standing vegetation, while BNPP was determined via in-growth cores. This long-term study is a continuing contribution to the DroughtNet international study and is the only known experimental gradient design within the coordinated network. We found a significant decrease in ANPP as chronic drought intensified, consistent with most studies that show these water-limited systems are responsive to variation in precipitation. However, we also found a significant increase in BNPP with increasing drought conditions ($p = 0.017$). The result of these contrasting responses was that total NPP did not vary with experimental drought. Rather, there was a significant shift in the allocation of NPP belowground as drought intensified. For future directions of this study, it remains to be explored 1. what is the compensatory mechanism that allows these communities to maintain NPP in extreme drought conditions; 2. how long can this production be maintained before collapse of this ecosystem function.

ID 140

Format Virtual Excursion

Theme Virtual Excursion

Plant species to community responses to an experimental precipitation gradient

Castillioni, Karen*[1]

University of Oklahoma[1]

Since 2016, I have been using an experimental design that manipulates a precipitation gradient with seven treatment levels: +50 %, 0 %, -20 %, -40 %, -60 %, -80 %, and -100 % change from ambient precipitation, replicated three times for a total of 21 2 m x 2 m plots. A 1 m x 1 m plot nested within each precipitation treatment plot is clipped once a year to mimic hay harvest, and was also called “clipping” treatment. The study site is located at Kessler Atmospheric and Ecological Field Station, a mixed grass prairie in central Oklahoma, USA (34°59' N, 97°31' W), last formed >45 yr. ago. First, I will provide a tour of the experimental plots and explain how they control precipitation at different levels. Second, I will show the most common species in the study site and briefly talk about their role in the community. Finally, I plan to talk about key ecological questions that have been asked and answered by using this experimental design.

ID 17

Format Oral Presentation

Theme Special session: The legacy of invasions

Can we predict the recovery rate of secondary savannas in abandoned pastures?

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Universidade Estadual Paulista[1]; Universidade Estadual de Campinas[2]; Instituto Florestal do Estado de São Paulo[3]

Millions of hectares of pastures cultivated with exotic grasses have been abandoned for mandatory restoration of Neotropical savannas across the Cerrado in central Brazil and peripheral regions. The first question to respond before any decision or action is: can native cerrado vegetation spontaneously recover in these pastures? The pace of recovery can vary among pastures, hindering a single and objective response to that question. A second question, thus, emerges: can we predict the potential for natural regeneration in a particular site from accessible ecological factors? Identifying the drivers of recovery rates could allow us to predict restoration outcomes and to differentiate cases where human interventions are needed from cases where no action or resources are required to achieve specific restoration goals. Aiming to support the decision-making process, we have monitored the cerrado vegetation spontaneously regenerating in 29 abandoned pastures, obtaining the recovery rate for each community attribute for each site. We thus investigated the influence of time since pasture abandonment, exotic grass cover, landscape and soil factors (predictor variables) on the variation of recovery rates (response variables) of those secondary savannas. We found that the regeneration rhythm varies widely among sites, leading to surprisingly high recovery rates in many cases, even doubling native cover over two years in some sites. There was a strong bias for woody vegetation, by quickly recovering richness, density and cover, while native grasses and forbs are hindered by the exotic grasses. Despite the good news, the ecological factors investigated do not allow reliable prediction of the recovery rates. The wide variation in the recovery rates among sites was not explained by time since abandonment nor by the distance to the nearest remnant native vegetation. Soil attributes, exotic grasses and native vegetation cover around a pasture explained just a small fraction of the variation in the recovery rates among sites. We did not find an isolated factor or a robust set of factors explaining the variation in the recovery rates for all vegetation attributes. We concluded that the use of predictive models based on soil properties, exotic grasses, landscape attributes or time since abandonment is unfeasible for inferring the recovery of savanna structure and richness after pasture abandonment. Therefore, case-by-case monitoring is required to assess the potential for natural regeneration. We do not disregard that other factors, such as land use history (pasture management intensity and duration of use) or even composition of the previously existing plant community can influence the recovery rates, but such factors are not possible to be rescued to be used in the models.

ID 168

Format Oral Presentation

Theme Conservation and restoration

Continental scale drivers of EU habitat richness

Cervellini, Marco*[1]; Di Musciano, Michele[2]; Zannini, Piero[1]; Fattorini, Simone[2]; Jiménez-Alfaro, Borja[3]; Agrillo, Emiliano[4]; Attorre, Fabio[8]; Angelini, Pierangela[4]; Beierkuhnlein, Carl[5]; Casella, Laura; Field[4], Richard[6]; Fischer, Jan-Christopher[5]; Genovesi, Piero[4]; Hoffmann, Samuel[5]; Irl, Severin D.H. [7]; Nascimbene, Juri[1]; Rocchini, Duccio[1]; Steinbauer, Manue[5]l; Vetaas, Ole R. [9]; Chiarucci, Alessandro[1]

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Achieving a relevant and measurable improvement of the habitat conservation status inside and outside of Natura 2000 is one of the main targets of the Council Directive 92/43/EEC (Habitats Directive). Annex I lists all the habitat types of conservation interest for EU. In this context, each Member State must provide every 6 years a map of habitat distribution at 10 km resolution. However, different Member States employ different methods to collect information on habitat distribution, ultimately questioning the validity of the data. At the same time, there is a lack of information on potential drivers of habitat distribution, which in turn could help disentangle reporting bias and foster habitat monitoring. To test which variables drive habitat richness, we used EU habitat distribution maps from the 3rd report to answer the following questions: i) How do bioclimatic, geographic, and anthropogenic variables affect habitat richness? ii) Which category is the most important? iii) How do interactions among these variables influence habitat richness and which combinations produce the strongest interactions? To model habitat richness, we used GLM, GAM, and GBM by adding residual-autocovariates, to account for spatial autocorrelation. The main drivers of habitat richness were geographic variables, with habitat richness decreasing from lower to higher latitudes, while positive relationships were observed for terrain ruggedness. Bioclimatic variables played a secondary role. Furthermore, the interaction between population density and fragmentation index had a strong negative effect on habitat richness, showing the key role of anthropogenic drivers at the European scale. To our knowledge, this is the first attempt to investigate spatial drivers of habitat richness at the continental scale, as a key tool for protecting European biodiversity. Similar approaches should be applied to habitat patterns analysis in other geographical contexts, to effectively disentangle the role of different drivers of habitat richness at a large scale, enabling to produce sound predictive models, useful for monitoring and conservation purposes.

ID 60

Format Poster Presentation

Theme Climate change

Savanna tree seedling´s response to a simulated future climate scenario

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The Brazilian savanna (Cerrado) is considered a biodiversity hotspot. However, Cerrado´s native areas have been threatened by agricultural development. In addition, climate change may increase species selection pressure and, together, both processes may lead to a serious loss of biodiversity and environmental services. Therefore, it is important to understand how species are going to respond to climate change. We aimed to investigate how tree seedlings respond to a future climate scenario simulated in growth chambers (phytotrons). We selected four widely distributed tree species from the Cerrado savanna: *Qualea grandiflora* (Vochysiaceae), *Hymenaea stignocarpa* (Fabaceae), *Tabebuia aurea* (Bignoniaceae) and *Kielmeyera coriacea* (Clusiaceae). We disposed their seeds to germinate in chambers at 28°C, and then raised the seedlings in pots filled with Red Latosol and sand (proportion of 3x1) under irrigation at 28 °C for 30 days. After that, we transferred the seedlings to plastic tubes of 1 m high and of 0.1 m in diameter for the growth experiments. When the first pair of leaves appeared, 30 individuals of each species were taken for initial measures, and other 33 individuals were transferred to each phytotron, summing up a total of 96 plants per species. One of the phytotrons was set with the current climate scenario, based on the last 50 years climate data from the Cerrado where max and min temperatures was 28 °C and 18 °C, and CO_2 concentration ([CO_2]) was 420 ppm. The other phytotron was set with the IPCC SSP 3-7,0 prospection for the Cerrado region for 2100 (WorldClim), where max and min temperatures reached 2.5 °C higher than at current climate scenario, and [CO_2] was 860 ppm. Humidity was 85 % for both phytotrons. Plants were grown for 120 days, being irrigated every two days with 120 ml of tap water. After this period, we proceeded with leaf counting of the individuals and then all plants were uprooted and taken to dry at 70 °C. After drying, plants biomass was measured by parts: total, root, shoot, and leaves. We observed a significant increase of biomass on the future scenario for all species, probably related to CO_2 fertilization. However, *K. coriacea* was the only one that invested more carbon on roots than shoot, with 57 % more root biomass under future climate scenario. *H. stignocarpa* invested the same proportion on root and shoot under future climate scenario as under current climate scenario. *Q. grandiflora* and *T. aurea* invested more than 2 times in shoot than root biomass of plants when they were under future climate scenario. The increase in shoot mass for *H. stignocarpa*, *Q. grandiflora* and *T. aurea* can be reflecting the leaf number that was bigger in individuals under the future scenario in comparison to those incubated in current climate scenario. In conclusion, when water is not scarce at the recruitment stage, there is carbon gain in response to the simulated future climate scenario, but its distribution can vary among species.

ID 68

Format Oral Presentation

Theme Conservation and restoration

Changes in species composition and plant functional traits during the landslide succession in high-mountain coniferous forest in central Taiwan

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Under the climate change threat, landslides caused by extreme weather events become a serious hazard, which results in vegetation cover destruction. The consequent restoration issue is critical to mitigating erosion and protecting human life. To improve the knowledge gap of vegetation success after landslide and apply the results for restoration, we are asking 1) How does the species composition change following the succession after landslide disturbance? 2) Which growth and adaptation strategies of woody plant species prevail in early successional stages and old-growth vegetation? 3) Can wood density be used as a criterion for plant species selection for restoration? The studied area is in the elevation between 2,500 and 2,800 m a.s.l. in the high-mountain area of central Taiwan, East Asia. We surveyed the spontaneous landslide vegetation (landslide plots) and selected the old-growth plots from the National Vegetation Database of Taiwan. A dataset of 67 plots, 388 species and four environmental variables was used for ordination and cluster analysis to examine change in the species composition and their relationship to environmental variables. Matrix of nine plant functional traits of 46 broadleaved species was used for PCA to explore the plant growth strategies. The weighted linear regression of the community-weighted mean (CWM) was used to examine changes in community-level traits along environmental gradients. The multiple regression analysis was applied to create a formula for selecting plant species for restoration based on wood density. The ordination analysis showed that the vegetation types change along the gradient of successional stage and elevation. Coniferous species, which dominate in the old-growth forest, are also present in the early successional stages on landslide scars. Deciduous species mostly accompany those coniferous species in the early successional stage, but they are replaced by evergreen broadleaved species in the old-growth forest. Deciduous species have higher specific leaf area (SLA), but lower wood density (WD) and thinner and less succulent leaves. Evergreen species, in contrast, have low SLA but high WD, and thicker and more succulent leaves. CWM of WD increases along both successional and elevation gradients. The plant species composition recruited after landslide disturbance is related to the elevation and successional gradient. Both coniferous and deciduous species dominate in the early succession stage, with deciduous species being replaced by evergreen species in the old-growth forest. The replacement of deciduous and evergreen species between LSP and OGP represents shift from resource acquisitive to conservative adaptation. CWM of WD is increasing when succession progresses and elevation increases. We suggest that WD can be applied as a criterion for selecting woody species suitable for restoration, but both successional age and elevation need to be considered simultaneously.

ID 161

Format Oral Presentation

Theme Theory and methods in vegetation science

Monitoring tropical vegetation through a novel deep learning framework

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Academy for Mathematics, Science, and Engineering[1]

Monitoring tropical agricultural lands is important to manage sustainable food production, biodiversity and forestry. As the world's population increases, we must have computational mechanisms to assess crops in agriculture. Recently, there have been developments within machine learning and computer vision, particularly in the 3D space. The approach of predicting 3D representation of objects in 2D imagery is crucial to many fields. In 2020, Goel et al. present Unsupervised category-specific mesh reconstruction, or U-CMR, which is an "analysis by synthesis" framework where the goal is to predict the likely shape, texture and camera viewpoint that could produce the image with various learned category-specific priors. Their particular contribution in this paper is a representation of the distribution over cameras, which we call "camera-multiplex". Instead of picking a point estimate, we maintain a set of camera hypotheses that are optimized during training to best explain the image given the current shape and texture. Separately, deep learning multi-temporal classification has become especially important in many interdisciplinary areas but specifically in crop classification. We train a convolutional neural network to classify images by crop category. In this work, we propose to combine these two methodologies, in other words to first classify and then create 3D representations using Unsupervised Category-Specific Mesh Reconstruction. This is an ongoing work and we hope to provide an enhanced novel computational way for farmers to gain insights into their crops. We hope that this work will lead to more productive food production and health outcomes in developing countries. Due to increased climate change around the world, many farmers in tropical and subtropical regions are experiencing the most devastating effect and must adapt to the changing time. Understanding trends in their crops through automated methods like the one we present here is a step in the right direction.

ID 109

Format Poster Presentation

Theme Informatics, databases, tools and new technologies

Forest Landscape Diversity Database for inventory and mapping

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The task is to develop the Forest Landscape Diversity Database (FLDD) of the European part of Russia as a means of storing and analyzing field information on biodiversity and ecology of forest communities. FLDD is currently based on Microsoft Access. It is intended to support research on flora and vegetation. The inventory block is used to enter data from relevés, field taxation, and soil data, store photographs of communities and species, extract various samples from these data both by points and by variables. The analytical block of the database is intended for calculating and storing data (variables) obtained as a result of processing primary information and transformed into certain indicators and indices (classification, calculation of alpha and beta diversity indices, etc.). The basic unit of the database is the description plot. Its unique characteristics are number and geographic coordinates. In addition to the data of relevé (which contains all species, including mosses, and their abundance), landscape and taxation characteristics each point is characterized by environmental variables (multispectral satellite images, spectral and texture indices based on them, digital elevation model and morphometric characteristics), further analysis is possible using a related set of vector and raster thematic maps. The resulting set of variables allows using multidimensional statistical methods to develop a model of the spatial distribution of forest communities, individual species or groups of species. The development of the final digital cartographic model of forests of different composition is accompanied by a detailed legend. The analysis of composition and spatial distribution of forests organization for central part of the Murmansk and the Moscow regions was carried out using FLDD (Chernenkova et al., 2015; Belyaeva et al., 2018; Kotlov, Chernenkova, 2020). In the future, it is planned to develop approaches in the following directions: 1) developing a unified classification system for boreal and hemi-boreal forests of European Russia; 2) assessing the patterns of distribution of species and communities in the light of geographic and ecological-coenotic factors; 3) placing regional interactive maps in free online access for verification and clarification of information about the state and dynamics of forests based on photographs and relevés. It is also planned to improve the functionality of the database and it is possible to transfer data to software. Currently FLDD includes relevés from Murmansk, Kostroma, Tver and Moscow regions. The data is partially transferred to EBFVD (Jašková et al., 2020).

ID 100

Format Oral Presentation

Theme Disturbance ecology

Effects of stand structure and ungulates on understory vegetation in managed and unmanaged forests

Chevaux, Laura*[1]

UR EFNO INRAE[1]

Conventional conservation policies in Europe notably rely on the passive restoration of natural forest dynamics by setting aside forest areas to preserve forest biodiversity. However, since forest reserves cover only a small proportion of the territory, conservation policies also require complementary conservation efforts in managed forests in order to achieve the biodiversity targets set up in the Convention on Biological Diversity. Conservation measures also raise the question of large herbivore management in and around set-asides, particularly regarding their impact on understory vegetation. Although many studies have separately analyzed the effects of forest management, management abandonment and ungulate pressure on forest biodiversity, their joint effects have rarely been studied in a correlative framework. We studied 212 plots located in 15 strict forest reserves paired with adjacent managed forests in European France. We applied structural equation models to test the effects of management abandonment, stand structure and ungulate pressure on the abundance, species richness and diversity of herbaceous vascular plants and terricolous bryophytes. We showed that stand structure indices and plot-level browsing pressure had direct and opposite effects on herbaceous vascular plant species diversity; these effects were linked with the light tolerance of the different species groups. Increasing canopy cover had an overall negative effect on herbaceous vascular plant abundance and species diversity. The effect was two to three times greater in magnitude than the positive effects of browsing pressure on herbaceous plant diversity. On the other hand, a high stand density index had a positive effect on the species richness and diversity of bryophytes, while browsing had no effect. Forest management abandonment had few direct effects on understory plant communities, and mainly indirectly affected herbaceous vascular plant and bryophyte abundance, and species richness and diversity through changes in vertical stand structure. Our results show that conservation biologists should rely on foresters and hunters to lead the preservation of understory vegetation communities in managed forests since respectively they manipulate stand structure and regulate ungulate pressure. Their management actions should be adapted to the taxa at stake, since bryophytes and vascular plants respond differently to stand and ungulate factors.

ID 186

Format Poster Presentation

Theme Theory and methods in vegetation science

Species richness estimation by using machine learning algorithms

Chiu, Chun-Huo*[1]

National Taiwan University[1]

Accurate estimation of richness is always a challenge in ecological statistics due to sampling resource limitations. Many richness estimators were proposed in the literature to address the underestimating problem of observed richness in the sample. According to the fundamentals of the statistical theorem, these richness estimators can be classified into two classes: parametric methods and non-parametric methods. The parametric methods assume that species composition as a random variable makes it available to derive the richness estimator using the traditional statistical inference approach. However, the problem of divergence and time-consuming made parametric methods overlooked in ecological applications. Non-parametric richness methods without assumption on species composition provide robust richness estimators, where Chao1 and Jackknife estimators are most widely used. However, non-parametric richness estimators are seriously underestimated in the sample of a small size or the community with high heterogeneity. Therefore, estimating richness given a random sample is essentially a prediction question. In this study, we use machine learning algorithms to estimate the true richness in a defined area. First, we generate training datasets by computer simulation based on a 95 % confidence interval of Chao1 estimate and adjusted sample species relative composition. Second, we select the potential features based on the concept of the Good-Turing frequency formula. We evaluate the statistical behaviors of four high frequently used machine learning algorithms (including Ridge Regression, K Nearest Neighbors, Random Forest, and Boosting) to decide the needed size of the training dataset and to select the features that should be included in the predicting model. The simulation results show that four machine learning methods have lower bias and RMSE than the non-parametric estimators, while there is no difference in statistical performance among these four machine learning techniques. Hence, ridge regression and random forest are recommended for the reason of shorter computational time. To illustrate the use of these algorithms, we used the proposed methods to analyze the diversity data of the cultivated weed in Taiwan.

ID 25

Format Oral Presentation

Theme Vegetation dynamics and succession

Ice-age vegetation of northern Siberia and Beringia: a view through mammoth stomachs

Chytrý, Milan*[1]; Axmanová, Irena[1]; Robovský, Jan[2]; Tichý, Lubomír[1]; Danihelka, Jiří[1]; Troeva, Elena[3]; Protopopov, Albert[4]

Masaryk University[1], Brno; University of South Bohemia[2]; Institute for Biological Problems of Cryolithozone, Siberian Branch of the Russian Academy of Sciences, Yakutsk[3]; Department of Mammoth Fauna Studies, Academy of Sciences of the Republic of Sakha (Yakutia), Yakutsk[4]

The structure and composition of vegetation in the Late Pleistocene landscapes of northern Eurasia and Alaska have been reconstructed based on pollen and other proxy data. However, there is still high uncertainty about the occurrence and abundance of individual vegetation types. These landscapes were inhabited by a specific megafaunal complex, which largely disappeared during the Pleistocene/Holocene transition. What remains are bones and occasionally found frozen carcasses of these extinct animals, containing remains of plants in their stomachs and intestines. We attempted to reconstruct Late Pleistocene vegetation of non-glaciated northern Siberia and Beringia by comparing the taxonomic composition of the plant remains found in the gastrointestinal tracts of the frozen carcasses of Pleistocene megaherbivores with the species composition of the current Siberian vegetation. We compiled a dataset of palaeobotanical records from 27 frozen individuals of Pleistocene megaherbivores (14 mammoths, 5 woolly rhinoceroses, 4 steppe bison, 2 horses and 1 reindeer) found in northern Siberia and Beringia and dated to the period from more than 50 kyr BP to 9 kyr BP. We also collected 2,839 vegetation plots from several regions and different habitats in Siberia and classified them into broad vegetation types. Then we analysed the similarity in the taxonomic composition of plants between these two datasets using a novel method that accounts for variable taxonomic resolution in palaeobotanical data. For most megaherbivore individuals, plant remains in their gastrointestinal tracts corresponded to tundra, forest and mire vegetation, while they showed low similarity to the steppe. This pattern was relatively constant over time, showing no remarkable differences between the Last Glacial Maximum and the periods before and afterwards. This suggests that during the Upper Pleistocene, a mosaic of mesic and wet vegetation types such as tundra with patches of forests and mires was common in northern Siberia and Beringia. In contrast, the steppe was rare to absent in the landscape or underused by the megaherbivores as a pasture since they found enough food in the widespread mesic and wet habitats with more productive vegetation.

ID 179

Format Oral Presentation

Theme Macroecology of vegetation

Effects of climate on abundance and richness of Neotropical epiphytes

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Understanding the mechanisms underlying spatial patterns of biodiversity is crucial in light of the current scenarios of biodiversity loss, climate change and landscape modification. Numerous hypotheses have been put forward to explain global patterns of biodiversity. One of the more central climate-related hypotheses is the more-individuals hypothesis (MiH). Although the MiH is considered a “species/energy” hypothesis, which postulates that diversity is regulated by productivity, in plants, given that water is involved, diversity is not solely driven by temperature or light. Epiphytes are amongst the most conspicuous and diverse components of tropical forests. Vascular epiphytes are plants that germinate and grow non-parasitically on other plants; due to their lack of contact with the soil, they often capture water and nutrients from the atmosphere. Thus, epiphyte diversity is assumed to be primarily determined by climate, which makes them an ideal system to test the MiH. We tested the MiH for vascular epiphyte diversity in the Neotropics and evaluated the following expectations derived from the MiH: a positive relationship of both (i) species richness and (ii) abundance with climatic variables; (iii) a positive relationship between species richness and abundance; and (iv) the relationship between energy and species richness is weaker than that to abundance, as well as that between abundance and climate. We used data from the first database of epiphyte community data: EpIG-DB, which were distributed across 22 ecoregions in the Neotropics. Climatic variables (predictors related to water availability and temperature) were selected using a principal component analysis. We performed structural equation models to explore

the direct and indirect effect of climatic predictors on epiphyte richness and abundance, as well as between species richness and abundance. The analysis was carried out for the whole assemblage (i.e., all epiphyte species) as well as for the three most representative epiphyte taxonomic groups separately (orchids, bromeliads and ferns). We found that climatic variables, mainly related to climatic stability, influence neotropical epiphyte richness and that this effect is mediated by abundance, but this picture varies between taxonomic groups of vascular epiphytes. All four MIH-related predictions were corroborated, for the first time for plants, providing an additional step to understanding large-scale patterns of epiphyte diversity in the Neotropics.

ID 81

Format Poster Presentation with lightening Talk

Theme Disturbance ecology

Fire effects on the seed bank of open savannas of the Cerrado

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Fire is an important ecological factor influencing vegetation communities in several ecosystems. In savannas of the Cerrado, fire exclusion results in changes not only in plant community composition and dynamics, but also in ecosystem services and possibly in their resilience. The post-fire regeneration is affected by fire regime, and availability of resources. We investigate the effect of the reintroduction of fire in savannas where fire has been excluded for a long time. We evaluated fire effects on the seed bank and we also aimed to understand if fire history differently influenced the seed bank composition. We hypothesize that, after fire, more species will germinate, showing that fire stimulates seed germination from the seed bank. Also, sites with longer periods of fire exclusion will show a different composition of its seed bank. We accessed the seed bank of areas with different fire histories: FE1985 – 30 years of fire exclusion, one fire event; FE2009 – 11 years of fire, three fire events. Soil samples (20 x 20 x 1 cm^3) were collected before fire and three days after prescribed fires. Using the seedling emergence method, seed bank trials were carried out in a greenhouse for four months. We found that seedling density in FE1985 was higher than FE2009. Fire significantly increased the emergence of seedlings at both areas compared to the seed bank sampled before fire (FE1985: 6 %; FE2009: 50 %). Furthermore, we observed a change of functional groups composition between both sites: we found more forb and shrub seedlings at FE1985, while FE2009 showed a dominance of graminoid seedlings (FE1985: 48 % forbs, 16 % shrubs, 16 % graminoids; FE2009: 88 % graminoids, 9 % forbs and 3 % shrubs). Thus, longer periods of fire exclusion (FE1985) also lead to an increase in shrub seeds in the seed bank, resulting in woody encroachment. As a conclusion, long-term fire exclusion also affects the seed bank composition, showing a shift in dominance from a grassy community (FE2009) to a woody one (FE1985). Finally, fire stimulated more species to germinate, showing that fire plays a major role also on the germination and consequently, on seedling recruitment of Cerrado species.

ID 95

Format Oral Presentation

Theme Conservation and restoration

Taxonomic and functional diversity in relation to pastoral value of plant communities subject to intense cattle grazing

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In the recent decades, the drastic decrease of traditional breeding activities that took place in Southern Alps led at the same time to the abandonment of pastures difficult to reach and to the over-exploitation of easily accessible ones. This land use pattern is a major cause of alpine pasture deterioration in terms of forage quality and productivity consequent to species loss. However, there are still few evidences of such effects on all components of biodiversity, specifically on functional identity and diversity of plant communities undergoing to over-grazing. In this study, we aimed to evaluate and compare changes of taxonomic and functional facets of biodiversity and to relate them to the pastoral value of plant communities subject to different degrees of cattle grazing. We applied multivariate ordination on random vegetation plots to investigate the floristic composition of pastures of Croce Domini (Italian Southern Alps) and main environmental gradients through community weighted mean (CWM) of Landolt ecological indicators. We assembled a data set of plant traits of each species, representative of plant size (LA, Leaf area; H, vegetative plant height) and economics (LDMC, Leaf Dry Matter Content; LCC and LNC, respectively Leaf Carbon and Nitrogen Content; SLA, Specific Leaf Area). For each community type, we calculated the mean pastoral value based on the index of specific quality, and finally taxonomic (species richness and evenness, Simpson's diversity index) and functional (functional dispersion and CWM of all plant traits) diversity indices. We applied generalized additive models to investigate patterns of taxonomic and functional diversity along the main environmental gradients, while we used a null model approach to test the effect of the functional diversity associated to grazing intensity on pastoral value. Analyzed plant communities ordinated themselves mainly according to soil humidity and nutrient loads. Taxonomic diversity showed a negative correlation with soil humidity and a peak at intermediate nutrient loads, resembling the humped-back curve between biodiversity and biomass. All the CWMs of plant traits increased with soil nutrient content, while they decreased at both extremes of soil humidity gradient. We observed an increase of functional divergence at high values of soil humidity and at intermediate nutrient levels. Higher pastoral values were found at intermediate levels of both soil humidity and nutrient load, and were associated with more acquisitive and competitive plant communities showing greater taxonomic diversity and functional divergence. Our results point out that over-exploitation of alpine pastures has a negative impact on taxonomic and functional diversity and a cascading effect on pastoral value, so it should be discouraged since it is not sustainable both for biodiversity conservation and forage production.

ID 133

Format Oral Presentation

Theme Informatics, databases, tools and new technologies

Citizen science can step in when we cannot step out: How the iNaturalist platform is contributing to the national vegetation map in South Africa

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The National Vegetation Map and classification system of South Africa were first published as a hardcopy map and description in a book edited by Mucina and Rutherford (2006). A CD of the map was also included with this publication. The curators of the map allowed for the ongoing refinement and improvement of the map and classification as new data and technology allowed us to gather better data. Traditionally this information was collected through vegetation plot studies, expert mapping from satellite imagery, and several other pathways that were often limited to contributions by experts only. This way of collecting data can often result in high data quality but can be slow and limited to the areas in which experts usually work. In more recent years, citizen science platforms have allowed us to expand our community of contributors so that we can increase the rate and extent of data collection. In particular, iNaturalist has been useful to enhance our collection of data through our project on the platform called VEGMAPhoto (s Afr). Thus far, the project has helped us collect photographic examples of the communities described in the national vegetation map, as well as assisted with augmenting the list of species that may occur within a vegetation type. We also have a field that allows citizen scientists to indicate whether the photograph represents an example of the type in a good or poor condition. In a few cases, the observations uploaded onto the project have highlighted communities that do not match the description in the current version of the national map, thus highlighting areas for further investigation and possible refinement. In the three years since we set up the citizen science project on iNaturalist, we have photographic examples of over 80 of our 459 vegetation types. We have added additional species to 141 of our vegetation types, with lists in 40 vegetation types growing by fifty percent. We have 56 members in the project, many of whom are known regional experts as well as citizen scientists, suggesting that the quality of data from most contributors may be acceptable. Nevertheless, data is verified before observations are included in the national dataset. We hope that these observations can one day be used to develop a photographic catalogue of each national vegetation type, along with examples of the habitat in a degraded condition. This can be useful to ecologists who cannot get into the field to observe the vegetation type in person, as was the case in 2020. This can also be an incredibly important training tool for young ecologists trying to build a mental picture of the communities that occur within a given type. Furthermore, the contributions made by citizen scientists in highlighting possible areas for improvement of the map and additional taxa in a region have already helped us take steps forward in areas where we have not yet been able to step into ourselves.

ID 46

Format Oral Presentation

Theme Ecosystem function

Applying vegetation science concepts to crops: trait diversity across rice varieties increases complementarity effects and productivity

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Biodiversity consequences for ecosystem functioning are surely amongst the most debated and fascinating effects in community ecology because of their potential impact on ecosystem services like primary productivity and food production. It is expected that niche complementarity, as caused by functional trait differences between organisms, will result in increased productivity in an ecosystem. Applied to monospecific crop production it could be expected that fields composed by genetically different varieties of the same species, hence varieties likely owing different functional attributes, could also cause biodiversity effects on ecosystem functioning. We tested this hypothesis in a pot experiment using six common rice varieties, grown in monocultures and all possible 2-varieties mixtures, where vegetative biomass and seed production were measured in each individual plant. Traits were measured in monocultures to characterize varieties' phenotype. Pots contained either 2 rice plants alone or with the addition of one typical weed of rice fields, *Echinochloa crus-galli*, in the middle between the two rice plants. Both vegetative biomass and seed production were decreased by the presence of the weed but increased with taller varieties and when the varieties were more different from each other in terms of leaf traits (SLA and LDMC). Seed production was also lower when varieties had higher acquisitive strategies (varieties with greater SLA and lower LDMC), but this effect was less evident when the weed was present. The so-called net diversity effect (i.e., the deviation of mixtures from the expected performance of the monocultures) was mostly related to niche complementarity (both coexisting varieties increasing performance) rather than to selection effect (one variety dominating over the other). Following theoretical expectations, both the net diversity effect and niche complementarity were significantly positive for vegetative biomass, indicating mixtures performing better than monocultures and this effect increased with greater functional trait diversity, particularly expressed in terms of leaf traits. However, weed suppression was not affected markedly by trait diversity, while it was affected by the presence of specific varieties, particularly taller ones, suggesting some competition for light from taller rice. The results show the potential of applying ecological theories developed in the fields of community ecology and vegetation science to crop production, particularly suggesting the importance of crop mixtures of genetically and phenotypically variable varieties.

ID 117

Format Virtual Excursion

Theme Virtual Excursion

Kahikatea regeneration dynamics in Waikato and Auckland

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The New Zealand podocarp kahikatea *Dacrycarpus dacrydioides* relies on large-scale disturbance, such as flooding to regenerate, and requires habitats with poorly-drained soils for competitive success. Currently, kahikatea appear to be threatened by the conversion of lowland forest to agricultural land-use, which has resulted in significant hydrological and ecological change to their habitat. This study aims to assess the state of kahikatea regeneration failure and disturbance histories in rural Waikato and Auckland. The distribution of kahikatea both seedlings and adult stands will be investigated using GIS environmental data and field surveys of stands in the Waikato and Auckland regions. Past disturbances that may have promoted kahikatea regeneration will be identified through local land-use histories based on present-day stand age, to be established through tree core sampling. Results are expected to show that kahikatea-dominated stands are associated with wetter and cooler topographies and soil types, seedlings are associated with wetter, open, non-grazed, sites absent of weeds, and stand age is expected to align with historic land clearance. This study will provide insight into past and future kahikatea regeneration dynamics and improve understanding of threats to kahikatea regeneration for management and conservation. The Virtual Excursion will take viewers on a trip into the world of kahikatea and the field work and experiments of Nina de Jong (BSc Hons student at the University of Auckland) in broadleaved-podocarp forest across Auckland and Waikato in Northern New Zealand.

ID 155

Format Poster Presentation with lightening Talk

Theme Invasive species

Unmanned Aerial Systems to investigate patterns of invasion of *Robinia pseudoacacia* at the individual level on riparian ecosystems

de Simone, Leopoldo*[1]; Bencistà, Martina[2]; Fanfarillo, Emanuele[1]; Fiaschi, Tiberio[1]; Maccherini, Simona[1]; Angiolini, Claudia[1]

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Riparian corridors of the Mediterranean region are complex “island” habitats, representing hotspots of vulnerable biodiversity. Unfortunately, riparian areas are extremely subject to human disturbance, such as unregulated cuttings or landscape fragmentation, which can facilitate the invasion by alien species such as *Robinia pseudoacacia* L. Small Unmanned Aerial Vehicles (UAVs) were successfully used to detect and monitor alien species. In this study, we produced a template for conducting an extensive aerial survey in a complex landscape such as riparian ecosystems. Our aim was to evaluate the effectiveness of such method in detecting the presence and ecological preferences of *Robinia pseudoacacia* at the level of individual trees. As a study area, we selected the Arbia river (Siena, Italy). In its 65 km, the water course flows at relatively low elevations (550 to 140 m a.s.l.), across a gradient of growing human-altered landscape. Aerial surveys were carried out with a Phantom 4 Advanced by DJI, in order to manually identify and geolocate tree species and to build a high-resolution 3D model of the riparian corridor. Sectors of 4 ha (500 m-length and 80 m-width) were investigated along the river. Eight to 10 Ground Control Points (GCPs) per sector ensured accuracy of <10 cm. Aerial images were captured by carrying out three different sets of flights using nadir, oblique, and horizontal imagery, and combining manual and autonomous flights. The first set was performed 30 to 40 m above ground level (AGL) with a Ground Sampling Distance (GSD) of 1cm/px. The camera was tilted 65 to 70°, with a front overlap of 70 % and a side overlap of 80 %. Nadir imaging was used in the second flight, at the average height of 80 m AGL (GSD: 2.2 cm/px). Front overlap was 85 %, side overlap 70 %. The third flight set was performed manually with horizontal and oblique images taken at the sides of sector boundaries. For each sector, all tree specimens were successfully identified according to their phenological and/or vegetative features. Following field surveys, during which the species composition and abundance of the studied riparian plant communities were also investigated, revealed that the individual mapping methods were able to successfully detect all the trees having a diameter higher than 4 cm. The 3D model was used to accurately measure surface inclination, bankfull width, tree height, its relative distance and altitude from the riverbed. Our hypothesis is that the spatial distribution of *R. pseudoacacia* is correlated with the UAV-obtained environmental variables and the surrounding assemblage composition and diversity obtained from the ground-based vegetation survey. This work revealed how small and relatively inexpensive UAVs are useful tools to study and map the invasion process of alien species. Thus, their use is promising for the management of alien species in riparian ecosystems.

ID 49

Format Poster Presentation with lightening Talk

Theme Invasive species

Inter-annual dynamics of Cerrado invaded communities under different fire seasons

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Invasive grasses can change natural fire regimes in invaded ecosystems. This might in turn change both the spatial and temporal structure of tropical savanna communities. In the Cerrado, the African grasses *Urochloa* spp. and *Melinis minutiflora* are the invasive species most widely distributed within protected areas. Here, we took advantage of an unique situation where a protected area has been partially invaded by *Urochloa brizantha* and *Melinis minutiflora* to investigate the effects of different fire seasons on the temporal and spatial beta-diversity of herbaceous - subshrub communities. We compared invaded communities submitted to fire exclusion (FE) and to different fire seasons: Early-Dry (ED, May), Mid-Dry (MD, July), and Late-Dry (LD, October) season. The data used in our analysis were composed of species coverage percentage on 32 plots (15 m x 15 m) sampled across 3 years (2014-2016): 4 plots x 4 treatments x 2 invasive species. In each experimental plot, ten random 1 m x 1 m grids were established for vegetation sampling. Linear models indicated that inter-annual temporal beta diversity, based on larger spatial scale (15 m x 15 m plots) before and after treatments, depended on fire season and on the identity of the invasive species ($p = 0.002$; $F = 6.26$; $R^2 = 0.45$). In plots invaded by *Melinis minutiflora*, we found higher variation in fire-excluded plots when compared to MD plots. MD plots also differed between the two species. Those invaded by *Urochloa brizantha* had higher temporal beta diversity than those invaded by *Melinis minutiflora*. Among subplots (1 m x 1 m) spatial beta diversity before and after treatments did not differ among fire seasons or invasive species. Our results suggest that the variation in species composition promoted by fire seasons in invaded communities is affected by the identity of the invasive species. While communities invaded by *Melinis minutiflora* tend to vary less temporarily under the influence of MD, the opposite happens when communities are invaded by *Urochloa brizantha*.

ID 71

Format Oral Presentation

Theme Vegetation dynamics and succession

Re-survey vegetation studies reveal long-term changes of epigeic bryophytes and lichens in German forests and grasslands

Diekmann, Martin*[1]; Becker, Thomas; Culmsee, Heike; Heinken, Thilo; Heinrichs, Steffi.; Leuschner, Christoph; Mazalla, Leonie; Osthaus, Magdalena; Schmidt, Wolfgang; Strubelt; Ilka; et al.

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Re-surveys of vegetation studies have become an important tool for monitoring changes in plant species composition and richness in response to environment changes. Until now, these studies have largely focused on herbaceous vascular plants. In contrast, epigeic cryptogams – bryophytes and lichens – have received little attention, because: (1) in many habitat types, they comprise fewer species compared to vascular plants, (2) many researchers consider them to be more difficult to identify and ecologically less relevant. As a result they are often ignored in the sampling of plots. Here, we present the results of those vegetation re-survey studies from forests and grasslands in Germany where bryophytes and lichens were included in the sampling. While some of the habitat types in fact are largely free of epigeic cryptogams, others show a high or moderately high abundance and species richness. The dynamics of individual species suggest a widespread eutrophication of both forests and grasslands, with lichens (especially *Cladonia* sp.) and e.g., *Leucobryum glaucum* being among the losers, and *Brachythecium rutabulum* and *Hypnum cupressiforme* (in forests) as well as *Rhytidiadelphus squarrosus* (in grasslands) among the winners. Dynamics partly differ between acrocarpous and pleurocarpous species.

ID 146

Format Poster Presentation with lightening Talk

Theme Ecosystem function

Synthesis on ecosystem services in the Carpathians (Central-Eastern Europe)

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In recent years, there is a significant demand for evaluation of conditions, functions as well as benefits of ecosystems, with a special focus on conservation and restoration efforts. According to the Biodiversity Strategy 2020, “by 2020 ecosystems and their services are maintained and enhanced” (including restoration of at least 15 % of degraded ecosystems). More precisely, the member states have to map and assess the state of ecosystems and their services in their national territory including assessment of their monetary value. The knowledge base of Europe’s ecosystems and their services is essential for the achievement of targets set in the strategy, furthermore, it is necessary for a wide range of EU sectoral policies. The Carpathians represent a wide range of different ecosystems with high nature value and they are one of the Europe’s largest biodiversity pools, however also one of the most intensively exploited. An assessment of the capacity of the Carpathians to provide ecosystem services (ESs) should highlight their irreplaceable functions and roles in maintaining ecological stability or mitigating the impacts of climate change. The aim of the study is to emphasize the significance of Carpathian ecosystems by assessing the capacity to provide selected ESs and to highlight the importance of their protection. In the first step, the map and database of ecosystems in the Carpathians will be processed by using existing data, especially Corine Land Cover 2018, which will be refined by OpenStreetMap data for selected ecosystems. Global Forest Change 2000–2019 will be used to refine forest ecosystems. ArcGIS 10.3.1 will be used for data processing and analyses by using standard, as well as advanced vector and raster analyses. The evaluation of the capacity of the Carpathian ecosystems for the provision of ESs will be processed in the second step of this research using the modified ESs potential matrix. The resulting map and database will contain provisioning, regulatory and cultural services most relevant for the Carpathians with values of their potential capacity. Some of the Carpathian countries have already prepared their national assessments of ESs, however, there are still countries in which there is a lack of knowledge on this topic. In addition, one unified methodological approach will be used for producing overall synthesis for the whole Carpathian region. With our research we support the MAES process, filling the existing data gaps. Most of all, we plan to promote the importance of the Carpathians regarding the ecological functions which will play an important role in mitigating the climate change. Furthermore, this evaluation can support achieving the goals within the Biodiversity Strategy 2030 in the evaluation of ESs and their monetary values. The produced data set will also provide a framework for national restoration plans and promote the cooperation of the Carpathian countries.

ID 58

Format Oral Presentation

Theme Functional traits

Floral and reproductive plant functional traits are multidimensional and independent within the whole plant economic spectrum

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The search for the set of traits capturing most of the variation in plant forms and related ecological functions is still ongoing. Leading dimensions of plant ecological strategies have been widely studied bringing forward the concept of 'economic spectra' of various plant organ types and underlying biological functions. A global study has found that the majority of trait variation can be described by two main axes: plant size and the leaf economic spectrum (LES), using only a limited array of plant traits. Although, by definition, reproduction is one of the main contributors to plant fitness, some reproductive traits and especially floral traits have largely been neglected in the functional-trait based literature so far. Here, we aimed at integrating floral and reproductive traits into the dimensionality of plant form and function. We used multivariate ordination techniques and trait network approaches to assess the correlation structure of different types of plant functional traits – leaf, belowground, floral and plant size related traits. We used two datasets with different herbaceous species pools to confirm the generality of the found patterns. Floral and reproductive traits defined one of the main axes of interspecific trait variability within both datasets, besides the previously identified dimensions of plant size and the LES. Floral traits were largely independent from the LES, however, flower size showed positive scaling relationships with other size related traits. Flowering phenology and mating system were hub traits mediating between modules of different plant tissue/organ types. We found that traits of the whole plant phenotype are coordinated to various degrees depending on the type of dataset. Within the pool of locally co-occurring species selection should promote greater independence between trait dimensions in order to maximize plant fitness via different trait combinations. However, when looking at larger pools of species across various environments, dimensions might appear more dependent and inter-correlated. Finally, we conclude that the coordination between vegetative and regenerative traits needs to be addressed in the future, involving the testing of floral traits within the recently proposed Floral Economic Spectrum. Moreover, integrating floral traits in the dimensionality of plant form and function can bring us closer to a holistic understanding of the whole plant economic spectrum.

ID 42

Format Oral Presentation

Theme Disturbance ecology

Vegetation-geomorphic disturbance feedbacks drive ecosystem development in unstable glacier forelands

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Glacier forelands are among the most rapidly changing landscapes on Earth. Stable ground is rare as geomorphic processes move sediments across glacier forelands for decades to centuries following glacier retreat. Yet, to fulfil chronosequence criteria, most ecological studies sample exclusively on stable terrain and miss potential vegetation-geomorphic disturbance feedbacks. Using vegetation and environmental plot surveys on both stable and geomorphologically disturbed terrain, we investigated relationships between geomorphic disturbance intensities, vegetation succession and soil development in two geomorphologically active glacier forelands in New Zealand and Switzerland. In contrast to studies on stable terrain, we found that vegetation successional stages are mostly independent from terrain age but relate to decreasing geomorphic disturbance intensities. In turn, geomorphic disturbance intensities decrease with increasing vegetation cover. Once vegetation covered more than 40 % of a plot, geomorphic disturbance intensities changed from high or moderate to low or stable and soils developed. Around this cover threshold, species with traits capable of stabilizing moving soils, e.g., mat growth with subsurface stems and extensive root systems, dominated and act as ecosystem engineers. Different effect traits of co-occurring ecosystem engineer species indicate complementary stabilization effects. Classification and non-metric multidimensional scaling of joint species-geomorphic disturbance datasets showed that vegetation and soil development relate to a sequence of linked decreasing geomorphic disturbance intensities with proceeding vegetation succession. We identify this sequence as ‘biogeomorphic succession’, a common successional pathway in geomorphologically disturbed ecosystems around the world. During biogeomorphic succession, ecosystem engineer stabilization appears to be essential for vegetation succession and soil development to proceed on unstable terrain. Our results indicate that vegetation-geomorphic disturbance feedbacks are a major driver for ecosystem development in glacier forelands across topoclimatic settings and biogeographic regions. Consequently, to advance understanding of ecosystem development in rapidly extending glacier forelands worldwide, we need to consider glacier forelands as ‘biogeomorphic ecosystems’ with inherent geomorphic disturbances and strong vegetation-disturbance feedbacks, similar to rivers, coasts and coastal dunes.

ID 73

Format Poster Presentation with lightening Talk

Theme Species composition and diversity

Soil properties drive plant composition in a Mediterranean alpine metacommunity

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In alpine habitats, plant communities are adapted to harsh conditions and usually distributed in patches of suitable habitat following a metacommunity model. Dispersal capacity and environmental filters are key drivers for explaining community composition and structure, but we lack empirical studies focusing on quantifying the specific factors that shape local metacommunities. We analysed a local alpine grassland metacommunity to test (1) the relative influence of topoclimatic, soil and spatial factors on community composition and structure and (2) whether the influence of these factors differ between specialist and non-specialist species. Following a systematic sampling across several ridges, we sampled 40 sites above 1,900 m above sea level in a Mediterranean siliceous mountain in northwest Spain. We assessed the influence of environmental and spatial factors using RDA, PCNM and variation partitioning in R. Our results from variation partitioning showed that environmental filters have a stronger effect in specialist species (67 % of explained variation) than in non-specialist species (40 % of explained variation). Especially soil properties, silt and clay content, were found to play a more relevant role in community composition. These results suggest that soil structural properties related to water content are the main filters structuring local metacommunities in Mediterranean alpine habitats. Further studies analysing species responses to water availability are needed to improve our understanding of vegetation dynamics under on-going climate change in the Mediterranean mountains.

ID 178

Format Oral Presentation

Theme Special session: Big data and big classifications

Braun-Blanquet meets EcoVeg: a formation and division level classification of European phytosociological units

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NatureServe[1]

Aims: to link the Braun-Blanquet units of the EuroVegChecklist (EVC) with the upper levels of the International Vegetation Classification (IVC), and to propose a division level classification for Europe. Study area: Europe. Methods: We established a tabular cross-walk between EVC classes and IVC formations and identified mismatches between these two levels. We then proposed IVC division level units to organize EVC classes. Results: We organized the EVC classes into 21 formations and 29 divisions. We flagged classes that did not fit comfortably within an existing formation, either because its content corresponded to more than one formation or because it did not fit any formation description. In three cases (Vaccinio-Piceetea, Loiseleurio-Vaccinietea, Juncetea trifidi), we split EVC classes because they seemed too heterogeneous to be assigned to a single formation. Conclusions: The IVC approach adds a set of physiognomic and ecological criteria that effectively organizes the EVC classes, which are already being increasingly informed by physiognomy. Therefore, the formation concepts are relatively natural extensions of concepts already embedded in the classes. However, physiognomic placement of Braun-Blanquet classes is difficult when the sampling of the vegetation is at a finer grain than usual in the respective formation (tall-scrub, annual pioneer communities). Some EVC classes seem too heterogeneous to fit into the IVC formation system. Delimitation of these classes has often been a matter of debate for many decades, and the IVC perspective might help to solve these intricate issues. In other cases, mismatches between phytosociological classes and IVC formations might better be solved by emending the current formation concepts.

ID 86

Format Poster Presentation with lightening Talk

Theme Special session: River vegetation

Effects of hydrological alterations in the riparian carbon stock capacity: understanding the past to predict the future

Fernandes, Maria do Rosário*[1]; Correia, Alexandra[1]; Martins, Maria João[1]; Rivaes, Rui[1]; Ferreira, Maria Teresa[1]; Aguiar, Francisca C.[1]

Forest Research Centre, School of Agriculture, University of Lisbon[1]

Riverine zones have been considered large carbon reserves and thus are crucial systems to mitigate the effects of climate change and to provide a Regulation and Maintenance Ecosystem Service. We analysed the effects of distinct levels of hydrological regulation (null regulation vs low regulation vs high regulation) in the carbon stock capacity along two studied areas located in Alva and Lima catchments, in mainland Portugal. We analysed 20.5 km of riverine areas in Lima River, downstream Touvedo (a run-of-river dam) and Alva River, downstream Fronhas (a storage reservoir). We quantified the changes in the Above Ground Biomass (AGB) of seven Land Use and Land Cover (LULC) classes located in the riverine zone (area submerged by centenary floods): riparian trees, riparian herbaceous, extensive agriculture, intensive agriculture, managed forests, unmanaged forest and scrubland. We used pre-dam (1965) and post-dam (2013) high-resolution airborne imagery to produce the riverine LULC maps. Carbon values for the riparian LULC classes were derived from an earlier study combined with field surveys, while the carbon values for agricultural and forest LULC classes were obtained from the literature. The results showed an overall increase of the total carbon stock after hydrological regulation, in both case studies, mainly related to the riparian enlargement resulting from agricultural land abandonment. The highest rise in the AGB was observed in the riverine areas located downstream of the storage reservoir (total AGB in pre-dam = 1.79Mt C to total AGB post-dam = 4.74Mt C), while the riverine areas located downstream of the run-of-river dam exhibited 2.85 Mt C in the pre-dam and 4.56 Mt C after hydrological regulation. Both riverine areas have significantly less riparian herbaceous and more unmanaged forests in the post-dam period while the new plantations of eucalyptus in Fronhas jointly contributed to the increase of carbon stocks. The riparian tree LULC class located downstream of the storage reservoir showed the highest average AGB per unit area (AGB pre-dam = 162 tC ha -1 vs AGB pos-dam = 165 tC ha^{-1}) of all LULC classes, followed by the riparian tree LULC class located downstream of the run-of-river dam (AGB pre-dam = 105 tC ha^{-1} vs AGB pos-dam = 104 tC ha^{-1}). These differences in carbon stock between case studies are related to the species composition and the total cover of the diverse species in the class. The different contributions to carbon stock of the riparian tree class in pre-and post-dam periods between case studies are likely the result of the different fluvial disturbance imposed by the distinct dams. Therefore, future land-use occupation and environmental flows provided by dams should also take into account the relevance of riparian areas as important carbon sinks in order to mitigate the effects of climate change.

ID 132

Format Oral Presentation

Theme Special session: Community ecology belowground

Going belowground to survive and persist: the underground world of a tropical savanna

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Tropical savannas are fire-prone ecosystems, composed of a species-rich flora on the herbaceous layer, dominated by C4 grasses and a high diversity of forbs, sub-shrubs and shrubs. These plants rely mostly on resprouting to survive and persist after fire events. Since plants from the herbaceous layer are in the fire line, being consumed or damaged by the flames, resprouting will only occur if buds are well-protected by plant structures such as bark, or if they are on the belowground, insulated by the soil, on bud-bearing storage organs. Also, savannas are open ecosystems that have their aboveground biomass, and consequently, carbon, removed after each fire event. However, much of their biomass is also allocated on the belowground, where the C is also stored and not affected by fire events in relation to biomass removal. Here, we want to show the belowground world of the Cerrado, revealing the high diversity of belowground bud-bearing organs and the high amount of biomass allocated belowground that assures regeneration after fire. Moreover, fire is of crucial importance to maintain the composition and structure of the belowground compartment of the Cerrado. Where fire is frequent, belowground bud banks present a high density of viable buds, associated with bud-bearing structures extremely adapted to resprout immediately after fire, e.g., xylopodium. This structure is connected to tuberous roots that provide enough reserve for repeatedly resprouting after biomass removal, assuring plant persistence under frequent fires. Also, in areas where fire is frequent and the vegetation is open, most of the biomass is allocated in belowground storage organs and roots, mostly fine roots located within the first 30cm. Therefore, after fire, most of the species of the herbaceous layer, even shrubs and small trees will have their aboveground buds damaged and biomass removed or killed, and regeneration will occur via belowground and basal resprouting. The longer fire is excluded, the fewer buds are found in the bud bank, and thus, regeneration will depend less on resprouting and more on germination and aboveground resprouting. Moreover, there is a decrease in the diversity of belowground organs, with an increase in the dominance of woody rhizomes and a decrease of xylopodia. Fire is not directly associated with changes in variation in morphological root traits. Following fire, absorptive root biomass increases at soil surface to respond to higher demand for belowground resources to ensure resprouting. In areas under frequent fires, there is a high proportion of absorptive roots, highlighting the main role of fine roots to support resprouting ability of savanna grasses. Therefore, to fully understand tropical savanna dynamics under different fire regimes, we need to go under and analyze the belowground compartment of the vegetation. Otherwise, only part of the history is being told, leading to the misinterpretation of changes in the aboveground plant community.

ID 47

Format Virtual Excursion

Theme Virtual Excursion

Plant communities through time in a temperate grassland of Děvín Hill, Czech Republic: What we discover by exploring inter and intra-annual dynamics?

Fischer, Felícia*[1]; Chytrý, Kryštof*[1]; Prokešová, Helena[2]

Masaryk University[1]; Pálava Protected Landscape Area Administration[2]

Temperate grasslands are known for their high diversity and marked variations in plant community composition through time, both intra- and inter-annually. Intra-annual variations occur due to seasonality, a constant weather oscillation to which species are adapted to. Inter-annual variations are less predictable and might affect the community structure in more extreme ways. To explore inter- and intra-annual plant composition dynamics, we are examining permanent plots in a dry temperate grassland (Festucion valesiacae) on Děvín Hill, SE Czech Republic. In this virtual excursion, we are showing the area where we are conducting our surveys and discuss our findings in situ. We show the main life-story groups present, and how they vary in response to inter-annual weather dynamics, highlighting some important species. We discuss what these variations mean in the longer term and what may happen with climate change. Regarding the intra-annual variation, we show how different the vegetation looks in May and July. We also talk about the magnitude of intra-annual temporal dynamics, and the possible consequences of neglecting it, by doing a single survey in the year, in vegetation science and in ecosystem ecology. Our excursion might be interesting for a broad audience: people from overseas can have a glimpse of a highly diverse rocky grassland of central Europe, while people who know this vegetation can have a deeper comprehension of the community's temporal dynamics. This excursion is related to the abstract “Weather fluctuations drive short-term dynamics and long-term stability in plant communities: a 25-year study in a Central European dry grassland”, which will be presented at the Vegetation dynamics and succession session, as an oral presentation.

ID 27

Format Oral Presentation

Theme Vegetation dynamics and succession

Weather fluctuations drive short-term dynamics and long-term stability in plant communities: a 25-year study in a Central European dry grassland

Fischer, Felícia*[1]; Chytrý, Kryštof[1]; Těšitel, Jakub[1]; Danihelka, Jiří[1]; Chytrý, Milan[1]

Masaryk University[1]

Question: Infrequent events of extreme drought or extreme temperatures may considerably affect the structure and functioning of vegetation. Here we ask how fluctuations in precipitation and temperature shape year-to-year dynamics and plant species composition in a dry grassland community, and how this variation affects plants with different life histories. Location: Dry grassland (Festucion valesiacae) in the Pavlov Hills, SE Czech Republic. Methods: Long-term trends of vegetation change in the studied grasslands were assessed by the ordination of plot records from vegetation surveys performed in different periods between 1930 and 2019. Additionally, year-to-year vegetation changes were studied in seven permanent plots of 16 m^2 surveyed annually from 1993 to 2018. Variation in species composition and abundances was related to temperature and precipitation of the previous two springs, summers, autumns and winters using ordinations and mixed-effect linear models. Results: There were no remarkable directional changes in the grassland community over the period of 1930-2019. However, during the last 25 years, the community exhibited pronounced year-to-year fluctuations, which depended on weather conditions in the previous two years. Species with different life histories (e.g., perennials vs annuals) and different ecologies (e.g., ruderal vs dry-grassland species) responded differently to specific weather patterns. Perennials were supported by wet summers, annuals profited from wet springs and autumns and moderately warm and wet winters, and ruderals of mixed life histories increased after dry summers. Conclusions: Plant species composition in a Central European dry grassland showed remarkable year-to-year dynamics in response to weather patterns over the previous two years. These community changes are non-directional and contribute to the stability of this grassland, which has not changed considerably over the past 90 years. However, increasing the frequency of drought events due to ongoing climate change can result in a directional change with an expansion of ruderal species.

ID 130

Format Oral Presentation

Theme Special session: River vegetation

Riparian forest connectivity for the provision of Ecosystem Services: the suitability of European Copernicus data for monitoring purposes in the Mediterranean and Central Baltic hydroregions

Fonseca, André*[1]; Ugille, Jean-Philippe[2]; Michez, Adrien[2]; Rodríguez-González, Patricia María[1]; Duarte, Gonçalo[1]; Ferreira, Maria Teresa[1]; Fernandes, Maria Rosário[1]

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Riparian forests are a source of ecological functions, goods and services. The effectiveness of riparian forests to provide these ecological values can be assessed by the concept of connectivity, i.e., by the amount of connected forest habitat that exists within the riparian zone. In this study, we addressed the suitability of the European Copernicus “Actual Riparian Zone” (ARZ) layer to assess the connectivity of riparian forests in the Mediterranean and Central Baltic hydroregions. Sampling sites were selected across a gradient of human pressure (Land-use/Land-cover and Hydromorphology) at two spatial scales (catchment and segment). We applied the Integral Index of Connectivity and validated the connectivity results by manually digitizing riparian woody vegetation patches over a very high-resolution Word Imagery layer creating a "Manual Riparian Zone" layer. Our results showed an overall reduced connectivity in both hydroregions, except for the least disturbed river segments in the Central Baltic hydroregion. The Copernicus ARZ layer proved suitable to assess the connectivity of riparian forests located in the Central Baltic hydroregion but displayed a consistent pattern of connectivity overestimation in the Mediterranean hydroregion. We argue that the further improvement of the spatial resolution and thematic accuracy of the Copernicus ARZ layer, by including data concerning floristic composition, would greatly improve the usefulness of this dataset to monitor the capacity of the riparian zones to provide Ecosystem Services.

ID 131

Format Oral Presentation

Theme Special session: River vegetation

Riparian vegetation potential to support distinct functional faunistic groups and related Ecosystem Services, in human-dominated landscapes

Fonseca, André*[1]; Zina, Vera[1]; Duarte, Gonçalo[1]; Aguiar, Francisca C. [1]; Rodríguez-González, Patricia María[1]; Ferreira, Maria Teresa[1]; Fernandes, Maria Rosário[1]

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Riparian areas support a wide variety of functional faunistic groups, with distinct dispersal abilities, thus promoting several Ecosystem Services (ES). In this study, we assessed the potential of riparian vegetation to support short-range dispersers (represented by ants), medium-range dispersers (represented by pollinators) and long-range dispersers (represented by birds and small mammals), in three human-dominated landscapes: Intensive agriculture (IA, e.g., irrigated cropland), Extensive agriculture (EA, agro-silvo-pastoral system) and Forest production (FP, e.g., blue gum plantations). Landscape metrics were used to characterize the size and shape of riparian vegetation patches. A metric consisting in the composition of riparian vegetation, assessed by classifying trees, shrubs and herbaceous plants at the family level, was used as a proxy to evaluate the potential of riparian vegetation patches to support seed dispersal and pollination ES provided by the aforementioned biological dispersal groups. Other metrics, related to the structure of riparian vegetation patches (including number/cover of native trees, invasive species, vertical strata), associated habitats (e.g., presence of micro and macro habitats, rocky formations, abundance of leaf litter) and management of woody and herbaceous strata were combined with the floristic composition to derive the global potential to support the three biological dispersal groups. We identified 55 woody taxa from 23 families and 45 herbaceous families. Euphorbiaceae, Portulacaceae and Cistaceae were considered the most important plant families contributing to seed dispersal by ants, while Rosaceae, Asteraceae and Fabaceae were the most important for pollination and Rosaceae, Oleaceae and Caprifoliaceae for the seed dispersal by birds and mammals. Riparian vegetation patches located in the FP landscape exhibited the highest potential for biodiversity support, mainly due to the high abundance and suitability of floristic resources to provide forage for the three biological dispersal groups. The riparian patches in the FP study area also exhibited complex shapes and a covered a larger portion of the landscape, when compared with those located in the other landscapes, representing more available habitat for the three faunistic groups. The riparian vegetation patches located in the IA landscape showed the lowest potential to support the three biological dispersal groups, although high values of habitat heterogeneity and higher overall plant richness (n = 65), especially in tree taxa (n = 21), were found in this landscape. The EA landscape achieved intermediate potential values. The management of riparian patches located in this landscape (tree and understory clearing) is preventing riparian areas from achieving higher levels of habitat suitability.

ID 165

Format Poster Presentation with lightening Talk

Theme Disturbance ecology

Post-fire reproductive phenology of a savanna in Central Brazil highlights fire-stimulated flowering of the ground layer

Fontenele, Hudson*[1]; Miranda, Heloisa[1]

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Post-fire flowering is a common trait in the savannas of Central Brazil. By resprouting from below-ground organs, several species produce flowers in a few weeks even with no rainfall. As fire clears the ground layer, new flowers are conspicuous and conditions are optimal for pollination. Seeds produced after a fire can benefit from better dispersibility and reduced competition. Also, the dehiscence of fruits may be induced by fire, dispersing seeds from the previous reproductive season into this favorable scenario. Therefore, we aimed to describe the short-term reproductive phenology of an open savanna in Central Brazil after a fire at the start of the dry season. Three plots (0.25 ha each) were established within a 20-ha area that was subjected to a management fire in the first week of May 2021. For seven weeks, we sampled experimental plots and compiled a list of reproductive species and their phenophase (flower bud, open flowers, fruiting, seed dispersal). We also recorded when flower buds were produced (before, together, or after vegetative shoots). We recorded 60 species showing at least one of the phenophases, and most were subshrubs (43 %), forbs (33 %), and graminoids (15 %). A single tree species was observed producing flower buds after fire. Forty-six species had already opened their flowers by the seventh week, producing mostly white (32 %), yellow (22 %), or pink (17 %) flowers, colors that show high contrast with the ash that covered the soil. The first species to flower was the sedge *Bulbostylis paradoxa* that flowers within days after fires without replacing its vegetative shoots. A subshrub also flowered before replacing leaves, but most species (51 %) produced flower buds together with new vegetative shoots. By the seventh week, 21 species were fruiting, and two *Asteraceae* had already dispersed the seeds produced after the fire. Fire also stimulated the fruits of *Bignoniaceae* species (*Jacaranda ulei, Anemopaegma arvense, A. glaucum*) to open, dispersing their seeds in the first three weeks. The subshrub *A. arvense* was also stimulated to flower after having dispersed pre-fire seeds, suggesting that fire plays an important role in its life history. Fast seed dispersal and seed production can be beneficial to the recruitment of new individuals since after fire competition is reduced and bare soil available. However, when considering dry season fires, the new seeds will be exposed to predation and senescence for three to four months before there is sufficient rainfall. Therefore, in early-dry season fires, species that flower later or have longer fruiting periods may benefit from dispersing seeds closer to the rainy season. The high number of reproductive species within only seven weeks evidences that post-fire flowering is an important strategy to the ground layer species. However, since some species have a very short reproductive cycle, many may not be noticed if sampling is not frequent enough to find them during flowering.

ID 96

Format Oral Presentation

Theme Disturbance ecology

Survival and flowering of three late-blooming grasses in a frequently burned Cerrado

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Universidade de Brasília[1]

In the open savannas of Central Brazil (cerrado), grasses are the main fuel component, and the dynamics of their populations are shaped by fire. For most species, resprouting from protected buds assures low mortality after a fire, and the flowering of many species is fire-stimulated. Thus, grasses are assumed to be fire-resistant and benefit from fires. However, recurrent fires could reduce the resprouting capacity of tussocks by depleting the bud bank and nutrient storages. We aimed to evaluate the survival and reproduction of three grasses in a frequently burned cerrado and hypothesized that fires would increase mortality and impair flowering. We chose to test our hypothesis on late-blooming species (grasses that bloom at the end of the rainy season) since they are usually not seen in post-fire flowering surveys. The study site experiences recurrent fires in late dry season (August–September) with a biennial fire regime. By late August 2019, three plots (0,3 ha each) were burned independently, and corresponding controls were kept unburned. Prior to the fire, we selected three perennial tussock grasses: *Aristida riparia, Schizachyrium microstachyum*, and *Trachypogon spicatus*. We randomly tagged 150 reproductive individuals of each species (25 individuals/plot) and collected descriptive parameters: vegetative height, number of reproductive shoots, and basal area. Post-fire recovery of the vegetative height was assessed monthly for six months and interrupted due to COVID-19 restrictions. Thus, in January 2021, we conducted a final survey on plant survival and reproduction when we counted the number of reproductive shoots per plant that were produced in the post-fire season (2019–2020). Overall, mortality was minimal in unburned plots but increased about 10% in burned areas for *A. riparia* and *S. microstachyum*. Basal area of tussocks could not predict mortality, and vegetative height of all species was recovered within six months. The below-ground organs and the bud bank allowed fast resprouting even with frequent fires, evidencing the resilience of grasses. However, the largest effect of fire was on reproduction. Flowering tussocks were reduced by over 50 % for *A. riparia* and *S. microstachyum* compared with unburned areas, and the number of shoots per plant was also smaller. Bigger tussocks were more likely to flower, possibly due to having larger nutrient storages that enable both vegetative recovery and reproduction. Interestingly, *T. spicatus* was stimulated by fire, increasing both the number of flowering tussocks and the number of shoots produced. Minimal mortality, fast recovery, and fire-stimulated flowering are possible traits that explain the dominance of *T. spicatus* in frequently burned cerrados. However, some late-blooming grasses are impaired by fire, reducing the number of flowering individuals and of reproductive shoots, which could impede the regeneration of dead individuals under frequent fires, leading to population reduction.

ID 148

Format Poster Presentation with lightening Talk

Theme Conservation and restoration

Effects of forest stand structure on population of endangered orchid species *Cypripedium calceolus* L.

Foremnik, Kacper*[1]; Krawczyk, Wojciech[1]; Surmacz, Bartłomiej[1]; Malicki, Marek[2]; Suchan, Tomasz[3]; Gazda, Anna[1]; Pielech, Remigiusz[1]

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Lady's slipper orchid (*Cypripedium calceolus*) has suffered a dramatic decline and is one of the most endangered orchid species in Europe. It grows mainly on calcareous soils in deciduous and mixed forests. Although numerous studies have contributed to our understanding of the causes of *C. calceolus* decline, surprisingly, little is known about the effects of forest stand structure on the spatial distribution and morphometric characteristics of *C. calceolus* ramets. In this study, we analysed how the spatial distribution of tree species and several structural characteristics of the forest stand affect the distribution and morphology of ramets of *C. calceolus*. For this, we used a remnant population of this species located in extensively managed forests in the Krowiarki Range (the Sudetes, SW Poland). The alarming decline of *C. calceolus* in this region over the last century is commonly attributed to forest management and land-use changes (abandonment of pastoralism in forests). The probability of the occurrence of *C. calceolus* was best predicted by proximity to silver fir (*Abies alba*) trees. We attributed this mainly to a positive effect by silver fir on the topsoil moisture, which can be especially beneficial to *C. calceolus* as this species is sensitive to drought. The occurrence of *C. calceolus* ramets was negatively affected by the basal area and positively affected by the diameter at the breast height of trees growing in a 5 m buffer zone. The structural attributes of the forest stand structure also affected the orchids' morphology. Ramets growing close to European beech (*Fagus sylvatica*) or sycamore maple (*Acer pseudoplatanus*) had lower leaf dimensions than the ramets close to fir and a pattern of decreasing leaf size with proximity to beech or sycamore was visible. This study spotlights the relationship between forest stand structure and the population of the endangered orchid *C. calceolus*. We formulated several recommendations for the protection of the remnant population of this species in managed forests. Adopting these recommendations may facilitate forest management and protection of the remnant populations of *C. calceolus*.

ID 26

Format Poster Presentation

Theme Functional traits

Phytomass structure of abandoned and managed mesic meadows in the forest zone: a case study from NW Russia

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Ecological succession in abandoned temperate semi-natural meadows is widespread in Eastern Europe, but its mechanism is still not clear. Abandoned meadows in the Central Forest Reserve in northwest Russia provide an interesting example of this type of succession. Although the management of these meadows stopped in the 1980ies-1990ies, they still have not been fully overgrown by woody vegetation. The aim of our study was to examine the impact of abandonment on the structure of aboveground phytomass and community weighted means of leaf traits in the meadows in the forest zone. We compared the phytomass structure of abandoned meadows in the core area of the reserve and managed meadows in the surrounding area, both belonging to the Cynosurion cristati Tx. 1947 alliance. To estimate the effects of management on the phytomass fractions and community weighted means of the specific leaf area and leaf area apart from the differences in other factors of the ecotope, mixed effect models were applied. The factors of the ecotope were estimated as Ellenberg's indicator values based on 100 m^2 survey plots, the soil temperature at the soil level and at the depth of 8 cm was measured using temperature loggers. The vascular plant biomass was significantly lower while the moss biomass and the specific leaf area were significantly higher in abandoned meadows than in managed meadows, but there was no significant difference in litter accumulation. Both abandoned and managed meadows had relatively high biomass of fine roots (up to 1 mm), where they accounted for ca 50 % of the total belowground phytomass. In all the communities, soil temperature peak was observed in June, later it began to decrease. In the winter of 2019–2020, when maximum daily temperatures did not exceed –1 ºC, soils froze only in the end of November at the soil level. Mean August temperatures at the soil level and at the depth of 8 cm were negatively correlated with soil water holding capacity. Furthermore, we observed a positive correlation of soil temperature at the depth of 8 cm with Ellenberg's indicator values for temperature. The studied abandoned meadows lacked sufficient productivity to allow rapid changes toward tall-herb ruderal communities.

ID 159

Format Poster Presentation with lightening Talk

Theme Informatics, databases, tools and new technologies

Natural Intelligence for Robotic Monitoring of Annex I Habitats: first steps in an unexplored world

Gigante, Daniela*[1]; Angelini, Franco[2]; Angiolini, Claudia[3]; Bagella, Simonetta[4]; Bonini, Federica[5]; Caccianiga, Marco[6]; De Simone, Leopoldo[3]; Gabellini, Antonio[3]; Rivieccio, Giovanni[4]; Valle, Barbara[6]; Garabini, Manolo[2]

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The Council Directive 92/43/EEC of 21 May 1992 has identified the Natura 2000 network, with its habitats and species (H&S) of European importance, as one of the main objectives of attention for effective protection of natural and semi-natural biodiversity. This process implies a huge effort for the EU States, which are in charge of implementing periodic monitoring of the state of conservation of H&S, and intervening with appropriate management measures, where necessary. Environmental monitoring is a complex task that requires a high level of experience, knowledge, and skills. Today, human operators are the only option to perform the activity of H&S monitoring, with the increasing support of supervised and semi-supervised tools (e.g., satellite or drone imagery). A possible artificial alternative is robotics, which made tremendous advancements in recent years. At present, most ground robots are not robust and efficient enough to survive in the real world, and cannot autonomously percept, interpret, and interact with highly uneven, slipping, and irregular grounds, not to mention the ability to manage unexpected contacts and impacts. As of 1 January 2021, the H2020 Project "Natural Intelligence for Robotic Monitoring of Habitats - NI " (call H2020-ICT-2020-2, ICT-47-2020 "Research and Innovation boosting promising robotics applications") started with the aim to develop quadruped robots able to successfully and autonomously move in different habitat types. Specifically, dunes, grasslands, forests, and rocky alpine terrains, corresponding, respectively, to 2120, 6210, 8110/8120, and 9110/9210 Annex I Habitats were selected as case studies. NI robots will be empowered by "natural intelligence", leveraging on the fusion of artificial cognition and articulated soft-robotics. In the developed experimental design, a set of specific parameters for each case study have been selected, concerning the physical environment, vegetation structure, and key species occurrence, in order to "teach" the robot's intelligence to acknowledge, recognize, and quantify some key indicators useful to assess the habitat's conservation status. The challenge is to develop tools that, although obviously not replacing the human botanical skills, might represent robust support for those repetitive and time-consuming activities in habitat monitoring, offering a valuable benefit for biodiversity conservation.

ID 129

Format Oral Presentation

Theme Invasive species

Seed persistence in the soil promotes local establishment, naturalization, and invasiveness in alien seed plants

Gioria, Margherita*[1]; Carta, Angelino University of Pisa[2]; Baskin, Carol[3]; Dawson, Wayne[4]; Essl, Franz[5]; Kreft, Holger[6]; Pergl, Jan[1]; van Kleunen, Mark[7]; Weigelt, Patrick[6]; Moravcova, Lenka[1]; Skalova, Hana[1]; Pyšek, Petr[1]

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Understanding the drivers of naturalization and invasiveness is key to preventing the introduction of potentially invasive species and to the management of alien plants. Here we tested (1) the relationship between native seed bank type (transient vs persistent) and density and the global naturalized and invasion status of 2,350 taxa, based on information extracted from the GloSSBank database; and (2) whether seed bank properties differ at home and abroad and how they relate to species' traits and local environmental conditions for 232 naturalized species, based on seed bank data from 5,345 sites. Species forming persistent (and dense) seed banks in the native range were more likely to become naturalized and invasive. Local seed bank type and densities did not differ at home or abroad, although latitudinal and mean annual precipitation patterns contributed marginally to local differences. Interestingly, seed dormancy and seed mass were not related significantly to naturalization or invasiveness. Globally, the ability to form persistent seed banks is a robust indicator of naturalization and invasiveness in seed plants. Our findings also show that seed bank type and density are more important than seed traits and environmental conditions in predicting invasiveness locally.

ID 91

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Drivers of herbaceous species composition and distribution in the Sudanian Savannas of West Africa

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Herbaceous plant species composition and distribution are interactively influenced by biotic and abiotic factors. Despite dramatic increases in land-use pressure and considerable climatic changes in West Africa's savannas, we still have a limited understanding of how these agents affect herbaceous vegetation composition and distribution in this region. The study applied a preferential sampling within strata. Three principal strata were oriented along a gradient of climatic aridity and sites were selected within strata to capture as much as possible of the variation in geology and land-use by choosing rangeland sites that maximised the range of grazing and topo-edaphic gradients. 450 plots were located along a climate gradient of 530 km x 200 km, reaching from northern Ghana to central Burkina Faso. In these plots, we assessed herbaceous plant species composition and environmental variables related to topography, soil and land-use (grazing pressure). Other variables that were used for the analyses were related to climate and geographic location. We used Mantel tests to explore vegetation-environment relationships and to partition variance explained by groups of variables. We also used non-metric multidimensional scaling (NMDS) ordination and hierarchical cluster analysis to visualise and describe the patterns of species composition. We found that 22.8 % of variation in the species composition and abundance matrix was explained by the considered variables including geographic location. Over half of the variance explained by climate was related to broad-scale geographic location. Approximately one-fourth of the variance explained by plot characteristics was related to broad-scale pattern. Our expectation of climate as a dominant driver of herbaceous vegetation differentiation was confirmed. Climatic drivers (mainly precipitation) were more important for species composition (62.5 % of the total explained variance) than plot characteristics (19.9 % of the total explained variance). We distinguished ten vegetation clusters arranged along three NMDS axes explaining 52 % of variation in species composition. All three axes were related to climate and grazing pressure. The results of this study highlight the importance of climate change for vegetation composition and species distribution in the region. Our findings are important for supporting land management conservation planning in the region.

ID 118

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Drivers of woody plant diversity and productivity in drylands of Ghana

Guuroh, Reginald Tang*[1]; K. Adeyiga, Gloria[2]; Kalanzi, Fred[3]; Adu-Gyamfi, Asamoah[2]; Obeng, Miracle[2]; Amponsah, Enock[2]

Council for Scientific and Industrial Research[1]; Council for Scientific and Industrial Research, Forestry Research Institute of Ghana[2]; National Forestry Resources Research Institute (NaFORRI)[3]

Vegetation properties – such as composition, diversity and biomass production – are interactively driven by various environmental variables, including climate and land-use. In the drylands of Ghana, the relative importance of these drivers for plant species composition and diversity is still poorly understood, which affects the identification and implementation of appropriate management strategies. We used a combined gradient approach, to detect the predictors of species diversity and productivity of woody plants. The study area comprised of the steep climatic gradient from the forest-savanna transition to the Sudan savanna of Ghana in combination with local gradients of land-use and soil conditions. The response variables comprised measures of diversity (species richness, species evenness and Shannon-Wiener Index) and productivity measures (basal area and aboveground biomass). Two-way ANOVAs were used to test the interactive effects of climate and land use on the one hand and response variables on the other hand. Linear mixed-effect models and model selection were used to test the relationships between multiple environmental variables and the response variables. The response of diversity and productivity indices to land-use variation differed with climate zones. Climate had significant effects on all diversity indices, while land use effect was significant except for species evenness. Both climate and land-use exhibited significant effects on basal area and total biomass production of woody vegetation. The importance and direction of predictor effects for the diversity indices and productivity measures varied considerably. For all response variables, climate variables were not retained in the final models. For the diversity indices, land-use and soil variables were both important drivers, while land-use (grazing pressure) was the main driver for the productivity measures. Generally, our models performed poorly in predicting productivity as compared to diversity. Among diversity indices, explained variance in species evenness (38 %) was lower than Shannon-Wiener Index (69 %) and species richness (77 %). For productivity measures, explained variance was higher in total biomass (41 %) than basal area (35 %). The marked differences in diversity and productivity for various land-uses along the climatic gradient imply that climate change will indeed affect vegetation properties. Our finding that grazing was the most important predictor for species diversity and productivity implies that land-use could override climate effects and that appropriate land management strategies could mitigate potential adverse effects of climate change.

ID 45

Format Poster Presentation with lightening Talk

Theme Informatics, databases, tools and new technologies

FERN Database: Data on vegetation across forest edges from the Forest Edge Research Network

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Saint Mary's University[1]

Well before Covid I started compiling data from all my research projects on vegetation at forest edges from the last few decades, and now the resulting database is particularly useful for virtual projects during the pandemic. Many studies have focused on vegetation across forest edges to study impacts of edges created by human activities on forest structure and composition, or patterns of vegetation at created or inherent natural edges, but results often vary. My database includes plant-related variables along transects across edges from various studies on different types of edges mainly from across Canada, but also in Brazil and Belize, as an introduction to the Forest Edge Research Network (FERN). I compiled data on vegetation along more than 300 transects perpendicular to forest edges adjacent to clear-cuts, fires, bogs, lakes, barrens, insect disturbances and riparian areas from over 20 studies. Data were compiled for more than 370 plant species and forest structure variables (e.g., trees, logs, canopy cover). All data were collected with a similar sampling design of quadrats along transects perpendicular to forest edges, but with varying numbers of transects and quadrats, and distances from the edge. The purpose for most studies was either to determine the distance of edge influence (DEI, edge width) or to explore the pattern of vegetation using contiguous quadrats. The FERN database provides extensive data on many variables that can be used for further study including meta-analyses, which can assist in determining answers to questions important to conservation efforts such as how DEI from created edges is affected by different factors. This database has already been used for undergraduate student projects including an examination of plant species composition across different types of natural forest edges in Nova Scotia, Canada, and another on the patterns of tree and shrub abundance across natural forest edges in Canada. I plan to expand this database with subsequent studies and I invite others to contribute to make this a more global database (please contact the first author). An International Forest Edge Research Network or iFERN global database will greatly facilitate global syntheses and meta-analyses of edge studies and contribute to edge theory.

ID 57

Format Oral Presentation

Theme Special session: Community ecology belowground

Bud bank, overwintering and seasonal development: community-level responses of herbaceous plants to variation in soil freezing

Henry, Hugh*[1]; Rycroft, Samuel[1]

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In seasonally snow-covered regions, many herbaceous plant species overwinter via organs of perennation positioned at or below the soil surface. Snow cover therefore can have a strong influence on frost exposure in these species. In experiments designed to examine the effects of reduced snow cover and increased soil freezing at the plant community level, we have observed disproportionately low freezing tolerance by legumes relative to non-leguminous species. In the current study, our objective was to explore whether this anecdotal observation was representative of a more general phenomenon. We manipulated soil freezing in the field via snow removal (1 m by 1 m plots) for three plant communities with pre-established legume populations: 1. a fallow area, 2. an old field and 3. a restored native tallgrass prairie, all located near London, Ontario, Canada. We also examined snow removal effects for an additional set of plots in these fields on transplanted legumes (*Trifolium pratense, Trifolium repens, Melilotus officinalis, Securigera varia, Lotus corniculatus, Desmodium canadense, Desmodium paniculatum, Lespedeza capitata* and *Lespedeza hirta*). For all snow removal plots, we estimated aboveground biomass production the following growing season to assess the effects of increased soil freezing relative to ambient snow control plots. In both the fallow area and the old field, reductions in the biomass of pre-established legumes caused by snow removal exceeded those of grasses and non-leguminous forms, the other two main functional groups. However, in the native prairie, where only one leguminous species (*Desmodium canadense*) was abundant, there was no disproportionate effect of freezing on legumes. For the transplanted legumes, the results from the fallow area and old field were consistent with those of the pre-established legumes. In contrast, for the native prairie, all of the transplanted legumes except *D. canadense* exhibited low freezing tolerance relative to the non-leguminous species. These results suggest that both native and non-native legumes exhibit low freezing tolerance relative to other species in our region, which may have important implications for the nitrogen budgets of these ecosystems in response to changing winters.

ID 77

Format Oral Presentation

Theme Special session: Community ecology belowground

A comparative study of root traits, plant lifespan and clonal growth forms

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Institute of Botany, Czech Academy of Science[1]

Plants rely on fine roots for absorption of nutrients from the soil. Differences in traits of fine roots and of the root system in general thus underlie differences among individual species in their ability to live in habitats differing in nutrient status and interactions with other species. However, root system structure is not independent of the overall structure of the plant body. Here we examine to what extent the structure of the root system is determined by whole-plant parameters, namely the expected life span of the rooting units (either genetic individuals or ramets in clonally growing plants) and their belowground non-acquisitive organs such as rhizomes. As differences in those plant parameters are themselves environmentally dependent, we also use data on species niches to separate their effects form from those due to shared environmental dependence of all these traits. We therefore link data on fine root traits on herbaceous species from the GRooT database with data on clonal growth forms and lifespan from the CLOPLA database with Ellenberg indicator values. The number of species analysed ranged, depending on the set of root traits analysed, from 90 to 615. We analysed the resulting data set by univariate and multivariate phylogenetically-informed techniques. We show that plant species form a continuum of increasing lifespan of their rooting units (from annuals and stoloniferous plants through rhizomatous plant up to non-clonal plants) that determines a range of root traits, namely mycorrhizal colonization, root mass fraction and root tissue density. This confirms that plant lifespan and belowground non-acquisitive organs play an important role as constraints for (fine) root traits in herbs.

ID 170

Format Virtual Excursion

Theme Virtual Excursion

Drought experiments in natural grasslands of southern Brazil

Hoss, Daniela*[1]; Genro, Raíssa[1]; Jorge, Bruna[1]; Winck, Bruna[2]; Fischer, Felícia[1]; Pillar, Valério[1]

Universidade Federal do Rio Grande do Su[1]l; Masaryk University[2]

The natural grasslands of southern Brazil are highly diverse ancient ecosystems that provide important ecosystem services. They are endangered as vast areas are being converted to cropland and afforestation. Further, with the ongoing climate change and increasing frequency and magnitude of extreme weather events, effects on the stability of grassland ecosystem functions may be expected. Therefore, it is of major importance to identify community mechanisms that could confer ecological stability during such events. In our work, we aim to understand how biodiversity responds to extreme climatic events and how this affects ecosystem multifunctionality. We explore plant communities in terms of functional traits, the resistance and resilience of natural processes, and the provision of multiple ecosystem functions and ecosystem services. Using field and greenhouse experiments, we are assessing effects of the community functional structure (i.e., functional diversity, redundancy, trait identity) on ecological stability under experimentally manipulated precipitation extremes (rainfall and drought), i.e., what is the role of biodiversity to buffer ecosystem properties during and after such events. We count on a transdisciplinary approach to evaluate multifunctionality, involving the fields of vegetation ecology, community ecology, functional ecology, soil biology and biochemistry, among others. In this virtual excursion we will show both experiments, which are based on natural communities from subtropical Campos Sulinos grasslands, in southern Brazil, 30°06'13" S, 51°40'55" W. The vegetation at the study area is dominated by perennial C4 grasses, with a lower stratum dominated by prostrate grasses (e.g., *Paspalum notatum*) and forbs (e.g., *Chaptalia* sp.), and varying density of tussocks (e.g.. *Aristida* sp., *Andropogon lateralis*), rosettes (*Eryngium horridum*) and shrubs (e.g., *Vernonia* sp. and *Baccharis* sp.) depending on the grazing management. The first study is a field rainout shelter experiment that has been run since 2013, where we will portray the experimental design and some of the maintenance methods, such as rainfall interception, vegetation clipping, diversity manipulation and invertebrate surveys. The second experiment is a greenhouse setting where monoliths of natural grassland are maintained and manipulated towards creating different levels of diversity. The plots were already submitted to extremes of drought and rainfall treatments, and we will be able to check which communities will be more stable under this disturbance and how this affects ecosystem stability in terms of biomass production.

ID 171

Format Oral Presentation

Theme Ecosystem function

Grassland stability: the role of biodiversity in the face of climate change

Hoss, Daniela*[1]; Vélez-Martin, Eduardo[2]; Menezes, Luciana[3]; Debastiani, Vanderlei[3]; Pillar, Valério[3]

UFRGS[1]; Ilex Consultoria Científica[2]; Universidade Federal do Rio Grande do Sul[3]

Climate changes are expected to increase frequency and intensity of extreme climatic events (e.g., droughts and floods). The effects of such disturbances on the stability of plant communities is a major concern, especially regarding the maintenance of ecosystem processes and services needed to ensure human welfare. Yet, biodiversity can buffer communities from the effects of these anomalies, providing resistance and resilience. Here we demonstrate how different biodiversity metrics can be used as indicators of biomass productivity stability under extreme climatic events of drought and rainfall on natural communities from subtropical grasslands in southern Brazil. We used data on plant species composition, functional traits, and ecosystem productivity for 250-m long plots located in twelve 5-km grids. For each plot, we retrieved a monthly based 18-year time series of NDVI (Normalized Difference Vegetation Index), as a proxy for plant productivity, using MODIS data (250 m spatial resolution and 23 acquisitions/year). To define climatic events, we used the Standardized Precipitation-Evapotranspiration Index (SPEI), which quantifies temporal variations in water balance on a 0.5-degree spatial resolution. We selected the SPEI-03, due to the high correlation with NDVI data. This allowed us to classify every month for each plot into dry or wet events outside the normal range (-0.68 < SPEI-03 < 0.68), as well as their intensity: extreme (SPEI-03 > |1.27|) or moderate (|0.68| < SPEI-03 < |1.27|). For each plot, normal months allowed us to construct a baseline for normal conditions as the mean monthly NDVI observed. We quantified resistance as the relative change of NDVI from its baseline, and resilience as the rate of return to the baseline. Here we show that the resistance and the resilience of native grassland communities depend on the biodiversity metric evaluated and the direction and intensity of the climatic anomaly. Overall, high levels of species richness, species diversity, functional diversity, and functional redundancy were positively related to the resistance of biomass productivity in dry and wet events, whereas resilience of biomass productivity to drought was positively related mostly to species richness. This indicates that the high plant diversity in the studied grasslands has ensured ecosystem stability throughout the climatic anomalies registered so far. Thus, the effects of biodiversity on the stability depend on which biodiversity dimension is considered and on the functional characteristics of the biodiversity. Therefore, this highlights the importance to consider the different components of biodiversity when investigating the relationships between ecosystem services and climate change.

ID 127

Format Oral Presentation

Theme Invasive species

Defining invasiveness and its inheritance using growth and reproductive traits of an invasive grass

Huebner, Cynthia*[1]; Corbett, Cameron[2]; Barrett, Craig[2]

USDA Forest Service, Northern Research Station[1]; West Virginia University[2]

Phenotypic plasticity is a key mechanism of invasiveness and, if inherited, could explain rapid adaptation to novel environments of some non-native plants. Measuring growth and reproductive traits of parent plants from different environments and comparing these traits to those of their offspring in a common environment enables us to evaluate inheritance of plastic traits. *Microstegium vimineum* (Japanese stiltgrass), an invasive grass, exhibits plastic traits in different environments. Our goal was to determine if these traits are heritable in different habitats and regionally. Given this species' low genetic diversity, inherited plastic traits may have an epigenetic source. Plants and seeds were collected from different latitudes/longitudes at paired riparian and southwest-facing slope/ridge habitats in five states in the U.S.A., including MD, OH, PA, VA, and WV. Field-collected progeny were grown under controlled greenhouse conditions. Morphological traits, including internode node length relative to height, biomass, and leaf shape, of parent and progeny were compared using generalized linear models. We also compared fitness-related traits including floret weight and reproductive effort. In addition to these variables, days-to-first flower of the progeny was compared with latitude, longitude, and elevation of the parents using regression analyses. Finally, we determined narrow sense heritability. Parents and progeny differed significantly from each other with parents having longer internodes relative to height and greater reproductive effort, suggesting these traits are not inherited. There were significant habitat and site effects with riparian sites having parents with longer internodes and progeny with shorter internodes; OH plants (only plants in the study of the awnless variety) had the lowest reproductive effort for both parents and progeny. The parents and progeny did not differ significantly from each other in terms of leaf shape or floret weight, suggesting these traits are inherited. OH parents and progeny had the widest leaves, and the OH and one WV site's parents had the smallest florets. The OH progeny also had the smallest florets, but the same WV site had the largest florets as progeny. The OH progeny took longer to flower than all other sites. More eastern sites were correlated with narrower leaves (parent and progeny), increasing days-to-first flower (progeny), and reproductive effort (progeny). Reproductive effort also increased with increasing elevation for the progeny, and internode length relative to height increased with increasing latitude of the parents. Thus, some traits measured differed between parents and progeny and other did not, supporting both phenotypic plasticity with and without inheritance. However, the traits that did not differ between parent and progeny varied in terms of site, habitat and narrow-sense heritability, indicating possible epigenetic or maternal effects may explain this species' invasiveness.

ID 172

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Patterns and controls on fine-root dynamics along a rainfall gradient in Ghana

Ibrahim, Forzia*[1]; Adu-Bredu, Stephen[1]; Addo-Danso, Shalom[1]; Duah-Gyamfi, Akwasi[1]; Amponsah Manu, Emmanuel[1]; Malhi, Yadvinder[2]

Forestry Research Institute of Ghana[1]; School of Geography and the Environment, University of Oxford[2]

Environmental conditions generally influence various properties of plant root dynamics. Understanding changes in root dynamics in response to environmental factors is crucial for a better understanding of ecosystem functioning and climate change projections. Yet, information on environmental controls of root dynamics is limited in the tropics. This study quantified fine-root dynamics along a rainfall gradient in Ghana, ranging from dry to wet evergreen forests. Two one-hectare (1 ha) plots were selected from each forest site for data collection. A systematic random sampling procedure was employed in the selection of subplots within the 1-ha plots at each of the study sites. Fine-root biomass and necromass were estimated by the sequential coring method for a year and analyzed in relation to measured environmental factors (rainfall, soil moisture content, air temperature and soil temperature) using generalized additive models (GAM). Overall, fine-root biomass increased along the gradient with the highest estimate found in the wet forest site. Mean annual fine root production ranged from 276.60 to 348.95 gm^{-2} yr^{-1} across the different forest types. Fine-root turnover rates ranged from 2.3 to 3.1 yr^{-1}, and roots tended to turn over faster in the dry than in the moist and wet forest sites. There was a non-linear but significant ($p < 0.001$) relationship between fine-root biomass and soil moisture content in the wet forest. None of the environmental factors was related to fine-root biomass in the moist forest. However, there was a significant ($p < 0.01$) non-linear relationship between rainfall and fine-root biomass in the dry forest site. These results suggest that environmental factors influence fine-root biomass differently across the three forest types. These findings indicate the fine-root dynamics is an important parameter for the study, and this could have implications for carbon storage on forest ecosystems.

ID 144

Format Virtual Excursion

Theme Virtual Excursion

Traditional grassland management practices supporting plant diversity

Janisova, Monika*[1]

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Traditional farming, once widespread in the whole of Europe, is now restricted to remote areas of the European mountains. The Carpathian Mountains belong to the areas with the best-maintained traditional grassland management practices. Since 2017, we studied plant diversity of semi-natural grasslands in seven countries of the Carpathians and related the botanical and ecological data to detailed information from parcel owners concerning the recent and historical land use. In a short film we will present those management practices and farming systems, which most support plot- and region-based plant diversity. We will show several extremely diverse and picturesque landscapes and focus on the traditional farming approaches that could foster plant diversity of modern landscapes if applied.

ID 82

Format Poster Presentation with lightening Talk

Theme Conservation and restoration

How many and which species to plant? A multi-trait-based approach to select species to restore ecosystem services

Jardim L., Raissa Iana *[5]; Carlucci, Marcos B. [5]*; Tsujii, Paula Kiyomi [1], Coutinho, André Ganem [1], Higuchi, Pedro [2], Müller, Sandra Cristina [3], Sosinski Jr. , Ênio E. [4]

Programa de Pós-Graduação em Ecologia e Evolução, Universidade Federal de Goiás, Goiânia, GO, Brazil[1] ; Departamento de Engenharia Florestal, Universidade do Estado de Santa Catarina. Lages, SC, Brazil[2]; epartamento de Ecologia, Universidade Federal do Rio Grande do Sul. Porto Alegre, RS, Brazil[3]; Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF, Brazil[4]; Laboratório de Ecologia Funcional de Comunidades (LABEF), Departamento de Botânica, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba, PR, Brazil[5]

It has been increasingly argued that ecological restoration should focus more on targeting ecosystem services than on species composition of reference ecosystems. In this sense, the role that species play on community assembly and functioning through their functional traits is very relevant, because effect traits mediate ecosystem processes, ultimately resulting in provision of ecosystem services. One major challenge in ecological restoration is to know which species to use to assembly in a community that will deliver the target ecosystem services. We developed an algorithm to select the minimum set of species that maximize the functional richness (FRic) and the functional redundancy (FR) of the restored community, a proxy for the provision of multiple ecosystem services and the resilience of the system to environmental changes, respectively. For this, we simulated the restoration of 24 riparian woody communities of the Brazilian Cerrado. Using the species pool of each original local community, we ran restoration simulations for gradually increasing species richness until reaching the total species richness of the original local community. We computed FRic and FR for each simulated restoration community using the traits specific leaf area, maximum plant height and seed mass. Our simulation results indicate that multiple ecosystem services could be restored with an average of 66 % of the species of the original community. Moreover, an average of 59 % of the species would be needed to restore communities resilient to environmental changes. Our approach contributes to solving one of the major challenges of ecological restoration, which is defining how many and which species should be used to achieve functional targets. We believe this approach can help in projects of restoration by enabling restoration practitioners to select minimum alternative sets of species that optimize the provision of multiple ecosystem services in a resilient restored ecosystem.

ID 169

Format Oral Presentation

Theme Ecosystem function

Abundance and diversity of edible wild plants in managed boreal forests

Jašková, Anni*[1]; Hotanen, Juha-Pekka[2]; Manninen, Outi[3]; Salemaa, Maija[4]; Tolvanen, Anne[5]; Merilä, Päivi[5]

Department of Botany and Zoology Faculty of Science, Masaryk University[1]; Natural Resources Institute Finland (Luke), Joensuu, Finland[2] ; Natural Resources Institute Finland (Luke), Rovaniemi, Finland[3]; Natural Resources Institute Finland (Luke), Helsinki, Finland[4] ; Natural Resources Institute Finland (Luke), Oulu, Finland[5]

Boreal forests are rich in non-timber forest products from plants, and approximately two hundred wild plant species have been documented for their nutritional uses in Finland, and many of these species occur in forests. The provisioning of edible plants by managed forests has received little attention, despite the fact that forest vegetation is altered by forest management practices. In this study, we use nation-wide forest vegetation and tree stand data consisting of a total of 1,778 sample plots to quantify the richness and abundance of edible wild plants in Finnish forests. Responses of edible species richness, abundance, and composition to stand characteristics such as site type, tree species composition, stand density, and management history are analysed with regression models, NMDS ordination, and diagnostic species analysis, for forests on mineral soils and on peatlands separately. A total of 68 edible wild plant species occur in our dataset, with their occurrence and abundance varying between species and between sites. Our results indicate that habitat characteristics, namely site fertility and stand density, are the strongest determinants of overall edible plant provisioning. I will present the main findings of our study, with a focus on the community composition, and discuss the possible explanations behind the findings.

ID 34

Format Oral Presentation

Theme Macroecology of vegetation

Post-glacial determinants of regional species pools in alpine grasslands

Jiménez-Alfaro, Borja*[1]; Ćušterevska, Renata*[2]; Adbulhak, Sylvain[3]; Attorre, Fabio[4]; Bergamini, Ariel[5]; Carranza, Maria Luisa[6]; Chiarucci, Alessandro[7]; Dullinger, Stefan[8]; Gavilán, Rosario[9]; Giusso del Galdo, Gian Pietro[10]; Kuzmanovic, Nevea[11]; Laiolo, Paola[12]; Loidi, Javier[13]; Malanson, George[14]; Marcenó, Corrado[15]; Milanovic, Djordjije[16]; Pansing, Elizabeth[14]; Roces-Diaz, Jose Vicente[17]; Ruprecht, Eszter[18]; Sibik, Jozef[19]; Stanisci, Angela[6]; Testolin, Riccardo[4]; Theurillat, Jean Paul[20]; Vasilev, Kiril; Willner[20], Wolfgang[8]; Winkler, Manuela[22]

University of Oviedo[1]; Ss. Cyril and Methodius University[2]; Conservatoride Botanique Alpine[3]; Sapienza, University of Rome[4]; WSL[5]; University of Molise[6]; University of Bologna[7]; University of Vienna[8]; University Complutense of Madrid[9]; University of Catania[10]; University of Belgrade[11]; Research Unit of Biodiversity (CSIC) [12]; University of the Basque Country[13]; University of Iowa[14]; Masaryk University[15]; University of Banja Luka[16]; CREAF[17]; Babeș-Bolyai University[18]; Slovak Academy of Science[19]; University of Geneve[20]; Bulgarian Academy of Science[21]; University of Natural Resources of Vienna[22]

The diversity and composition of regional species pools in alpine ecosystems may respond to area effects, environment, connectivity and isolation, yet these factors have been rarely evaluated in concert. In this study, we investigate the influence of these determinants in alpine grasslands across European mountain regions, including the Alps, the Carpathians and the three large southern Peninsulas. We used a comprehensive dataset of vegetation plots to calculate the size and composition of species pools in 23 geographic regions, We used species-area relationships to test the influence of the extent of alpine areas on regional richness, and mixed-effects models to compare the effects of 12 spatial and environmental predictors. Variation in species composition was addressed by generalized dissimilarity models and by a coefficient of dispersal direction to assess historical links among regions. In total, we compiled species occurrences for 2,888 taxa, which were further divided into 794 specialists (alpine species) and 2,094 generalists (non-alpines). Although regional pool sizes were partially explained by current alpine areas, the other predictors largely contributed to regional differences. The number of alpine species was influenced by area, calcareous bedrock, topographic heterogeneity and regional isolation, while non-alpines responded better to connectivity and climate. Regional dissimilarity of alpine species was explained by isolation and precipitation, while non-alpines responded to isolation. Past dispersal routes were correlated with latitude, with alpine species showing stronger connections among regions. These results suggest that besides area effects, edaphic, topographic and spatio-temporal determinants are important to understand the organization of regional species pools in alpine habitats. Moreover, species with different specialization to alpine habitats show distinct macroecological patterns. The number of alpine species is especially linked to refugia and isolation, but their composition is explained by past dispersal and post-glacial environmental filtering. On the contrary, non-alpines are generally influenced by regional floras through mass effects.

ID 53

Format Oral Presentation

Theme Remote sensing of vegetation

Drought years in peatland rewetting: rapid vegetation succession can maintain the net CO_2 sink function.

Jurasinski, Gerald*[1]; Beyer, Florian[2]; Jansen, Florian[1]; Koch, Marian[1]; Schröder, Birgit[1]; Koebsch, Franziska[3]

University of Rostock[1]; Julius-Kühn-Institute[2]; University of Göttingen[3]

The rewetting of peatlands is regarded as an important nature-based climate solution and intended to reconcile climate protection with the restoration of self-regulating ecosystems that are resistant to climate impacts. Although the severity and frequency of droughts are predicted to increase as a consequence of climate change, it is not well understood whether such extreme events can jeopardize rewetting measures. In our study we analysed vegetation with remote sensing and greenhouse gas exchange with eddy covariance in a coastal peatland to better understand drought effects on vegetation development and the exchange of the two important greenhouse gases CO_2 and CH_4, especially in rewetted fens. Based on long-term reference records, we investigated anomalies in vegetation dynamics, CH_4 emissions, and net CO_2 exchange, including the component fluxes of ecosystem respiration (Reco) and gross ecosystem productivity (GEP), in a rewetted fen during the extreme European summer drought in 2018. Since flooding in 2010, the fen was characterized by a patchy mosaic of open-water surfaces and vegetated areas. After years of stagnant vegetation development, drought acted as a trigger event for pioneer species such as *Tephroseris palustris* and *Ranunculus sceleratus* to rapidly close persistent vegetation gaps. The massive spread of vegetation assimilated substantial amounts of CO_2. In 2018, the annual GEP budget increased by 20 % in comparison to average years (2010–2017). Reco increased even by 40 %, but enhanced photosynthetic CO_2 sequestration could compensate for half of the drought-induced increase in respiratory CO_2 release. Altogether, the restored fen remained a net CO_2 sink in the year of drought, though net CO_2 sequestration was lower than in other years. CH_4 emissions were 20 % below average on an annual basis, though stronger reduction effects occurred from August onwards, when daily fluxes were 60 % lower than in reference years. Our study reveals an important regulatory mechanism of restored fens to maintain their net CO_2 sink function even in extremely dry years. It appears that, in times of more frequent climate extremes, fen restoration can create ecosystems resilient to drought. However, in order to comprehensively assess the mitigation prospects of peatland rewetting as a nature-based climate solution, further research needs to focus on the long-term effects of such extreme events beyond the actual drought period.

ID 56

Format Oral Presentation

Theme Conservation and restoration

Combining field mapping and LiDAR data to improve assessment and conservation management of Natura 2000 priority habitat types

Kermavnar, Janez*[1]; Kozamernik, Erika[1]; Kutnar, Lado[1]

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Priority habitat types within the Natura 2000 network are of high conservational importance in Europe. However, they often occur on smaller areas and their conservation status lacks trustworthy information. Among them is also the habitat type of *Tilio-Acerion* forests of slopes, screes and ravines (9180*). To improve the assessment of the conservation status of this priority habitat type we performed a study in the Natura 2000 site Boč-Haloze-Donačka gora in the Sub-Pannonian region of eastern Slovenia. The study site is characterized by a matrix of European beech forests and exhibits a wealth of stands assigned to *Tilio-Acerion* forests. In 2020, we did a field mapping of habitat types using a combination of field mapping and remote sensing data (LiDAR and derivatives). As the conservation of habitat types calls for a more detailed approach, we distinguished between four pre-defined habitat subtypes: a) stands dominated by *Acer pseudoplatanus, Acer platanoides* and *Ulmus glabra* growing mostly in concave terrain; b) stands dominated by *Fraxinus excelsior* growing on slopes; c) stands dominated by *Tilia platyphyllos* and *Tilia cordata* occurring on ridges; d) stands occurring on more acid soils with *Acer pseudoplatanus* as the dominant species and frequent admixture of *Castanea sativa*. The first three subtypes are confined to more calcareous bedrock. We supported the field mapping with LiDAR-derived data such as slope, topographic position index (TPI) and digital models of tree heights. Our preliminary results show that subtypes of *Tilio-Acerion* forests differ significantly in terms of area they cover and can be distinguished based on tree species composition, forest stand characteristics (e.g., tree height), relief features (concave vs. convex morphology), and various threats (e.g., fragmentation, mortality of the key tree species, game browsing pressure on the key tree species regeneration, competition by non-native tree species) they experience. This study provides baseline information for setting more realistic management objectives and increasing conservation efforts for priority forest habitat types. Conservation management should not only be done at the Natura 2000 habitat type level due to specificities of the individual subtype.

ID 21

Format Poster Presentation with lightening Talk

Theme Species composition and diversity

Windthrow events enhance biodiversity in a mesic *Quercus* forest in the Central Russian Upland

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Effects of mass windthrow and falls of individuals trees on biodiversity have been studied in the Kaluzhskie Zaseki Nature Reserve (coordinates 53.5-53.9 °N and 35.6-35.9 °E; total area is 185 km^2). According to historical data, a large section of the Reserve with *Quercus robur* (being more than 300 years old) and other broad-leaved trees (maximum age of *Fraxinus excelsior, Ulmus glabra, Tilia cordata,* and *Acer platanoides* is 150 yr) was part of the Abatis belt beyond the Oka River of the Moscow State of the 16th and 17th centuries. There were no clear cuts in this area since the end of the 18th century while selective cuttings, forest pasturing of cattle, and removal of deadwood were widespread before the establishment of the Reserve in 1992. Forests in the other parts of the Reserve are dominated by *Populus tremula, Betula* spp*., Picea abies, Pinus sylvestris,* and *Alnus glutinosa*. Falls of individual trees occurred throughout the Reserve. The mass treefall in June 2006 was caused by a hurricane wind with rain and hail: the area of 291 damaged patches ranges from 0.04 to 51 ha with a total area of 285 ha; forests dominated by *Populus tremula* and *Betula* spp. were damaged to a greater extent than areas dominated by old *Quercus robur* trees. We studied (1) effects of large fallen logs on the vegetation in the forest tract dominated by old *Quercus robur*; (2) effect of tree falls with uprooting on the vegetation in patches of mass windthrow; and (3) xilotrophic fungi on fallen logs of eight tree species 14 years after the mass windthrow. Our results showed that windthrow events essentially enhance species diversity of vascular plants and xilotrophic fungi as in old-growth forests, as in patches of mass windthrow. In the aged forest stand, fallen logs significantly affected species richness and composition in terms of both woody seedlings and herbaceous species. This was mainly achieved by the appearance of low-competitive species that are able to grow on fallen logs because of their ecological demands: these were boreal, light-demanding and nitrophilous species. In microsites formed by tree uprooting, in addition to species of the same above-mentioned groups, plants of waterlogged and poor and dry habitats (in the pits and mounds, respectively) were encountered. Additive diversity partitioning confirmed that vascular plant species diversity on large fallen logs and on tree-uprooting microsites significantly contributed to the total gamma diversity of the studied forests. Among 100 species of basidial macrofungi identified by fruiting bodies on eight fallen logs and 33 cross-sections of eight tree species in patches of mass windthrow, 52 species were rare for European Russia. A low alpha diversity - with a high beta diversity - leading to a high gamma-diversity of fungi was observed. Twenty two fungi species were identified as indicator species for eight tree species (sensu Dufrêne & Legendre, 1997). The work is funded by RFBR, project 20-04-00733.

ID 134

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Using ecological classification to enhance predictions on incidence of invasive shrub species: The case of *Prosopis juliflora* in the Marigat Plains

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The potential impact of shrub invasive species may be higher in comparison to annual plants because of the resilience of woods and their usually taller size. *Prosopis juliflora* is listed as one of the worst invasive shrubs species across the Tropics worldwide. The Marigat Plains in the Baringo basin is one of the best known examples of an area invaded by *Prosopis* in Kenya, where it has been acclaimed as encroaching grassland areas and blocking the access to watering points for livestock. Thus modeling the actual and potential distribution of *Prosopis* is crucial for implementations on risk assessment and for the prevention of expansion to non-invaded areas. The ecological preference for intra-zonal habitats and the highly heterogeneous patterns on the geology and soils at the Marigat Plains result in a low capacity of models to predict the invasion by *Prosopis*. Furthermore disturbances by agricultural land use, livestock and infrastructure construction cause additional interactions making the interpretation of results very difficult. To quantify the degree of infestation we carried out two surveys in the Marigat Plains, one in 2014 and one in 2019. In the field we assessed the total vegetation cover as well as the relative and absolute cover of *Prosopis*. A huge variability have been observed both, in the total vegetation cover as well as in the cover of Prosopis indicating that the suitability of soils for plan establishment is highly heterogeneous in the plains. We quantified the dynamics on NDVI as a proxy to the interaction between soil/geological conditions and plant growth and we classify these patterns in combination with landscape and spatial distributions to produce ecological units (regions). A map was produced manually a priori to provide training points for the classification model. We implemented classification and regression trees to generate ecological units. While this method seems to be very promising not only in terms of the detection capacity but also in terms of a comprehensive explanation of model results, the major challenges are related with the selection of proper variables to discriminate unities with similar characteristics.

ID 153

Format Oral Presentation

Theme Vegetation dynamics and succession

Spatial indicators for evaluating changes in inner-alpine dry grassland species composition

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The Venosta valley in South Tyrol (Italy) is one of the few inner-alpine valleys in Europe that feature diverse semi-natural dry grassland habitats with high conservation value. As these grasslands originate from traditional pasture management, they are affected by transforming land-use. By translating land-cover changes into spatial indicators, we aim at explaining differences in dry grassland species composition. Initially, we resurveyed 51 vegetation plots historically documented by Josias Braun-Blanquet. We extended classical pairwise ordination methods by novel model-based approaches that use species frequencies to assess species-level contribution to compositional differences. Followingly, we analysed the areal change of the potential habitat by comparing the historical and current land-cover derived from orthoimages across sites. We related changes in species composition to spatial indicators derived from the areal map (habitat area, distance to anthropogenic infrastructure, protection status and habitat connectedness). The results indicate that the species composition change is especially pronounced for areas without an active nature protection status. Vegetation plots in protected areas, instead, maintained a more closely related composition compared to the historical sites. This is also reflected by habitat connectedness and area. This study could represent a step forward to identify drivers that lead to changes in species composition of dry grassland communities.

ID 119

Format Oral Presentation

Theme Vegetation dynamics and succession

Accelerated and relocated abandonment in a Mediterranean mountainous landscape: drivers and consequences on vegetation succession

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The European Red List of Habitats indicates that habitat types related to traditional land uses are among the most threatened. In Europe's mountains in particular, major threats include the abandonment of low-intensity agriculture and grazing. Abandonment in these marginal regions leads to progressive vegetation succession of farmland and grassland to scrubland, followed by afforestation. Our work aimed to identify spatiotemporal patterns in abandonment and succession, and relate them to socioeconomic and biophysical drivers. Since Greece is among the regions with high abandonment risk, we studied the land cover history of a traditionally used sub-mountainous area in northwestern Greece (northern Pindus). We mapped the dynamics of land cover and landscape characteristics since the outset of abandonment from the end of World War II until recently. Intensity Analysis enabled the comparison of land cover change rates between time periods. We spatiotemporally related land type occurrence with socioeconomic, physiographic, geological and climatic predictors via random forest modelling. We found 89 % withdrawal of farmland, and 189 % expansion of forest. This intensive afforestation decreased the ecotone diversity and the spatial heterogeneity and aggregation of the historical landscape. In particular, the historically large farmland and grassland patches were replaced by smaller and more numerous grassland and scrubland remnants in the expanding forest matrix. Grassland, open- and closed-scrub retained relatively stable cover over time. Nevertheless, these intermediate successional stages participated dynamically in the channeling farmland conversion to forest. Most of the land type transitions were in the direction of progressive succession, while the retrogressive successional transitions were minor and decreased over time. The Intensity Analysis revealed an overall acceleration of abandonment and succession. Farmland abandonment accelerated and relocated from uplands to lowlands, doubling its rate in the most recent time period during which a second depopulation wave was recorded. Grasslands kept their relative cover by persisting in the uplands, and by replacing farmland during the altitudinal descent of its abandonment. This dependency on altitude - and other drivers such as slope, aspect, bedrock, settlement proximity, population and livestock change - indicates that abandonment and succession can accelerate and shift due to the environmental heterogeneity and intense socio-economic changes of the mountainous regions. Thus, cost-effective management and restoration require timely and spatially targeted measures to reduce wildfire risk, increase streamflow, and conserve such biodiverse, multifunctional and cultural landscapes which are under threat.

ID 79

Format Virtual Excursion

Theme Virtual Excursion

Discovering the mysterious subtropical Brazilian Atlantic Forest

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The Atlantic Forest extends across the eastern Brazilian coast and reaches more continental areas in Brazil, Argentina, and Paraguay. This forest has strong gradients of soils, rainfall, and temperature. These environmental conditions lead to large variation in forest structure, species richness, and composition, leading to high levels of alpha and beta diversity of tree species with high number endemic tree species. In the subtropical region, from latitudes 23 ° to 30 °S, frost is frequent in the winter, and large forested areas in the plateaus (*Araucaria* forest) separate the Moist coastal Forests and the western Seasonal Forests. Permanent plots were established across the subtropical region of the Atlantic Forest in 2009 by the Plant Ecology Lab from the Federal University of Rio Grande do Sul aiming to discover the mysteries of this region. Since then, tree communities have been monitored to assess long-term changes in the forest structure and functioning. In this virtual excursion, we will show our permanent plots and some results from this long-term project. Concerning the structure of these forests, they are able to store large amounts of biomass. Moreover, these forests hold high species, phylogenetic and functional diversity, with species and clades functionally adapted to local conditions. Temporal forest dynamics indicate the great capacity of these forests in acting as a carbon sink, contributing mainly to the global carbon cycle. Finally, the long-term monitor has shown upslope migration, with shifts in community composition due to increasing temperatures.

ID 164

Format Poster Presentation with lightening Talk

Theme Functional traits

Shifts in ecological strategies at inter and intraspecific levels of woody plants in forest-grasslands mosaics

Klipel, Joice*[1]; Scarton Bergamin, Rodrigo[1]; Gliesch Silva, Mariana[2]; Carlucci, Marcos[3]; Duarte, Leandro[1]; Müller, Sandra Cristina[1]

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Forests in southern Brazil often form mosaics with grasslands and woody species may occur in just one or both habitats. Biodiversity patterns and ecological strategies shifts between species restricted to forest, to grassland, and those occurring in both habitats (i.e., generalists) are not well-known. In this study, we (i) compare shifts in functional (FD) and phylogenetic diversity (PD), and functional composition (CWM) among forests and grasslands; (ii) evaluate if forest, grassland, and generalist species have distinct ecological strategies; and, (iii) test the potential intraspecific trait variability among generalist species. To that end, forest and grasslands plots were surveyed in a paired design (18 pairs). Each plot (70 m x 70 m) had 15 100 m^2 subplots randomly distributed, and all woody individuals with at least 5 cm at breast height in the forest and soil height in the grassland were measured. Leaf samples were collected for each species per plot per habitat to calculate leaf area (LA), specific leaf area (SLA), and leaf dry matter content (LDMC). We calculated FD, PD and CWM of communities located in forest and grassland habitats, based on density. To calculate FD and PD, we removed the overlap in the variation between the functional and phylogenetic information among species. We run ANOVA to test for differences in FD, PD and CWM between habitats. We tested differences in functional traits among species groups (forest, grassland, and generalist species) with ANOVAs. Finally, we used the generalist species to performed t-tests evaluating how the leaf traits respond to forest and grassland habitats (intraspecific variability). Forests had higher FD than grassland communities when the FD was computed excluding the evolutionary legacy on the traits. PD and CWMs did not differ significantly between habitats. The paired t-test showed that the three species groups differ for LA: species sampled only in forests had higher LA ($F = 12.95$, $p < 0.01$) than generalist and grassland species. Moreover, we found significant intraspecific trait variation among generalist species, for the LA ($df = 68$, $t = 3.74$, $p < 0.01$), SLA ($df = 68$, $t = 5.40$, $p < 0.01$), and LDMC ($df = 68$, $t = -4.29$, $p < 0.01$). In general, forest individuals exhibited higher LA, SLA, and lower LDMC than grassland individuals of the same species. The FD and PD results indicate that although the communities have a similar evolutionary history, forest communities allow a greater range of trait variation, contrasting with grasslands. We found that acquisitive traits that confer competitive ability and faster recourse acquisition were associated with species occurring in forests. In contrast, conservative traits were associated with species occurring in grassland, where the conditions are more stressful (e.g., fire and drought). Additionally, our results indicate that intraspecific variability underlies the ability of species to persist in these contrasting habitats.

ID 32

Format Oral Presentation

Theme Climate change

Functional response of grassland plants to extreme drought

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Under climate change, the predicted increasing occurrence of extreme droughts will limit water availability for plants. Species will respond differently to drought by employing drought avoidance or tolerance strategies, leading to changes in individual species abundance. We hypothesized that species' abundance in response to drought will be best predicted by a combination of water economic traits in ambient conditions and the ability of plants to adjust these traits to increase their drought resistance. We predicted that the specific functional adjustment will depend on the drought's intensity, with potential shifts in terms of drought tolerance and drought avoidance strategies. We tested these hypotheses in a four-year-long experiment in mesic grasslands with simulated climate change scenarios of 30 % and 50 % rainfall reduction. We quantified species abundance response to these scenarios as the standardized effect size (SES) of abundance between control and the respective rainfall reduction. We measured traits in ambient and drought conditions and quantified the ability of species to functionally adjust (SES of traits). In both scenarios, abundance response of species to extreme drought was best explained by a combination of traits in ambient conditions together with the ability to functionally adjust, showing that in both scenarios species with smaller leaves were more likely to cope with drought. In the 30% scenario, species' abundance response was also associated with their ability to increase leaf dry matter content. In contrast, in the more pronounced 50% scenario, species ability to cope with drought was associated with both a less negative turgor loss point (TLP) in ambient conditions and plants' ability to adjust towards less negative TLP under drought. These results show a shift from a drought tolerance strategy (adjustment towards tougher leaves) to a drought avoidance strategy (less negative TLP to avoid tissue desiccation) to cope with drought as its intensity increases.

ID 145

Format Poster Presentation with lightening Talk

Theme Vegetation inventory and mapping

Inventory of grassland habitats of Ukraine using phytosociological databases

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Our aim was to establish the current state of distribution of grassland habitats in Ukraine, to identify their floristic and ecological peculiarities, to develop measures to stop their losses and ensure their long-term existence. According to the results of analysis of 23,746 vegetation plots from three phytosociological databases (GIVD codes - EU-00-030, EU-UA-001, EU-UA-009) using the expert system EUNIS-ESy (Chytry et al. 2020) with the subsequent verification, 28 types of grassland habitats were identified: R11, R12, R13, R15, R16, R18, R1A, R1B, R1C, R1M, R1P, R1Q, R21, R22, R23, R35, R36, R37, R43, R44, R51, R55, R56, R62, R63, R 64, R65, X36. Grid maps of their distribution based on geo-referenced plots in the databases and maps of the predicted distribution based on Bayesian random forests have been created. The comparative analysis of species richness, diversity and evenness, values of ecological factors on the basis of Didukh ecological scales (Didukh 2011), and the proportion of rare and synanthropic species of the resulted types has been carried out. Lists of diagnostic, constant and dominant species for vascular plants, bryophytes and lichens, characteristic rare and synanthropic, including invasive species, have been compiled. An assessment of the conservation status of habitats according to IUCN criteria as well as assessment of the conservation value, the impact of threats and risks of loss has been made. The habitat types that need protection at the national and pan-European levels have been identified. The results of the study will be used in the National Atlas of Grassland Habitats of Ukraine and in the development of a draft Strategy for the conservation of grassland habitats in Ukraine. The project was implemented with the financial support of the National Research Foundation of Ukraine (project No 2020.01/0140).

ID 152

Format Oral Presentation

Theme Climate change

Predicting the risk of grassland habitat loss in Ukraine due to global warming based on phytoindication methods

Kuzemko, Anna*[1]; Budzhak, Vasyl[2]; Chorney, Illia[1]; Tokaryuk, Alla[1]

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Recent forecasts for climate change scenarios for Europe suggest that temperatures in Central Europe will rise by about 3 °C by 2100. Thus, there is a real threat of loss of a number of ecosystems of different levels, including grassland habitats, which have already undergone significant changes in the last 50 years. We calculated the degree of possible threat for grassland habitats of Ukraine in terms of decrease of their extent or loss due to average annual temperature rise using the methodological approach of Y. P. Didukh. The essence of this approach is that according to the results of phytoindication assessment of communities and correlation and regression analysis, obtained equations describe the dependence of changes in 11 ecofactors on changes in thermal regime. These equations are used to predict the change in the value of a particular ecofactor at a temperature rise by 1, 2 and 3 ºC. It was established which of these factors can be limiting (their values exceeded the tolerance range) for the existence of these habitats. Phytoindication assessment and prediction were made on the basis of 17,687 vegetation plots representing 28 types of grassland habitats of Ukraine (R11, R12, R13, R15, R16, R18, R1A, R1B, R1C, R1M, R1P, R1Q, R21, R22, R23, R35, R36, R37, R43, R44, R51, R55, R56, R62, R63, R 64, R65, X36). It was revealed that an average temperature rise by 1 °C is not threatening for the existence of the studied habitat types, because the change in the value of ecofactors is in the range of their variability. However, an increase in temperature by 2ºC threatens the existence of 16 types (R13, R15, R16, R18, R1A, R1M, R1P, R22, R23, R35, R37, R43, R44, R51, R65, X36). For 10 of them, the limiting factor is the soil acidity, and for nine, limiting is the thermal regime of the climate. Raising the temperature by 3 ºC is critical for 26 of the 28 types. The limiting ecofactors will be the soil water regime (10 types), soil acidity (18 types), soil salt regime (four types), and carbonate content in soil (eight types), climate thermal regime (20 types), climate humidity (one type) and climate cryoregime (four types). In general, the change in thermal regime causes a change in soil-forming processes and, as a consequence, a change in soil pH, which can lead to a change or complete loss of 64 % of grassland habitats in the study area. Somewhat unexpected was the negative impact of rising temperatures on steppe habitats, which can be explained by the inverse correlation between thermal regime and humidity, so further rising temperatures will only increase the arid climate and moisture deficit will increase, which will negatively affect especially meadow-steppe communities. The data obtained reflect the risks of loss of existing grassland habitats, but the future outcome will depend on how the potential adaptation of the species that form them is realized. The study was supported by the National Research Foundation of Ukraine (project No 2020.01/0140).

ID 107

Format Oral Presentation

Theme Special session: Big data and big classifications

A continental scale (but not only) vegetation classification project - The European aquatic vegetation

Landucci, Flavia*[1]; Šumberová, Kateřina[2]; Knollová, Ilona[1]; Chytrý, Milan[1]

Masaryk University[1]; Czech Academy of Sciences[2]

Since the European Vegetation Archive (EVA) was launched in 2013, many projects aimed to review, revise and unify the classification of European vegetation have been run. Works about beech, floodplain and alder carrs, oak-hornbeam and pine forests, but also weed, dune, fen and marsh vegetation of Europe have been already successfully published by several authors. All these works except one produced a classification with alliances at the finest level. The work about marsh vegetation is the only one that produced a classification up to the association level. In this new project we aimed to review and produce a formalized classification of aquatic vegetation (phytosociological classes *Charetea, Lemnetea* and *Potamogetonetea*) up to the association level. A data set of 82,378 plots containing at least one aquatic species have been extracted from EVA. To classify and formalize the vegetation units we applied the Cocktail method. This method allowed us to produce an Expert System - a text file, composed by formulas using the logic operators to combine species abundance and groups of species, able to classify any data set with the aquatic species that occur in Europe. We classified and produced formulas for 35 associations of *Charetea*, 22 of *Lemnetea*, and 81 of *Potamogetonetea*. Twelve of these associations are dominated by exotic species. This is a continental scale classification based on a European data set, however due to the large (sometimes global) distribution area of most aquatic species it can be partially extended to other continents.

ID 12

Format Oral Presentation

Theme Vegetation inventory and mapping

Introducing the Global Vegetation Project: a crowd-sourced platform for open-access vegetation photos

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The Global Vegetation Project (http://gveg.wyobiodiversity.org) is a new initiative to host an online database of open-access, georeferenced vegetation photos. The mission of the Global Vegetation Project is 'to inspire and empower people of all ages to learn about the diversity of vegetation on our planet and to provide educators with a resource for teaching ecology online.' We have released two R-Shiny web applications that allow users to 1) submit photos of plant communities through a user-friendly online portal and 2) explore submissions made by others through an interactive global map. The location data of each photo is used as a spatial reference to extract various relevant data, including climatic information, to create Walter and Lieth climate diagrams for each photo. We are currently developing curricular materials to facilitate the use of the platform in the classroom. The success of such an ambitious project will depend on the generosity of the global community of vegetation scientists, and we invite you all to explore the map and submit photos to the project.

ID 98

Format Oral Presentation

Theme Invasive species

Belowground traits and root distribution of African invasive grasses vary with soil composition and can create legacy effect in Brazilian savannas

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Invasive alien plant species have competitive attributes that favor resource acquisition, and thus cause environmental change in the ecosystems they invade. Root traits, that are essential for resource acquisition, should give invasive species a competitive advantage over natives especially in systems where belowground resources are limiting, as in savanna ecosystems. However, modifications occurring in the belowground compartment due to invasive species and how these changes are associated with ecosystem functions are poorly studied. Therefore, we assessed if in invaded savannas variation in belowground traits is associated with changes in soil composition and litter accumulation, i.e., two ecosystem functions that drive successional trajectories. In three different areas, we selected ten paired sites of open savanna in the Cerrado of Brazil: five were uninvaded (pristine) sites and five were invaded by African grasses of the genus *Urochloa* (i.e., always paired with one uninvaded). We evaluated root depth distribution, root functional parameters in the upper soil layer (0–10 cm), biomass allocation, soil nutrients and litter accumulation. Presence of invasive species was associated with belowground modifications and altered soil chemistry. Invaded savannas were characterized by roots with higher relative length density (RLD), higher fine root diameter and biomass at the soil surface, and lower relative dry mass content (RDMC). Root distribution varied as well with higher fine root biomass at soil surface and lower fine root biomass in deeper soil layer in invaded savannas compared to pristine areas. In parallel, soil chemical composition in invaded sites showed higher silt content, higher pH, P, K, Ca and Mg, and lower Al compared to pristine sites. Litter quantity did not differ between pristine and invaded sites. We concluded that invasive species occupied more space at soil surface and have belowground traits showing ability for soil exploration and resource acquisition. These modifications are correlated with variation in soil chemical composition. Whether root traits of invasive species can lead to soil modifications needs to be explore, however we showed that competitive advantage occurred also belowground in open savannas. Besides variation in morphological root traits, alteration of root distribution can also affect competitive relationship and ecosystem functions.

ID 113

Format Poster Presentation with lightening Talk

Theme Functional traits

Effect of wind and soil conditions on inter- and intraspecific leaf trait variation of broadleaf trees in the cloud forest: a case study from Taiwan

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Even though several studies suggested that plant intraspecific trait variation (ITV) is important for the understanding of trait-environment relationship on a community level, most previous studies focused only on interspecific trait variation and ignore ITV. Here, we explored the trait-environment relationship for broadleaf woody species in the cloud forest using the CWM approach, and asked the following questions: 1) When comparing leaf trait variation on inter- and intraspecific level, which trait-environment relationships are the most important? 2) What is the relative importance of inter- and intraspecific trait variation in these trait-environment relationships? Our study was done in the one-hectare Lalashan Forest Dynamics Plot, located in the subtropical montane cloud forest in northern Taiwan (24°42′ N, 121°26′ E, elevation 1,758 – 1,782 m a.s.l.), on the wind-exposed flat ridge between two mountains. In 25 10 m × 10 m systematically distributed subplots within LFDP, we surveyed all trees with DBH ≥ 1 cm. For broadleaf species only, we collected and measured leaf traits, including leaf area, leaf thickness, specific leaf area, leaf dry matter content, leaf succulence and relative chlorophyll content, for up to three individuals per species and subplot (in total, 665 individuals of 48 species). We also measured topographical variables, including windwardness. We calculated the site-specific, fixed and intraspecific CWMs of each trait, regressed them against topographical variables or soil variables, and tested the significances of each regression. We also partitioned the trait variation among sites into fractions caused by species turnover, intraspecific trait variation and their covariation. We found that the trait-environment relationship on intraspecific trait level is more important than on the interspecific level. In particular, on an intraspecific level, leaf thickness and leaf succulence are positively related to windwardness, while specific leaf area is negatively related. The chronic wind (caused by northeastern monsoon) seems to be related to the trait response on the level of individuals, but does not cause compositional turnover. At the interspecific trait level, leaf area is negatively associated with the combined effect of soil texture, soil pH and soil copper availability. Our study have shown that trait variation on intraspecific level can respond to completely different environmental variables than the variation on interspecific level (effect of wind vs. effect of soil conditions). Our results also support the argument that it is important to consider ITV in the studies of trait-environment relationships, especially in studies conducted on a relatively small spatial scale (e.g., one-hectare).

ID 175

Format Oral Presentation

Theme Vegetation inventory and mapping

Community maps: spatially constrained clustering of vegetation data

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Hierarchical clustering is a well-known method of multivariate data analysis. It is used to identify groups of objects (e.g., sites) that are more similar within than among the groups. For some questions involving sites observed in geographic space, like the delineation of ecological regions or community maps, one may want to divide a study area (map) into groups of sites that are geographically connected to one another in addition to having similar response variables, e.g., vegetation data. To find an appropriate solution, the geographic information must be incorporated into the cluster analysis, in addition to the information from the dissimilarity matrix D computed from the response (e.g., vegetation) data. Spatially-constrained hierarchical clustering is well adapted to these ecological objectives. The method, for which new software is available in R, will be described. A simple example will be presented, followed by a habitat study of the Barro Colorado Island forest dynamics plot in Panama.

ID 149

Format Poster Presentation with lightening Talk

Theme Theory and methods in vegetation science

Local estimation of community stochasticity reveals increasingly predictable functional composition along a productivity gradient

Lengyel, Attila[1]*; Barabás, Sándor[1]; Berki, Boglárka[1]; Csecserits, Anikó[1]; Gyalus, Adrienn[1]; Kabai, Melinda[1]; Lhotsky, Barbara[1]; Rédei, Tamás[1]; Ónodi, Gábor[1]; Botta-Dukát, Zoltán[1]

Centre for Ecological Research, Institute of Ecology and Botany[1]

Explaining the properties of ecological communities with environmental, spatial or temporal variables is of focal interest in community ecology. The term ‘stochasticity’ is used for lack of regularity or lack of fit of community properties on the hypothesised explanatory variables. Brownstein et al. (2012, J. Ecology) introduced the ‘nugget’ (that is, the predicted dissimilarity to zero distance) of the distance decay model as an index of stochasticity of a community. This utilizes all between-plot compositional dissimilarities and geographical distances, and returns a single estimate of stochasticity for the sample. Here we propose that plot-level estimates can be obtained as well, if only dissimilarities and distances from a focal plot are used. We tested this method on a data set sampled on three sites representing herbaceous vegetation of the Kiskunság Sand Ridge lowland region in Hungary. In each site the sample covers a long productivity gradient ranging from semi-arid grasslands to wet meadows and marshes. We used field estimates of NDVI as a proxy for productivity. For all species we gathered plant trait data for canopy height, specific leaf area (SLA) and seed mass. We calculated dissimilarity matrices between plots using a taxon-based index and a trait-based index. Then, we calculated an index of functional beta redundancy which expresses what proportion of taxonomical dissimilarity is translated into functional dissimilarity. We fitted distance decay models on all three variables, and acquired estimates at zero distance (that is, estimates of stochasticity) for each plot. Finally, we examined the relationship between stochasticity estimates and productivity. Taxonomical stochasticity was higher than functional, which is an algebraic necessity. Taxonomical stochasticity showed an unclear trend along productivity with slightly decreasing mean and increasing variance. However, functional stochasticity decreased significantly with increasing productivity on all three sites. Parallelly, zero-distance estimates of functional beta redundancy increased along productivity. Towards high productivity canopy height and SLA increased, while seed mass decreased. In summary, more productive plots seemed more predictable in terms of functional composition, than less productive plots based on zero distance local estimates of the distance decay model. Strengthening competition towards higher productivity may select for the dominance of a particular competitive trait syndrome, and thus can increase functional redundancy. Alternatively, the limited set of traits included may not sufficiently represent functional beta diversity at productive sites, thus providing a false impression of functional redundancy. However, we discuss other alternative explanations too.

ID 116

Format Oral Presentation

Theme Species composition and diversity

Woody species richness along elevation in Taiwan: patterns and mechanisms

Lin, Po-Yu*[1]; Zelený, David[1]; Li, Ching-Feng[1]

National Taiwan University[1]

The richness-elevation relationship is one of the classical yet peculiar diversity-gradient relationships. A number of studies had reported the shape of this pattern in different taxa. Among various shapes, the hump-shaped richness-elevation relationship is the most commonly observed. Several mechanisms were proposed to explain this hump-shaped richness-elevation relationship, such as the mid-domain effect (MDE), the effect of productivity, land area, environmental heterogeneity, and ecotone effect. In this study, we described the shape of the regional-scale richness-elevation pattern of woody species in Taiwan, a subtropical island in East Asia with an elevation range of almost 4,000 m. Then, we tested which of the proposed mechanisms provides the most plausible explanation of the observed richness-elevation pattern. We used vegetation plots from the National Vegetation Database of Taiwan (AS-TW-001, forest plots of mostly 20 m × 20 m size), selected only zonal forest vegetation plots (3,617 plots were used for analysis) and divided them according to elevation into 17 elevation bands. Then, we standardized the richness of elevation bands based on fixed completeness and used the standardized values to describe the pattern of woody species richness along elevation. Simple linear regression was performed to test how much different mechanisms and interactions between two mechanisms (multiplying the values of the variables they represent) can explain the observed richness-elevation pattern. MDE was represented by the null model, the effect of land area by square-rooted land area, the effect of environmental heterogeneity by topographic ruggedness index, and the effect of productivity by potential evapotranspiration. For the ecotone effect, we analyzed the standard deviation of mean elevations of species distribution to quantify the level at which species from near elevations overlap. The results show that the pattern of woody species richness along elevation in Taiwan is hump-shaped, with the species maximum at lower middle elevation (1,079 m a.s.l.). Interaction of land area and environmental heterogeneity effects can explain the most variation in species richness, indicating that large land area and high environmental heterogeneity at lower middle elevation boost species richness to the maximum. MDE by itself does not show a significant effect on species richness; however, its interaction with the effect of land area or productivity is significant. Ecotone effect is strongest on the boundaries of main zonal vegetation types, especially between submontane evergreen broadleaf and montane cloud forest, indicating possible contribution to the mid-elevation richness optimum. Our findings are consistent with previous studies that many processes influence the richness-elevation relationship, and none of the single mechanisms can perfectly explain the pattern by itself.

ID 18

Format Oral Presentation

Theme Macroecology of vegetation

Hedgerows across Europe: Forest plant species in the context of management and regional climate

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Hedgerows are semi-natural wooded habitats and an important element in agricultural landscapes across Western and North-Western Europe. They reduce erosion, function as carbon sinks and thus provide essential ecosystem services. Moreover, they form a structurally diverse ecosystem for numerous taxa and connect otherwise fragmented forest habitats. This study compiled data from the hedgerow-rich oceanic regions of Europe, covering a gradient from Southern Sweden to Northern France, to analyse the influence of management, landscape context and climate variables on the number of herbaceous forest specialists in hedgerows. Additionally, the forest species frequencies in hedgerows were related to their functional traits to identify plant characteristics that are beneficial for species dispersal and persistence in hedgerows. Our results show that numerous forest plant species, but not all, can thrive in hedgerows. Those that thrive are likely thermophilic, tolerant against regular disturbance and able to disperse efficiently. Hedgerows in warmer and drier regions contain fewer forest species. Intensive adjacent land-use had a negative impact on forest species richness, while the surrounding forest cover was not significantly important. In congruence with previous regional studies, wider hedgerows contain more forest species, which is most likely caused by a more effective buffering of the microclimate. Thus, hedgerow width gains in importance in times of climate change and increasing extreme weather events. It is a key factor for habitat quality also on a European scale that needs to be considered for future management strategies.

ID 163

Format Poster Presentation

Theme Functional traits

Weak coordination between leaf drought tolerance and proxy traits in herbaceous plants

Majekova, Maria*[1]; Hájek, Tomáš[2]; Albert, Agnes J. [3]; de Bello, Francesco[4]; Doležal, Jiří[3]; Götzenberger, Lars[3]; Janeček, Štěpán[4]; Lepš, Jan[2]; Liancourt, Pierre[3]; Mudrák, Ondřej[3]

Tübingen University[1]; Faculty of Science, University of South Bohemia[2]; Czech Academy of Sciences, Institute of Botany[3]; CIDE-CSIC[4]

Increased drought is predicted to have a major impact on plant performance under environmental change. Yet leaf hydraulic traits directly related to drought tolerance, such as leaf turgor loss point (TLP), are underrepresented in trait-based studies and have been largely overlooked within the main frameworks evaluating trait–trait coordination and trade-offs: the leaf economics spectrum and the global spectrum of plant form and function. Using 122 herbaceous species from the Central European temperate grasslands, we investigated (1) the coordination between TLP and traits often used as proxies for drought tolerance: SLA, leaf area, leaf dry matter content (LDMC), leaf thickness, plant height, and intrinsic water use efficiency; (2) whether the strength of the trait–trait relationships differed across plant functional types (graminoids and forbs) and depended on species phylogeny; (3) whether single or multiple traits, combined with either plant functional types or phylogenetic relatedness, provide a good prediction of TLP. We found that higher leaf drought tolerance (a more negative TLP) was coordinated with higher LDMC and higher intrinsic water use efficiency. This pattern was consistent among forbs and graminoids and also after accounting for phylogenetic relatedness. However, the coordination of TLP with other traits was weak. For leaf thickness and plant height, it was driven by the differences between forbs and graminoids. For SLA and leaf area, it was only observed after accounting for phylogenetic relatedness. The most parsimonious model predicting TLP as a function of other traits retained LDMC and leaf area and explained 37 % of the variation in TLP. Since TLP showed a strong phylogenetic signal, accounting for the influence of phylogenetic relatedness further improved TLP prediction by 17 %. In herbaceous temperate plants, we found relatively weak coordination between leaf drought tolerance (TLP) and traits representing key dimensions of the leaf economics spectrum and the global spectrum of plant form and function. None of the proxy traits considered here, alone or in combination, provided a strong prediction of TLP across a large number of grassland plant species. Therefore, our work emphasizes the need for direct measurements of leaf hydraulics when estimating plant drought responses to better understand and predict species responses to environmental change.

ID 177

Format Poster Presentation

Theme Special session: River vegetation

Floodplain vegetation mapping of Northern Dvina and Pinega rivers, Archangelsk region, Russia

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The investigation of floodplain vegetation and mapping were carried out in two key-plots: valleys of the rivers Northern Dvina and Pinega. The key sites were located in the exit area of limestone and gypsum of the Perm period. Pinega is the influx of Northern Dvina. In the vegetation cover of the river valley there are many common features. There are also differences. For the rival part of the floodplain are characterized by communities with the *Petasites spurius, Equisetum arvense* or *Carex acuta*. In the central part of the floodplain, a variety of meadows are common: herbaceous, tall, geranium and other. In the terrase part, different compositions of willow and deciduous forests were described. As a result, large-scale maps of the vegetation cover of the valleys of the Northern Dvina and Pinega rivers were created.

ID 20

Format Oral Presentation

Theme Special session: Big data and big classifications

Wild edible plants of Europe: the WEPE project

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Roma Tre University[1]

Wild edible plants (WEP) have been important resources for humans since the Palaeolithic. The scientific literature in this field is mainly related to nutraceutical and ethnobotanical studies, and several checklists of WEP are available at the regional and national scales. Ecological studies on WEP at the European scale using big data are still missing despite their potential scientific and social relevance. We created a species list of WEP, harmonizing the data from the most relevant scientific literature on ethnobotany. We combined the list of WEP species in Europe with vegetation plots from the European Vegetation Archive (EVA) to (i) model the richness of WEP and to locate the WEP diversity hotspots, (ii) explore the relationships between WEP, their functional traits, and their preferential habitat types, and (iii) outline the relative importance of different lineages of WEP within ecoregions, based on the phylogeny of WEP across Europe.

ID 76

Format Oral Presentation

Theme Conservation and restoration

How long do bracken (*Pteridium aquilinum* (L.) Kuhn) control treatments maintain effectiveness for conservation?

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Pteridium aquilinum is a problematic, perennial invasive species worldwide that poses serious problems in the British uplands. However, there is a lack of knowledge on long-term success in terms of weed control and land improvement. We assessed the effects P. aquilinum-control treatments at two acid-grassland sites in the Scottish Borders (Sourhope 1 & 2). There were six treatments: (i) untreated, (ii) cutting once-yearly, (iii) cutting twice-yearly, (iv) the herbicide asulam sprayed in year 1, (v) cutting once in year 1/asulam in year 2, and (vi) asulam in year 1/cut in year 2. The annual cutting treatments were stopped after 9/10 years. We measured the response of three variables over 25/26-years assessing P. aquilinum-performance, agricultural-improvement and species richness. We used GAM modelling of the treatment responses though time and then “effect windows” for each of the five *P. aquilinum*-control treatments.The “effect window” was estimated by measuring the length of time (years) over which a significant effect (-ve for bracken variables, +ve for agricultural/ biodiversity ones) was found effect compared to that of the response of the untreated controls. Results were completely different for all variables in the two experiments. At Sourhope 1 the cutting treatments had much longer effect windows than the herbicide-based treatments in bracken performance, especially twice-yearly (25-year window). At Sourhope 2, the treatment differences were much reduced with the best treatment (cut twice yearly) producing a 13-year window. At both experiments, herbicide treatments produce a minimum effect window of 10 years. Increases in the agricultural-improvement index and species richness were obtained at both sites. ”Effect window” ranges for the agricultural-improvement index were 12-20 and 9-20 years for Sourhope 1 and Sourhope 2, respectively. Species richness ”effect windows” were 7-17 and 2-10 years respectively, although there was a reduction in species richness through time in all treatments. It seems that that cutting, and preferably twice per year, was the most effective treatment but also the costliest, with the cost-effective approach being a single spray of asulam. However, effect windows suggest that repeating spraying every 10-years is needed. Unfortunately, where the aim is to recover biodiversity, other more interventionist techniques such as seeding will also be needed.

ID 30

Format Oral Presentation

Theme Special session: Community ecology belowground

Plants with ruderal strategy do not rely only on seeds, they also resprout from roots

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Disturbed habitats are significantly heterogeneous and exposed to disruptions, which might reach the soil profile and thus cause severe aboveground biomass damage and also root system fragmentation. Plants growing there possess a typical ruderal strategy – they have a short lifespan to fit between two disturbance events and produce a lot of seeds dispersable in space and/or time. However, in disturbed habitats, there are not only those typical seeders, but also plants surviving body fragmentation and resprouting from roots. Based on experiments and correlative studies, we have tested (i) whether species with root-sprouting have an advantage over species without this ability under disturbance, and (ii) whether root-sprouting species are capable to explore soil heterogeneity by foraging. We found that the evolution of root-sprouting is driven by occurrence in disturbed habitats, that root-sprouters of ruderal habitats resprout more vigorously than other root-sprouters, that injury can increase the fitness of root-sprouters and might be more favourable than regeneration from seeds, and that root-sprouters do not forage for nutrients in heterogeneous soil. The root-sprouting represents an alternative ruderal strategy. It is an especially useful strategy for population persistence in places lacking seed banks or when a disturbance occurs during less-than-suitable conditions for germination.

ID 19

Format Oral Presentation

Theme Remote sensing of vegetation

Measuring alpha and beta diversity by field and Remote-Sensing data: a challenge for coastal dunes biodiversity monitoring

Marzialetti, Flavio*[1]; Cascone, Silvia; Frate, Ludovico[2]; Di Febbraro, Mirko[1]; Acosta, Alicia Teresa Rosario[1]; Carranza, Maria Laura[1]

Molise University[1]; Roma Tre University[2]

Combining field and remotely sensed (RS) data represents a promising approach for an extensive and up-to-date ecosystem assessment. We investigated the potential of the “Spectral Variability Hypothesis” (SVH) in linking field collected and remote sensed data in Mediterranean coastal dunes and explored if spectral diversity provides reliable information to monitor floristic diversity, as well as the consistency of such information in altered ecosystems due to plant invasions. We analyzed alpha diversity and beta diversity of herbaceous coastal vegetation in well-preserved (EUNIS category N14: Mobile coastal sand ridges including embryonic dunes and semi-permanent dunes and N16: Fixed dune grasslands including chamaephytic communities of the inland dunes and annual species-rich communities colonizing dry interdunal depressions) and in invaded Mediterranean coastal dunes with *Carpobrotus* spp. at the Tyrrhenian coast (Central Italy). We integrated the floristic field data, conformed by 163 random 2 m x 2 m vegetation plots sampled during the growing season (April – May) lately collected (years 2017 – 2020), and the Remote Sensing data derived from PlanetScope images, consisting of four spectral bands (blue, green, red. near infrared) and two spectral indices MSAVI2 (Modified Soil-Adjusted Vegetation Index 2, a proxy of biomass and CI (Coloration Index depicting soil conditions). We explored the relationship among alpha field floristic diversity (Species Richness, Shannon index, Inverse Simpson index) and remote sensed spectral variability (Distance from the Spectral Centroid index) through linear regressions. For beta diversity, we implemented a Distance Decay Model (DDM) relating floristic pairwise (Jaccard similarity index, Bray-Curtis similarity index) and spectral pairwise (Euclidean Distance) measures. Among the analyzed alpha diversity indices, Species Richness scored the highest goodness-of-fit (R2= 0.383), followed by Inverse Simpson index (R^2 = 0.342) and Shannon index (R^2 = 0.322). In all regressions, the regression line of the N14 EUNIS category resulted below the other categories. The regression line of the N16 EUNIS category and of the invaded areas showed similar trends. As for DDM, we found negative and significant relationships in all categories between Euclidean spectral distance and the two floristic similarities analyzed. The DDM based on Bray-Curtis floristic similarity showed most intense decay rates compared with the other DDM. We provided a first assessment of the relationship between floristic and spectral RS diversity in Mediterranean coastal dune habitats (i.e., natural or invaded). SVH provided evidence about the potential of RS for estimating diversity in complex and dynamic landscapes. The observed relationship between spectral and floristic diversity in natural and invaded dune vegetation is certainly a good applied outcome of the SVH suggesting its potential as an early warning system for preventing biodiversity loss.

ID 141

Format Oral Presentation

Theme Climate change

Microclimate shapes vegetation response to drought in calcareous grasslands - results are robust to relocation error

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University of Bremen[1]

Climate change as a driver of weather extremes, such as drought events, is becoming an increasingly important factor for biodiversity. Droughts reportedly have a positive effect on calcareous grasslands, which are biodiversity hotspots in Europe. They contribute to the long-term stability of the typical species assemblages by eliminating less drought-adapted and more competitive species. While semi-natural grasslands have been shown to be quite resilient to drought, there seems to be no uniform response of different grassland types, functional groups, or individual species. Differences in microclimate, such as between steep, south-facing slopes (SSF) and flat or north-facing slopes (FNF), may additionally have an impact on vegetation response to drought, especially in water-limited environments. Knowledge about these processes has been primarily gained from experimental studies. To study the effects of a severe drought in the field, 112 plots first established in 2008 in semi-arid calcareous grasslands (*Mesobromion*) in North-West Germany were resurveyed in 2019, after 11 exceptionally dry years. Relocation inaccuracies are a recurring problem in resurvey studies. To test the reliability of quasi-permanent plot relocation compared to truly permanently marked plots, we resampled 85 plots twice, once after relocalisation via GPS data and once via buried magnets. This study covers two main aspects. It assesses the effect of microclimatic conditions on species composition before and after drought stress and examines the reliability of GPS data in resurvey studies. The species composition in the initial survey was significantly influenced by the microclimate of the plots. This confirmed the assumption that drier and warmer conditions on SSF have had a positive effect on character species. Phosphorus availability played an equally important, albeit reversed, role. Overall vegetation change between 2008 and 2019 showed strong signs of the severe drought. However, the comparison of SSF and FNF revealed different trajectories of vegetation change in response to drought. On SSF, total species richness decreased, negatively affecting all species groups except ruderal species. Remarkably, this also applied to character species of dry grasslands. On the other hand, conditions on FNF promoted an increase in total species numbers and character species, but also an increase in eutrophication indicators. All main findings were obtained similarly with the data from the GPS and the magnet data set. Our results indicate that a semi-permanent method can be as suitable as permanent markings for resurvey studies in open landscapes. We conclude that sites with a dry and warm microclimate have so far had a positive, stabilising effect on the typical vegetation of calcareous grasslands. However, the increasing intensity of droughts poses a potential threat to the characteristic species composition, especially at sites with more extreme microclimates.

ID 41

Format Poster Presentation with lightening Talk

Theme Conservation and restoration

Nardus grasslands and wet heaths are affected differently by the reintroduction of management and pH recovery – a resurvey after 32 years

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University of Bremen[1]; Carl-von-Ossietzky Universität Oldenburg[2]; Bundesamt für Naturschutz Bonn[3]

Semi-natural habitats in temperate regions are local hotspots of biodiversity, but multiple stressors such as land use change and atmospheric deposition pose a threat to the existence and functioning of these ecosystems. We conducted a resurvey of *Nardus* grasslands and wet heaths in the Eifel mountains, Germany, to monitor the development of these habitats under the influence of a long-term management regime and the above-mentioned stressors. Surveys of 50 plots of *Nardus* grasslands and 14 of wet heaths from 1986 were repeated in 2018. Prior to the first survey, the meadows had been fallow for approx. 30 years. Shortly afterwards, they were entered into a contractual nature conservation program with annual mowing from mid-July. We found significantly increased soil pH values from an average of 3.9 up to 4.6 since the 1980ies, as a result of the reduction in SO2 depositions. Ellenberg indicator values for soil reaction and nutrients increased significantly in the wet heaths, but stayed relatively stable in the *Nardus* grasslands. All meadows that were *Nardus* grasslands in 1986 could still be identified as such, with high total species numbers and a high proportion of character species. However, cover sums of these declined, while more species typical of agricultural grasslands and small sedge fens appeared. Low-competitive species (e.g., *Carex pilulifera, Pedicularis sylvatica*) profited, while species that can gain dominance in fallow situations (especially *Molinia caerulea*) were pushed back. The consistent management of the sites contributed essentially to this outcome by effectively counteracting eutrophication through atmospheric deposition. The relatively early date of mowing (from mid-July) enabled successful nutrient removal and resulted in a characteristic structure and species composition. However, some quantitative changes indicate that there is indeed a certain risk of eutrophication, and that continued management will be crucial for a sustained conservation of *Nardus* grasslands. The same management, however, was not equally able to preserve wet heaths. The changes observed here were more drastic – they had transformed into wet varieties of *Nardus* grasslands, small sedge-dominated swards, or wet meadows with signs of eutrophication. Other management strategies (e.g., periodic top soil removal, possibly combined with extensive grazing) should be considered. In any case, we recommend further monitoring to secure the survival of these important remnants of historical land use.

ID 128

Format Virtual Excursion

Theme Virtual Excursion

How frost and fire shape a tropical landscape in central Angola

Meller, Paulina*[1]; Frazão, Raquel[2]; Lages, Fernanda[2]; Finckh, Manfred[1]

Universität Hamburg[1] ; Herbário do Lubango, ISCED Huíla[2]

The Miombo ecoregion in south-central Africa is one of the largest savanna areas worldwide. C4 grasses, together with a varying degree of tree cover, typically characterize the ambience, making it a very fire-prone region. *Brachystegia, Isoberlinia* and *Julbernardia* are characteristic miombo tree genera. However, the miombo also includes closed-canopy dry tropical forests, frost-prone geoxyle grasslands and peaty wetlands. The heterogeneous, mosaic-like, and disturbance-prone landscapes are home to a highly diverse flora with many endemic plant species, which often are poorly studied or even not yet formally described. Our group works in Cusseque, a miombo study site in central Angola, since 2011. The site is located in a rolling landscape of forested hills, sparsely wooded slopes and treeless valleys with small streams, which is the typical landscape aspect in the Bié province. We study the overall plant diversity, the ecology of geoxyles (“underground trees”, resprouters with massive belowground woody structures), and the effects of frost and fire on the vegetation. In 2017, we established a systematic fire experiment in the geoxyle grassland to study the effects of fire exclusion and annual burning in early and late dry season on the vegetation. In this virtual excursion we want to take you along with us to our study site and show you where and how we work. We demonstrate how tricky it is to conduct controlled burning in grasslands, how we measure plant diversity and selected traits, and how strikingly different the vegetation responds to the three fire treatments. You will see that although fires occur annually in the grasslands, the frequent dry season frost plays an important role in keeping the valleys treeless.

ID 84

Format Oral Presentation

Theme Macroecology of vegetation

Individual fitness is decoupled from coarse-scale probability of occurrence in North American tree species

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Habitat suitability estimated with probability of occurrence in species distribution models (SDMs) is used in conservation to identify geographic areas that are most likely to harbor individuals of interest. Ecological theory predicts that probability of occurrence is coupled with individual fitness, which we here define as 'fitness-centre' hypothesis. However, such relationship is uncertain and has been rarely tested across multiple species. Here, we quantified the relationship between coarse-scale habitat suitability projected with SDMs and individual fitness in 66 tree species native of North America using field data (US Forest Inventory Analysis plots) and common garden data retrieved from the literature. We show 'fitness-suitability' relationships are rare, with only 12 % and 11 % of cases showing a significant positive correlation for field and common garden data, respectively. Furthermore, we found the 'fitness–centre' relationship is not affected by the precision of the SDMs and it does not depend upon dispersal ability and climatic breath of the species. Thus, although the 'fitness–centre' relationship is supported by theory, it does not hold true in nearly any species. Because individual fitness plays a relevant role in buffering local extinction and range contraction following climatic changes and biotic invasions, our results encourage conservationists not to assume the 'fitness–centre' relationship when modelling species distribution.

ID 184

Format Oral Presentation

Theme Climate change

Response of the alpine and subalpine plant communities of the Mt. Field Plateau, Tasmania to climate change

Minchin, Peter*[1]; Davies, John[2]

Southern Illinois University Edwardsville[1]; Tasmanian Herbarium[2]

Research in Eurasia and North America has shown upward altitudinal shifts in plant communities in response to climate change but there have been few studies in the southern hemisphere. We examined changes in the vegetation of the Mt. Field Plateau, Tasmania, over the past 40 years by resampling 234 vegetation plots in February-May 2019, which were a balanced subset of a network of 438 plots, initially surveyed in the summers of 1980-1982. The plots span an altitudinal range of 900 to 1,370 m and ordination analysis has revealed two major dimensions of community variation, correlated with altitude and soil drainage, with a third dimension related to fire history. The original data were classified into 21 vegetation communities using k-means clustering applied to percentage cover data standardized by species' maxima, followed by the Hellinger transformation. The plots resampled in 2019 were then allocated to clusters based on distance to centroid. For those plots that had changed clusters (i.e., moved to a different community), a paired t-test on the mean altitude of their 1980-1982 cluster versus the mean altitude of their 2019 cluster ($t = 3.33$, $df = 70$, $p = 0.0014$) found a mean difference of 25.1 m (95 % confidence interval 10.1 - 40.2 m). Thus compositional changes have been, on average, towards lower altitude (warmer) communities. These results are consistent with vegetation response to a warming climate.

ID 75

Format Oral Presentation

Theme Species composition and diversity

Wind stress as a climatic driver of plant species distributions and community-level characteristics

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The effects of temperature and precipitation, and the impacts of changes in these climatic conditions, on plant communities have been investigated extensively. The ecological importance of other climatic factors is, however, comparatively poorly understood, despite potentially also strongly structuring community patterns and individual species responses. Wind, for example, is seldom considered when forecasting species responses to climate change, despite having direct physiological and mechanical impacts on plants. It is, therefore, important to understand the effect of wind conditions on plant communities and individual species, particularly given that wind patterns are shifting globally. Here, we examine the relationship between wind stress (i.e., a combination of wind exposure and wind speed) and species richness, vegetation cover, community composition, and individual vascular plant species distributions using fine-scale, field-collected data from 1,440 quadrats in a windy sub-Antarctic environment. Wind stress was consistently a strong predictor of all three community characteristics, even after accounting for other potentially ecophysiologically important variables. Wind stress was additionally a significant predictor of the occurrence of twelve out of the sixteen species, and was more important than temperature or precipitation variables in predicting the occurrence of six species (and three species' cover). Wind conditions are, therefore, clearly related to plant community characteristics, as well as individual species' distributions, in this ecosystem that experiences chronic winds. Consequently, wind conditions require greater attention when examining environment-community relationships and when modelling species distributions. We propose that changing wind patterns should be explicitly considered in climate change impact predictions.

ID 65

Format Poster Presentation

Theme Invasive species

Seed persistence and its role in species invasiveness. Insights from burial experiments.

Moravcová, Lenka*[1]; Gioria, Margherita[1]; Skálová, Hana[1]; Pyšek, Petr[1]

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Seed persistence can play a key role in promoting invasions by alien seed plants. Here, we assess its role as a potential determinant of species' invasiveness by testing differences in seed persistence between 22 invasive and 37 non-invasive species alien to the Czech Republic. Seed persistence was assessed by exhuming seeds annually for seven years (2014–2020) and determining the proportions of germinated, viable, but non-germinated, and decayed seeds. While seed persistence was highly species-specific, preliminary results indicate that invasive and non-invasive but naturalized species differ in seed persistence, both in terms of number/proportion of viable seeds and seed bank type (transience vs. short-/long-term persistence). Invasive species displayed a lower proportion of species forming transient seed banks, suggesting that seed persistence is a critical trait in the invasion process. Also, they germinated in higher percentages and displayed a greater viability/germination during the first three years from burial, while a greater proportion of non-invasive species displayed long-term persistent seed banks and higher seed viability/germination after three years. Our findings suggest that high germination at the initial stages of the invasion process might promote invasiveness. Yet, slower seed bank depletion in non-invasive species could promote their invasiveness in the future.

ID 185

Format Oral Presentation

Theme Remote sensing of vegetation

How does the changing resolution affect the way vegetation heterogeneity is assessed by remote sensing? An example from above the tree line

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High spatial and temporal heterogeneity is symptomatic to all natural ecosystems, with mountains being one of the most heterogeneous from the spatial point of view. One way to approach this variability can be remote sensing, specifically unmanned aircraft systems (UAS). Providing high spatial resolution and covering inter-annual phenological changes, it is a perfect tool for vegetation mapping and monitoring. The question remains about the optimal spatial/temporal resolution of the survey, and the differences in heterogeneity covered at different scales. We infer that at different resolutions, different parts of ecosystem variability are covered, and that with growing heterogeneity, the amount of "meaningful information" about vegetation composition is not necessarily increasing. This would mainly be due to the noise, position inaccuracies and very fine grain vegetation mosaic that in very high detail can impede generalization of the findings. Naturally, this would also depend on the purpose and definition of "meaningful information" for a particular study. To test this hypothesis, we chose an extremely heterogeneous mountain habitat above the treeline, where vegetation is often formed by small to very small patches dominated by one of the species/assemblages/life forms. It is composed of a variety of species and life forms, forming a fine grain mosaic of short herbs, grasses and mosses, chamaephytes and shrubs as well as bare soil, rocks and scree, often covered by lichens. Whereas such an ecosystem can be considered rather homogeneous from the temporal point of view, changing slowly in extreme mountain conditions, it is very heterogeneous spatially. Using Krkonoše Mts. in the Czech Republic as an example, we assess the effect of changing scales of the UAS survey on the variability covered by the data. UAS multispectral data were acquired regularly four times over the season at four study sites representative for main vegetation types, i.e., sub-alpine grassland, peatland, cirque and exposed slope with a high share of bare ground and scree. The spatial resolution of 5 cm was resampled to 10, 20 and 50 cm, and on simulated data, vegetation was classified using both pixel- and object-based methods. Results were compared to the detailed ground survey and expert onscreen interpretation of vegetation from the UAS orthophotos, to compare vegetation heterogeneity covered by different resolutions, and to assess the power of remote sensing in mapping, classifying and monitoring high mountain ecosystems.

ID 173

Format Poster Presentation with lightening Talk

Theme Functional traits

The effect of overgrazing on the physiological and morphological leaf traits of *Argania spinosa* L. Skeels under arid climate.

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More than 65 % of the arid lands are used for livestock grazing. Knowledge of the complex interactions between aridity and overgrazing is very limited, making it difficult to estimate the consequences of global change on agro-silvo-pastoral ecosystems in general, and on Argan tree ecosystem in particular. Studies conducted to date on the ecological impact of overgrazing in arid and semi-arid regions are not convincing and often contradictory. Indeed, the introduction of climate change as a new stress factor, with an increase in aridity, makes the ecological implication of overgrazing in these ecosystems even more controversial. The combined and often synergistic effects of these pressures make the ecosystems more vulnerable. The aim of the study is to evaluate the impact of aridity and overgrazing on physiological, anatomical and morphological leaf trait of the species *Argania spinosa*. For this purpose, the experiment was performed in two different areas, a grazing exclusion area that has been under protection for more than 20 years, and a grazed area that is under strong herbivore pressure. In each sample area, anatomical, morphological and physiological parameters were measured at the beginning and at the end of the summer season: stomatal density, stomatal conductance, leaf thickness, leaf area, leaf dry weight, sclerophyll index, tissue density, relative water content, water use efficiency, pigment content, gas exchange, and photochemical efficiency. Preliminary results show a variation in the different variables measured, in the presence and absence of overgrazing, between the beginning and the end of the summer. The variation is even more pronounced in the anatomical and morphological characteristics of the leaf.

ID 182

Format Oral Presentation

Theme Species composition and diversity

Towards conservation of Caspian coastal dune relicts: how do natural and anthropogenic factors influence on plant diversity?

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University of Mazandaran[1]; University of Tehran[2]; University of Gilan[3]; University of Guilan[4]; University of Cagliari[5]

The south Caspian coastal dune system in northern Iran, with an approximate length of 650 km, was once widely distributed, while now, mainly due to human-related exploitation, it is only restricted as fragmentary remnants in some coastal areas. A total of 277 plots comprising 368 vascular plants, some environmental data, and six anthropogenic factors were collected along 34 cross-shore transects. Five main plant communities corresponding to five vegetation zones and the most important factors affecting the zones were identified using multivariate analyses. To assess the conservation status of the vegetation, different attributes of diversity index (Hdune), Endemicity Index (EI) and Naturalness (N) were estimated based on endemic, alien and total species contributions per plot. The vegetation zones seem to be driven by both zonal (climate, distance from the sea and pH) and azonal (salinity) factors. Contrary to Hdune index, EI followed a decreasing pattern across coast-inland gradient, whereas N shows a unimodal pattern of distribution with the highest value at the middle where the mobile dune zone occurs. Two main gradients of salinity and alkalinity shaping floristic composition are more prominent than the distance to the sea and the anthropogenic factors. Human-related factors only partially explain the variability of the vegetation data. While most of the anthropogenic factors have no effect or even positive effect on species richness and diversity indices, they negatively affect naturalness and endemicity indices in the coastal dune systems. Both N and EI indices can be suggested as a bioindicator for proper conservation strategies to preserve the last fragments of sand dunes of the Caspian Sea.

ID 52

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Composition and diversity of restored forest ecosystems on mine-spoils in South-Western Ghana

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In response to national policy obligations, many mining companies in Ghana have restored/reclaimed degraded mined out sites through revegetation. While the area extent of such restored areas is unknown, there is also paucity of data on the success of restoration and the species diversity and compositional dynamics of such restored landscapes, particularly when mixed species were used. This study assessed stand structure, composition and diversity dynamics of sites restored with mixed species and models species abundance distribution on these sites. Three reclaimed and one control site were inventoried using 27 30 m x 30 m plots on the Hwini-Butre and Benso concession of the Golden Star Wassa Limited. Overall 3,057 and 150 individual trees were recorded in the overstorey of the reclaimed and control sites, respectively. In all, 31 species in 13 families occurred on the reclaimed site while 61 species in 29 families occurred on the control. Species richness, abundance and diversity were significantly lower in the reclaimed sites than the control in the overstorey ($p \leq 0.018$), mid-storey ($p \leq 0.032$), and understorey ($p \leq 0.031$). Species composition of the reclaimed and control sites were completely dissimilar in the overstorey, midstorey, and understorey. However, the midstorey and overstorey of the reclaimed sites showed high similarity in composition (Jaccard's index = 0.817). Pioneer and shade-tolerant species were most dominant in the understorey of the control, while only shade-tolerant species (mostly herbs and grasses) dominated the reclaimed sites. Species abundance distribution of both reclaimed and control sites followed the geometric series model, indicating that both sites are disturbed but at different intensities. It is concluded that reclamation with mixed species does not necessarily lead to rapid restoration of indigenous climax species on mine spoils. Nonetheless, it may lead to accomplishments of short-term goals of stabilizing and protecting landscapes while conditioning the sites for colonisation of the climax species.

ID 166

Format Oral Presentation

Theme Species composition and diversity

Endemics determine bioregionalization in the alpine zone of the Irano-Anatolian biodiversity hotspot (South-West Asia)

Noroozi, Jalil*[1]; Khalvati, Sina[2]; Nafisi, Haniyeh[3]; Kaveh, Akram[3]; Nazari, Behnaz[3]; Zare, Golshan[4]; Minaei, Masoud[5]; Vitek, Ernst6[2]; Schneeweiss, Gerald M.[1]

University of Vienna[1]; Bu-Ali Sina University[2]; Tarbiat Modares University[3]; Hacettepe University[4]; Ferdowsi University of Mashhad[5]

Alpine habitats are characterized by a high rate of range-restricted species compared to those of lower elevations. This is also the case for the Irano-Anatolian global biodiversity hotspot in South-West Asia, which is a mountainous area harbouring a high amount of endemic species. Using two quantitative approaches, Endemicity Analysis and Network-Clustering, we want to identify areas of endemism in the alpine zone of this region as well as to test the hypothesis that, given the high proportion of endemics among alpine species, delimitation of areas of endemism is determined mainly be endemic alpine species. Endemicity Analysis identified six areas of endemism irrespective of data set (total alpine species versus endemic alpine species), whereas the Network-Clustering approach identified five and four Bioregions from total alpine species and endemic alpine species, respectively. Most of these areas have been previously identified using the endemic flora of different elevational zones. The identified units using both methods and both datasets are strongly congruent, proposing that they reveal meaningful distribution patterns. As most of these areas of bioregionalization in the Irano-Anatolian biodiversity hotspot is determined by the endemic alpine species, a pattern likely to hold in alpine regions outside the Irano-Anatolian hotspot.

ID 89

Format Poster Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Engaging local communities in the restoration of degraded savanna ecosystems of Kenya

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Lambwe valley, located in Homabay County (0°40'0'' S and 34°15'0'' E) in the southern part of western Kenya covers an area of 324 km^2, which until 1960ies was conserved due to tsetse infestation the kept humans and grazing livestock away. Eradication of the tsetse menace in the 70ies opened the area for settlement and rapid population growth, but also serious environmental degradation, including biodiversity losses. To address the local communities have been involved in restoration programs through Farmer Managed Natural Regeneration (FMNR). This study examined the effectiveness of FMNR on: a) the restoration and preservation of indigenous forest tree species and b) arthropod diversity. Field surveys were done twice a year for four years. FMNR had positive influence on forest recovery and plant species diversity. After a period of 2.5 years of fencing, there was a significant ($p < 0.05$) increase in tree stem densities, vegetation cover. Changes in vegetation cover positively influenced the soil quality. The total plant biomass increased, an indication that this form of conservation positively affects the ecosystem's potential for carbon sequestration and storage, a form of climate mitigation strategy. Also, the increased vegetation cover and plant species diversity positively influenced arthropod diversity and density. The success of FMNR in ecosystem restoration depends on its uptake and implementation by farmers. Thus, involvement of the local farmer community in the restoration process is vital in restoring the degraded ecosystems of the Lambwe valley.

ID 106

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Comparative assessment of the response of seedlings from different provenances of *Tetrapleura* species (aidan tree) to drought

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Tetrapleura tetraptera (Schum. & Thonn.) Taubert and *Tetrapleura chevalieri* (Harms) Baker F. are tropical tree species of medicinal and nutritional values in Ghana and elsewhere in the tropics. However, these species are threatened, by poor natural regeneration, indiscriminate harvesting, wildfire and deforestation. Drought and other extreme climatic events are anticipated to negatively affect natural regeneration, seedling growth and establishment of the species. While drought effects on most timber species are known, the performance of trees that have medicinal value in response to drought are largely unknown. We determined the effects of drought on the performance (growth and survival) and the morphological characteristics associated with the drought survival of different provenances of *Tetrapleura* species. Seedlings from 12 seed provenances originating from Ghana, Nigeria and Uganda, were exposed to 3 watering regimes; continuous watering (watered every 3 - 4 days), periodic watering (every 15 days) and water withheld for eleven weeks. The observed average survival time for the *Tetrapleura* species was 73 days. First sign of visible wilting was observed in seedlings produced from Ntotolo 2 and Bunimwari in Uganda at week 3 of drought. Eight provenances started wilting in the fourth week except *Tetrapleura chevalieri* and Ntotolo 1 that showed wilting in the fifth week. Seedlings produced from seeds collected from Dogonaaji, Bobiri and *T. chevalieri* in Ghana survived better than the other provenances so they can be used for plantations and / or forest rehabilitation. Drought significantly reduced RGR (height) of the seedlings ($p \leq 0.001$), decreased transpiring leaf mass ($p \leq 0.001$), increased allocation to roots ($p \leq 0.001$), specific root length ($p \leq 0.001$) and root length per unit plant mass ($p \leq 0.001$). The results of the study suggest that *Tetrapleura* species has the potential to survive anticipated dry period projected by climate change models for the tropics including Ghana.

ID 16

Format Oral Presentation

Theme Special session: Community ecology belowground

Belowground dominance, biomass scaling and functional traits in temperate grasslands

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Dominants are key species which largely determine ecosystem functioning. Plant dominance is typically assessed on aboveground features; this approach is reliable in ecosystems where plants allocate most of their biomass aboveground (i.e., forested biomes). Yet, looking only at plants aboveground may be misleading in disturbance-prone grassy and shrubby biomes – accounting for ~60% of land cover worldwide. In these biomes, individual species allocation into belowground organs (e.g., fine and thick roots, rhizomes) may not scale proportionally with their aboveground dimension. I present some challenges and possible solutions how to start tackling this issue. Then, I discuss two case studies from 52 temperate grasslands in the Czech Republic varying in management regime (i.e., mown once or twice per year), and corresponding to two distinct regions. With the first study, I illustrate that community-level biomass allocated belowground to non-acquisitive organs (i.e., rhizome; responsible for the key plant functions of space occupancy, resprouting after damage, and seasonal rest) can account for a vast proportion of biomass. Rhizome biomass scaled linearly with aboveground biomass, and more intensive management negatively and disproportionally affected rhizome biomass. This finding may have important implications for the persistence of temperate grassland plants and their provision of ecosystem services (e.g., soil carbon sequestration, soil stabilization) in relation to changing environments. With the second study, also at the community level, I focus on belowground clonal organs and traits of temperate grassland perennial species. The main goal here was to test whether incorporating the underexplored clonal traits improves the ability to predict key ecosystem functions, i.e., biomass production and soil carbon in temperate grasslands. Relationships between five plant functional traits (canopy height, specific leaf area [SLA], lateral spread, multiplication rate, persistence of rhizome) and biomass allocation (aboveground, roots, rhizomes) and soil organic carbon (SOC) were examined. The most important traits in predicting biomass allocation were canopy height and persistence of rhizome. Results, however, varied greatly for the two regions. Persistence of rhizome and canopy height emerged as traits largely affecting ecosystem functioning at the less intensively managed grasslands – likely because of their links to biomass production and plant economics spectrum. At the more intensively managed grasslands, canopy height and SLA were negatively correlated with root biomass, with persistence of rhizome playing a minor role. We found no significant predictors for SOC. Findings indicate that the ability of plant functional traits in predicting temperate grassland ecosystem functioning is highly context-dependent, differing considerably even within the same community type.

ID 11

Format Oral Presentation

Theme Macroecology of vegetation

Phylogenetic structure and functional diversity of European forest communities

Padullés Cubino, Josep*[1]; Biurrun, Idoia[2]; Bonari, Gianmaria[3]; Braslavskaya, Tatiana[4]; Font, Xavier[5]; Jandt, Ute[6]; Jansen, Florian[7]; Rašomavičius, Valerijus[8]; Škvorc, Željko[9]; Willner, Wolfgang[10]; Chytrý, Milan[1]; Lososová, Zdeňka[1]; Agrillo, Emiliano[11]; Atorre, Fabio[12]; Bergmeier, Erwin[13]; Campos, Juan Antonio[14]; Čarni, Andraž[15]; Ćuk, Mirjana[16]; De Sanctis, Michele[17]; Indreica, Adrian[18]; Jiménez-Alfaro, Borja[19]; Khanina, Larisa[21]; Knollová, Ilona[1]; Lenoir, Jonathan[23]; Pielech, Remigiusz[20]; Svenning, Jens-Christian[21]; Vassilev, Kiril[22]

Masaryk University[1]; University of the Basque Country[2]; Free University of Bozen-Bolzano[3]; Russian Academy of Sciences[4]; University of Barcelona[5]; Martin Luther University Halle-Wittenberg[6]; University of Rostock[7]; Nature Research Centre[8]; University of Zagreb[9]; University of Vienna[10]; Institute for Environmental Protection and Research[11]. Sapienza University of Rome[12]; University of Göttingen[13]; University of the Basque Country UPV/EHU;[14]; University of Nova Gorica[15]; University of Novi Sad[16]; Sapienza University of Rome[17]; Transilvania University of Brasov[18]; University of Oviedo[19]; Institute of Applied Mathematics of Russian Academy of Sciences[21]; Université de Picardie Jules Verne[23]; University of Agriculture in Kraków[20]; Aarhus University[21]; Bulgarian Academy of Sciences[22]

Forest ecosystems represent approximately 40 % of the land cover in Europe. However, the spatial patterns and the drivers of the phylogenetic structure and functional diversity of forest plant communities across Europe have not yet been examined. Using > 60,000 vegetation plots sampled across Europe, we analyzed and mapped (1) the phylogenetic structure (i.e., the degree of species relatedness) of forest communities and (2) the abundance-weighted patterns in the leaf economic spectrum (LES) and plant size spectrum (PSS) of forest understory communities. Our results showed that plant species in forests located in areas with higher climatic stress and instability were more phylogenetically related than random (i.e., more phylogenetically clustered). Clustered forest communities were broadly distributed in Fennoscandia, particularly in areas that were glaciated during the Pleistocene, likely reflecting limited postglacial migration of certain plant lineages after deglaciation. In contrast, forest communities whose plants were more distantly related than random (i.e., phylogenetically overdispersed) were relatively common in the hemiboreal zone in Russia, which could reflect the effect of the transition between the boreal and temperate biogeographical regions or a distinct anthropogenic activity. Overdispersed forest communities were also relatively more common in some areas around the Mediterranean Basin, which partially overlapped with areas considered as refugia for many lineages during the Pleistocene glaciations. In terms of functional diversity, we found that forest understories had more conservative leaf economics in areas with relatively low or high mean annual temperatures (mainly Fennoscandia and the Mediterranean Basin, respectively), more extreme soil pH, and under more open canopies. Warm and summer-dry regions around the Mediterranean Basin and areas of Atlantic Europe also had taller understories with heavier seeds than continental temperate or boreal areas. We also found that forest types in Europe are differently positioned along major axes of trait variation. For example, understories of broadleaved deciduous forests, such as *Fagus* forests on non-acid soils, or ravine forests, more commonly hosted species with acquisitive leaf economics. In contrast, some coniferous forests, such as *Pinus, Larix*, and *Picea* mire forests, or *Pinus sylvestris* light taiga, and sclerophyllous forests, more commonly hosted species with conservative leaf economics. Altogether these findings highlight the importance of environmental filtering in driving the assembly of communities of closely related plant species with more conservative leaf economics. We provide

the first maps and analyses on the phylogenetic structure and functional diversity of European forest vegetation at the plot level.

ID 120

Format Poster Presentation

Theme Vegetation dynamics and succession

Coenological and biomass investigation of the sandy grasslands along the Danube

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Festuca taxa are important grassland species in the pannonian vegetation, and are defining members of it where conditions are too extreme for most plants. Based on surveys on grassland management, habitats of narrow-leaved or small Festuca species are an indicator of poor productive capacity, but are important in terms of nature conservation. The significance of these grasslands are likely to be increasing in line with climate change and expanding dry habitats. Coenological plots and cut samples of biomass were made along the Danube from 17 areas, beginning in the northwestern part of the Little Hungarian Plain, across the central great sandy plains of the Carpathian Basin (divided into three parts: north, middle, south) to the southernmost part of the Basin at Deliblato, Serbia. The last samples were made beyond the Carpathians on the Romanian Great Plain and Bulgaria. 6 samples were recorded in each area using 0.5 m × 0.5 m quadrats. Samples were divided to the following categories: 1. *Festuca* taxa, 2. other grasses; 3. legumes; 4. other dicots; 5. other monocots; 6. dead leaves. We followed the sandy vegetation from the Little Hungarian Plain (Csallóköz) to the Romanian Great Plain along the Danube. Our main goal was to determine the quantity and comosition of the biomass of these grasslands. The main questions were the following: What is the quantity of biomass and does it change at various locations? How do the composition of biomass and the composition values of *Festuca* spp. make these grasslands capable of pasturing? According to our results, the biomass of the grasslands was low, varying from 300 to 800 g/m^2. It is under 500 g/m^2 in open sandy grasslands, and was relatively higher in closed ones. *F. vaginata* grasslands had the lowest value, while *F. rupicola/javorke* had the highest, but comparing to the other categories, the relative biomass of *Festuca* taxa was high in every habitat. Dicots (without legumes) were also an important category. The relation of these two groups also changed: the more closed the habitats (from *F. vaginata* across *F. wagneri* to *F. rupicola javorkae*), the lower the relative abundance of *Festuca* taxa and the higher of legumes. Samples from *F. rupicola/javorkae* and *F. wagneri* included also the most legumes. The quality and quantity of hay from these dry grasslands is low, it can be a usable feed source for the small ruminant industry, i.e., sheep grazing. However, as the climate of the Carpathian Basin is getting drier in line with climate change, their role in pasturing should be reconsidered in the future. The work was supported by OTKA K-125423.

ID 108

Format Oral Presentation

Theme Vegetation inventory and mapping

Unknown islands – Bedrock Meadows in the interior Pacific Northwest North America

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Masaryk University[1]; Unversity of Alberta[2]; Büro Áchero[3]; University of Trier[4]

The Interior Pacific is well known for its vast forests, which have been studied with respect to their community composition and ecological functioning. However, few ecologists know that the region is also home to meadows that occur scattered among its mid-elevational forests and prevail on shallow and vernally seepy soils. Referred to as “Bedrock Meadows” in a regional report, this habitat type has never been studied, and its species composition and diversity remain unknown. However, given their small size and open structure, Bedrock Meadows could be disproportionately vulnerable to the effects of human disturbance and non-native species invasions. In order to evaluate their importance for conservation and land-use planning, it is crucial to understand how Bedrock Meadows differ from other open habitat types in the region. We compared Bedrock Meadows to four other habitat types in the wider region, including prairie and intermountain grasslands, maritime mountain meadows, alpine and timberline meadows, and asked how they differ with respect to: (i) species composition of vascular plants, (ii) habitat structure, (iii) climate characteristics, and (iv) functional composition (plant-life spans, growth forms). We combined field data with existing data (total n = 1162 plots, including 110 plots in Bedrock Meadows) and compared habitat types using classification and indirect ordination techniques. Our results show that Bedrock Meadows form communities that are distinct with respect to their taxonomic composition, habitat structure and functional composition. Compared to related habitat types, Bedrock Meadows appear to have an open structure with high proportions of bedrock, bare soil, and high covers of non-vascular plants, especially bryophytes. Their climate attributes take an intermediate position between coastal and interior grasslands, and between high and low altitudinal climates. Their functional composition resembles most closely those found in maritime mountain or Timberline Meadows. Specifically, Bedrock Meadows have high proportions of annual plants and geophytes, with the latter made up mostly of species with bulbs and corms. These life-forms are ideal for surviving the dry and hot summer and the shallow soils that prevail in this habitat type. Given their distinct ecological attributes, Bedrock Meadows should be recognized as a separate habitat type. Future research needs to focus on the conservation value and threats to this habitat type and continue to explore its biological components.

ID 88

Format Oral Presentation

Theme Special session: The legacy of invasions

Invasion legacy effects versus sediment deposition as drivers of riparian vegetation

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Riparian zones are formed by interactions between fluvio-geomorphological processes, such as sediment deposition, and biota, such as vegetation. Establishment of invasive alien plant (IAP) species along rivers may influence vegetation dynamics, evidenced as higher seasonal or inter-annual fluctuations in native plant diversity when IAP cover is high. This could impact the overall functioning of riparian ecosystems. Conversely, fine sediment deposited in riparian zones after floods may replenish propagule banks, thus supporting recruitment of native species. The interactive effects of invasion and fine sediment deposition have hitherto, however, been ignored. Vegetation surveys across rivers varying in flow regime were carried out over 2 years to assess changes in community composition and diversity. Artificial turf mats were used to quantify over-winter sediment deposition. The viable propagule bank in soil and freshly deposited sediment was then quantified by germination trials. Structural Equation Models were used to assess causal pathways between environmental variables, IAPs and native vegetation. Greater variation in flow increased the cover of IAPs along riverbanks. An increased in high flow events and sediment deposition were positively associated with the diversity of propagules deposited. However, greater diversity of propagules did not result in a more diverse plant community at invaded sites, as greater cover of IAPs in summer reduced native plant diversity. Seasonal turnover in the above-ground vegetation was also accentuated at previously invaded sites, suggesting that a legacy of increased competition in previous years, not recent sediment deposition, drives above-ground vegetation structure at invaded sites. The interaction between fluvial disturbance via sediment deposition and invasion pressure is of growing importance in the management of riparian habitats. Our results suggest that invasion can uncouple the processes that contribute to resilience in dynamic habitats making already invaded habitats vulnerable to further invasions.

ID 72

Format Poster Presentation

Theme Climate change

Impact of urban climate on phenology and fitness of herbaceous plant species

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Urban areas represent a convenient setting to analyze the impact of changes in temperature and relative air humidity in the context of global climate change on the vitality of plants. However, few studies have investigated this effect on herbaceous plant species. This study provides ground-based evidence of changes in phenology and fitness (height) of six herbs in the city of Bremen (Germany). A direct gradient analysis was carried out to examine the influence of mean temperature, mean relative humidity, impervious surface area (ISA-Index) and distance to the city centre on the performance of *Anthriscus sylvestris, Epilobium hirsutum, Filipendula ulmaria, Geum urbanum, Iris pseudacorus* and *Lythrum salicaria*. The results revealed an accelerating impact of increasing mean temperature on the phenological phase of three species (*G. urbanum*: -11.4 days/ 1°C, *L. salicaria*: -9.2 days/ 1°C, *I. pseudacorus*: -3.2 days/ 1°C), while relative air humidity showed no consistent effect. In addition, the ISA-Index (with higher values likely related to higher temperatures) influenced phenology and fitness almost exclusively positively, while the distance to the warmer city center mainly had a negative impact. These findings suggest that temperature-related spatial differences in phenology may reflect temporal changes in phenology as a consequence of climate change.

ID 123

Format Poster Presentation

Theme Vegetation classification

The taxonomic problems of the *Festuca vaginata* agg. and their coenosystematic aspects

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We studied the vegetation of the sandy areas along the Danube. The most important dominant species of these grasslands is *Festuca vaginata*. Besides *Festuca vaginata*, another taxon, *Festuca pseudovaginata* was also discovered (Penksza 2003). According to Borhidi et al. (2012) *F. dominii* is a dominant species on acidic grasslands. Taxonomical judgement of *Festuca dominii* Krajina has changed remarkably. Šmarda et al. (2007) clarified the taxon, and named it as a subspecies of *F. psammophila* (Čelak.) Fritsch (which occurs only in pine forests in North Europe). Pawlus (1985) has distinguished several new series within the *Festuca* genus. The *F. trachyphylla* series includes 3 species: *F. trachyphylla* (Hack.) Krajina, *F. macutrensis* Zapalowicz, *F. duvalii* (St-Yves) Stohr. Subsequently, Šmarda et al. (2008) in their work treated *F. trachyphylla* taxon validly as *F. brevipila*. We checked in the Carpathian Basin and in the natural grasslands which of these 3 taxa occur: *F. vaginata, F. pseudovaginata, F. brevipila*. In addition to these, hybrid taxa have been detected during our investigations, and the expulsion of *Festuca wagneri* and *F. javorkae* has also been widened, and their vegetation types has been clarified. In 20 Hungarian areas, we examined individuals belonging to *F. vaginata*. On the basis of the results, we found that taxon *F. vaginata* were the typical without awn. In addition, we have collected shorter or longer awn from the tip of the lemma, which have short fibers under the tip of the lemma. Clarification of taxa also means clarifying the name and dominant species of sandy vegetation, and the overriding and correction of the associations and coenotaxa described above is also necessary. The work was supported by OTKA K-125423. References Borhidi, A., Kevey, B., Lendvai, G. (2012): Plant communities of Hungary. Akadémiai Kiadó, Budapest. Pawlus M. (1985): Systematyka i rozmieszczenie gatunków grupy *Festuca ovina* L. w. Polsce. Fragm. Florist. Geobot. 29: 219–295. Penksza, K. (2003): *Festuca pseudovaginata*, a new species from sandy areas of the Carpathian basin. Acta Bot. Hung., 45, 356-372. p. Šmarda, P., Šmerda, J., Knoll, A., Bureš, P., Danihelka, J. (2007): Revision of Central European taxa of *Festuca* ser. *Psammophilae* Pawlus: morphometrical, karyological and AFLP analysis. Plant Systematics and Evolution, 266, 197-232. p. http1: The Plant List (www.theplantlist.org)

ID 13

Format Oral Presentation

Theme Invasive species

Effectiveness of PAB factors' proxies to explain the spatial pattern of *Solidago* invasion at a regional scale

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Understanding the drivers of alien plant invasion is important for the management and control of invasive species. Here, the effectiveness of proxies of the PAB framework (propagule pressure (P), abiotic characteristics of the environment (A), and biotic characteristics of both the invader and recipient vegetation (B)) to explain the spatial pattern of *Solidago canadensis* and *S. gigantea* invasion using invasive species distribution models were analyzed. The data on species presence or absence were from an atlas of neophyte distribution based on a 2 km × 2 km grid in the Polish part of the Carpathian Mountains and their foreground, covering approximately 31,200 km^2 (7752 grid cells). Proxies of PAB factors, along with data on the historical distribution of invaders, were used as explanatory variables in Boosted Regression Tree models to explain the distribution of invasive *Solidago*. The areas with potentially lower sampling effort were excluded from the analysis based on a target species approach. Distributions of both species were limited climatically because a mountain climate is not conducive to their growth; however, the *S. canadensis* distribution pattern was correlated with proxies of human pressure, whereas *S. gigantea* distribution was connected with environmental characteristics. The varied responses of the species concerning distance from their historical distribution sites indicated differences in their invasion drivers. Proxies of PAB are helpful in the choice of explanatory variables as well as the ecological interpretation of species distribution models. The results emphasize that human activity can cause variation in the invasion of ecologically similar species. Keywords: alien plants, biological invasion, Boosted Regression Trees, drivers of invasion, PAB framework, *Solidago* spp.

ID 54

Format Oral Presentation

Theme Remote sensing of vegetation

Linking spectral heterogeneity and plant diversity across scales and time: a Czech Republic experience

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Measuring biodiversity is critical in monitoring ecosystems and preserving their functions, although field-based data collection might present limitations related to costs and time. Furthermore, biodiversity variation in space, time and across scales makes its assessment challenging and non-standardized. Remote sensing represents a convenient approach providing frequent, near-real-time information on wide areas. In light of the Spectral Variation Hypothesis, remotely-sensed spectral diversity (SD) represents an effective proxy of environmental heterogeneity and, thus, of ecosystem biodiversity. To date, the studies assessing the link between SD and biodiversity have reported contradictory findings, which might be ascribed to a lack of a systematic consideration of some of the key factors influencing such relationship (e.g., spatial scale, phenology, applied metrics, and type of ecosystem). The investigation of how such factors affect the link between SD and biodiversity, as well as determining the conditions under which such relationship is stable, are essential for understanding whether and how SD-based remote sensing (RS) approaches could support biodiversity monitoring across larger areas. Consequently, the aim of this study is to further investigate the link between SD and species richness (SR) by accounting for the influence of the spatial scale and of the seasonality on such a relationship. Plant diversity data were obtained from the PLADIAS database, which contains more than 13 million records of almost 5000 taxa of vascular plants, with most of them being collected after 1980. SR data are available in field mapping units (5' × 3') composing a grid of more than 2000 cells encompassing all the Czech Republic. Using the Google Earth Engine platform, Landsat 7 spectral dataset was processed to make “greenest pixel” composites resampled at different spatial resolutions (pixel size: 30 m, 60 m, 120 m, 240 m, 480 m) by selecting the highest Normalized Difference Vegetation Index (NDVI) value of the time series (1999-2017). To estimate the impact of phenology, median NDVI values were calculated for each of the four seasons. Finally, SD was estimated as the standard deviation of the NDVI within each field mapping unit. Our preliminary results indicate a considerable effect of both spatial scale and seasonality on the linear models testing the SR-SD relationship. Indeed, the strength of the relationship increased towards finer spatial resolution. Furthermore, the strongest relationship (i.e., the highest R2) was observed when considering summer NDVI values. Even though a clear influence of the two investigated factors emerged, the absolute low R2 values (0.21 and below) of the models indicate that considering more predictors could help improve the analysis. Based on these findings, further research on the effect of other factors, such as the applied metrics and ancillary environmental variables, on the SR-SD relationship are envisaged.

ID 174

Format Oral Presentation

Theme Special session: River vegetation

Plant species richness in riparian forests: Comparison to other forest ecosystems, longitudinal patterns, role of rare species and topographic factors

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This study aimed to analyze plant species richness in riparian forests at both local and regional scales across several watersheds in the Sudetes (Poland, Central Europe). Specifically, species richness in the riparian forest was compared to other forest types in the same region. It was also hypothesized that riparian forests share a higher number of rare species due to high complexity and dynamics. In addition, the longitudinal pattern of species richness was analyzed at both local and regional scales. Finally, the effect of topography on species richness in riparian forests in spring areas and along rivers of various sizes was analyzed. Riparian forests have significantly higher alpha diversity than beech and ravine forests, but oak forests showed a similar level of diversity. However, a comparison of accumulation curves showed, that riparian forests are the most species-rich at a regional scale. All forest types had a similar share of rare species. Eight uniform groups of rare species were distinguished in riparian forests and reflected the riparian complexity and dynamics. The number of plant species per plot was highest in spring areas and decreased from headwaters to lower reaches. The estimated total number of species showed a similar pattern; however, the highest number was estimated for riverine forests along 3rd order streams and therefore suggests a unimodal pattern of gamma diversity along a longitudinal (upstream-downstream) gradient. The effect of topographic variables on species richness differed depending on the position in the river network.

ID 33

Format Poster Presentation with lightening Talk

Theme Vegetation classification

Maps of European alliances: examples of distribution patterns

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The first compilation of European vegetation types published as EuroVegChecklist (Mucina et al. 2016, Appl. Veg. Sci.) included all so far known vegetation alliances of Europe. Although the distribution of each alliance was indicated, their real spatial extent remained incomplete. We collated a data set, from the literature and vegetation-plot databases, on the occurrence of all vegetation alliances listed in the EuroVegChecklist. Countries, larger islands, and archipelagos were defined as the basic mapping units. Biogeographically heterogeneous and large countries were divided into finer units, using the map of European bioregions (EEA) as lead. Coastal alliances were mapped separately only for coastlines. We involved 67 European vegetation scientists to share their expert opinion to help revising the distribution maps of the alliances. In total, the distribution of 1105 European alliances was mapped in 131 mapping units. Degrees of uncertainty about the occurrence of individual alliances were displayed by different colours in the maps. Mapping units with the highest number of alliances (including the possibly occurring alliances) are: Mediterranean Spain, Italian Peninsula, Bulgaria, Greece and other Balkan countries. The lowest number of alliances was found in all coastal mapping units, together with Svalbard, Faroe Islands, Cyprus, Russia Arctic, Greenland, Malta and Azores. The highest number of alliances occurs in the Mediterranean and Submediterranean areas known for rich floras and steep elevational gradients, whereas low richness reflects partly true biogeographical pattern, partly lack of data. The alliances reported in most mapping units (including their possible occurrence) are those of aquatic or wetland vegetation: *Bidention tripartitae, Chenopodion rubri, Glycerio-Sparganion, Lemnion minoris, Magnocaricion elatae, Nymphaeion albae, Phragmition communis, Potamogetonion, Ranunculion aquatilis* and *Stratiotion*. The alliances with the highest degree of uncertainty of presumed occurrence are: *Violo rivinianae-Stellarion holosteae, Euphorbio taurinensis-Geranion lucidi, Asplenio scolopendrii-Geranion robertiani, Seslerio rigidae-Pinion, Plantagini salsae-Artemision santonici, Pyracantho coccineae-Hippophaeion fluviatilis, Rubo caesii-Amorphion fruticosae* and *Mesembryanthemion nodiflori*. All are relatively poorly studied. The mapping units with the largest proportion of uncertain alliances are: Luxembourg, Kaliningrad area, European Turkey, Cyprus, Kosovo, Moldova, Northern Ireland, Faroe Islands, Azerbaijan and Albania. Unclear delimitation of alliances and lack of data underpin this pattern. Despite of scarcity of vegetation classification studies in Northern, Eastern and South-Eastern Europe, involving vegetation experts helped to overcome the initial paucity of data in some areas. We understand this work as the baseline that needs to be improved and further developed through further vegetation studies especially in poorly studies regions.

ID 160

Format Oral Presentation

Theme Disturbance ecology

Evolutionary history of grazing and resources determine herbivore exclusion effects on plant diversity

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Canonical ecological models predict that the effects of mammalian herbivore exclusion on plant diversity depend on resource availability and plant exposure to ungulate grazing over evolutionary time. Using an experiment replicated in 57 grasslands on six continents, with contrasting evolutionary history of grazing, we tested how resources (mean annual precipitation and nutrient addition) determine herbivore exclusion effects on plant diversity, decomposed into richness and evenness. We test the hypothesis that in sites with a long history of ungulate grazing, plant diversity decreases with herbivore exclusion in resource-rich sites; whereas in short-history sites the effect of herbivore exclusion depends on plant species origin (native or exotic from long-history sites). We found that in long-history sites, herbivore exclusion reduced plant diversity by reducing both richness and evenness, but only the response of richness to herbivore exclusion decreased with mean annual precipitation. In short-history sites, the effects of herbivore exclusion differed for native and exotic plant richness and depended on fertilization; native species richness was unaffected by herbivore exclusion, whereas exotic species richness declined with herbivore exclusion in fertilized plots. In sum, herbivore exclusion caused loss of plant diversity in resource-rich grasslands that evolved with ungulates, but these findings do not simply extrapolate to other grasslands, rather they depend on grazing history and plant provenance. Thus, plant species' evolutionary history of grazing continues to shape the response of the world's grasslands to changing mammalian herbivory.

ID 36

Format Poster Presentation

Theme Functional traits

Variation in belowground functional traits of plant species along the marl prairie-slough gradients in the Everglades

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Functional plant traits have been used to characterize differences in resource use pattern among species within and across communities, and understand how environmental cues restrict trait distributions across landscapes. Some of the expectations about the distribution of functional traits underpins the economical tradeoffs between traits associated with growth and stress tolerance. Although these tradeoffs are largely based on foliar and stem observations, a root economic spectrum (RES) is also expected to provide a framework explaining differences in belowground investment strategies among plant taxa. Under the RES, the fine roots usually follow a gradient in trait characteristics ranging from fast foraging with shorter lifespan (acquisitive strategy) to slow foraging with longer lifespan (conservative strategy). However, the majority of these trait relationships with the environment are based on relatively few species and most have not been replicated along environmental gradients and soil types Therefore, major objectives of our study are to measure root traits within the framework of the RES differences among plant species along a freshwater hydrologic gradient that includes variation in water regimes and soil characteristics. In the Everglades, plant communities are primarily arranged along hydrologic gradients, and thus are sensitive to the large-scale restoration activities, including modifications and operational changes in water management associated with the Comprehensive Everglades Restoration Plan (CERP). A natural freshwater hydrologic gradient exists from the short hydroperiod marl prairies (MP) to the long hydroperiod ridge and slough landscape (S). Along the MP-S gradient, plant diversity together with relative abundance C4 plant species decreases, while soil organic matter (SOM) content increases with an increase in wetness and soil depth. Our study focuses on the root traits of the major plants species that define the communities along the gradient. Both short- and long-hydroperiod species are expected to exhibit a wide range of inter- and intra-specific variation in root traits. Along the MP-S gradient, environmental filtering will play an important role wherein the most competitive traits will cluster in their respective habitats. For example, in the drier portions of the gradient, short-hydroperiod species will exhibit thinner and longer fine roots. In the flooded portions, however, long-hydroperiod species will exhibit thicker and shorter fine roots in order to compensate for the flooding stress. In the ecotone zones of MP-S gradient, root traits of both short-hydroperiod and long-hydroperiod species will converge, resulting in wide intra- and inter-specific variation in root traits along the whole gradient. Our study will establish the functional basis at the root level to assess the plant community responses to restoration activities and will provide feedback for the adaptive management of Everglades wetland ecosystems.

ID 104

Format Oral Presentation

Theme Special session: River vegetation

Prioritizing the causality of environmental stressors on the quality of riparian vegetation and macroinvetebrates

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We investigated the specific paths by which environmental stressors drive the ecological quality of river ecosystems, specifically focusing on riparian vegetation and benthic macroinvertebrates as proxies. We used a nationwide existing dataset from Portuguese rivers, obtained under the Water Framework Directive national monitoring program, to develop and test an ecological network model concept in order to assess possible factors standing out as main drivers of the ecological quality of multiple biological elements in river systems. We assessed the interactions between land use, hydrology, water quality, riparian vegetation and benthic macroinvertebrates, by means of confirmatory factor analysis using structural equation modeling. The study initiated with the ecological network model conceptualization supported on expert knowledge and literature review to propose an initial theoretical model, which was tested against the observed data from 158 sample sites scattered across the country and encompassing several different river types and stressors intensities. The theoretical model was successfully fitted and achieved a good adjustment for the empirical data according to different approximate fit indexes. As an initial approach to a holistic perspective of the fluvial system, a first analysis of the ecological model shows the different weights of the environmental factors on the ecological quality of the two biological elements and their interactions. Results point to a possible prioritization for restoration efforts to the ecological improvement of river systems grounded on nature-based solutions, addressing together multiple biological elements, therefore finding an agenda for restoration of river systems. This first attempt is also a fact-finding analysis with the intent to call out researchers for a concerted data collection effort in order to achieve a worldwide, larger biological element comprehensiveness and more robust analysis of the utmost pressing factors affecting river quality.

ID 87

Format Oral Presentation

Theme Functional traits

Foliar summer frost resistance measured via electrolyte leakage approach as related to plant distribution, community composition and performance

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Frost resistance (FR) is a fundamental process determining various aspects of plant life. Measurements of FR remain challenging as existing methods are time- and labour-intensive. In this study, we tested the applicability of foliar FR measured via the 'electrolyte leakage' approach (FRPEL), a simple and inexpensive technique so far underused in ecological research to estimate FR. Specifically, we tested the ability of this trait to predict i) species occurrence, ii) community composition along an elevational gradient, and iii) analysed its relationship to 9 other traits (SLA, Cmass, Nmass, Pmass, Camass, Mgmass, Kmass, canopy height and the ability to form rosettes) related to plant performance. We studied 183 vascular species occurring at 37 sites, which we also analysed in terms of species composition along an elevation gradient from 656 to 2363 m a.s.l. in the Bavarian Alps, Germany. Species' FRPEL values correlated significantly with the species occurrence along the elevational gradient. However, this relationship was weak as it explained only 10 % in the variation of the Landolt indicator values, a proxy for species geographic ranges. We found a strong positive relationship between community-weighted FRPEL values and elevation suggesting a strong environmental filtering of this trait that removes species with low foliar FR from the local species pool at high elevations. The community functional diversity of FRPEL significantly increased with increasing elevation suggesting a higher trait divergence of communities in harsher climates. We found significant negative relationships between FRPEL and specific leaf area, canopy height and the ability to form leaf rosettes, indicating a trade-off in plants between the investment in conservative strategies, in our case frost resistance, and fast resource acquisition. Our study highlights a high potential of using FRPEL more frequently in ecological research as we were able to re-confirm three patterns inferred by more precise yet time-consuming and labour-intensive approaches. We demonstrate that the trait can be used to predict species occurrence and infer assembly rules along elevational gradients. Furthermore, we found that FRPEL is linked to plant functional traits associated with plant performance as well as morphological features of the plants. However, the trait's predictive power varied greatly among the study objectives and levels.

ID 85

Format Oral Presentation

Theme Functional traits

Seed germination requirements explain wetland species distribution at local scale

Rosbakh, Sergey*[1]; Phartyall, Shyam[2]; Poschlod, Peter[1]

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Wetlands represent an extremely heterogeneous environment for their specific plants, because key abiotic factors, such as light, oxygen availability, and temperature fluctuations, vary there rapidly at relatively small spatial but also temporal scales. Yet, wetland plants exhibit the well-known clear distributional patterns within such compact and heterogeneous habitats. Despite a large number of studies on wetland vegetation ecology, there is still a substantial lack of knowledge in which and how plant traits control these sharp local distributional ranges. Seed germination is an important element of regeneration niche (sensu Grubb, 1977) and, due to its high sensitivity to environmental perturbation, was found to be critically important for understanding terrestrial and wetland plant distribution at different scales, their community assembly, and vegetation dynamics. In this study, we explore the seed germination requirements for light, oxygen, and temperature of 50 typical Central European wetland species in relation to the local niches they occupy. We clearly demonstrate that seed germination of wetland species is only triggered by the combination of environmental factors that reflect the onset of favourable conditions for successful seedling establishment. This finding, therefore, extends the applicability of ‘gap-detection’ mechanism of seed reproduction to aquatic habitats. Furthermore, the results of our study could help to reach a better understanding of the existing patterns of wetland plant distribution at local scales, wetland vegetation dynamics, as well as facilitates nature conservation measurements and aquatic habitat restoration.

ID 143

Format Oral Presentation

Theme Vegetation inventory and mapping

An investigation into the causes of tree species identification errors in large forest inventory and monitoring programs

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The USDA Forest Service, Forest Inventory and Analysis program (FIA) has conducted comprehensive field-based inventories of forest resources across the U.S. since the 1930s. A quality assurance/quality control (QA/QC) program is important to ensure data quality because of the large number of field people involved in data collection across the U.S. Species identification is one of the very important data elements and is the cornerstone of any biological investigation. Beyond the formal QA/QC program in FIA there were other indicators (data logic checks) pointing to possible species identification problems not revealed in the QA/QC checks. This led to concerns that error rates were actually higher than indicated by the QA/QC program. To corroborate this inconsistency, we designed a study to independently check (apart from FIA QA/QC personnel) species identification on previously measured plots. Sample plots measured between 2010 and 2015 from the state of Arkansas were used in this case study. The FIA sample design is a 5-year re-measure and is administered at the state level. Sample plots consist of a 4- subplot cluster, each subplot 7.3 m in radius and all trees monumented. Identification verification of previously tallied trees was done by a contracting botanist in 2018 on 154 sample plots randomly selected from a state total pool of 3,500 plots. This resulted in 4,499 live trees with DBH ≥ 2.54 cm being verified. The overall error rate for gymnosperms and angiosperms, combined, was 8.6 percent (compared to 2.6 percent derived from QA/QC checks). Several minor species had error rates approaching 100 percent. Although the sample design did not stratify on specific error elements, empirical analysis did reveal six factors that might lead to species identification errors: 1) inherent difficulty in specific taxon, 2) degree or level of training in field crew members, 3) the season of year when sample data were collected, 4) the size/maturity of trees being sampled, 5) specimen components out of reach/view, and 6) species components not present at the time the sample was collected (plot re-visits are not possible or practical). We recommend increasing the number of QA/QC checks, from 3 percent (currently), to 8–10 percent; advanced botanic training for QA/QC personnel; periodic botanic training for field people; stronger emphasis on important academic elements when hiring field people; a strong QA/QC check plot scoring system so work performance can be evaluated fairly (this may require weighting the scores of certain variables). An important unknown is what is an acceptable species identification error rate? This study is important for reinforcing the ideal of quality work in large comprehensive surveys, often challenging because of the inherent difficulties in field sampling. We emphasize the importance of a strong QA/QC program. Such a program not only includes checking past work but should also include a strong emphasis on periodic training.

ID 156

Format Oral Presentation

Theme Special session: Community ecology belowground

Influence of plant root systems on soil processes along an altitudinal gradient in the French Alps

Roumet, Catherin*[1]; Bounous, Manon[2]; Angeles, Guillermo[3]; Anthelme, Fabien[2]; Barois, Isabelle[3]; Cruz-Maldonado, Nereyda[2]; Decaens, Thibaud[1]; Freschet, Grégoire T.[4]; Jiménez, Leonor[3]; Ma, Jing[5]; Mao, Zhun[2]; Marín-Castro, Beatriz Eugenia[6]; Merino-Martín, Luis[2]; Mohamed, Awaz[2]; Piedallu, Christian[7]; Reijnen, Hans[1]; Reverchon, Frédérique[3]; Weemstra, Monique[1]; Stokes, Alexia[2]

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Control of soil erosion is a critical environmental challenge, especially in mountain ecosystems. Plant community composition has been identified as a key factor to control soil erosion: aboveground, plant cover intercepts rainfall and protects the soil surface against the impact of rainfall drops; belowground, root systems influence the fluxes of water and sediments by improving water infiltration and soil-aggregate stability. This study aimed to better understand how changes in plant community composition, and especially in root traits, affect soil structural stability and water infiltration along an elevation gradient. We performed a study along an elevation gradient (1400–2400 m) in the French Alps. At six altitudinal levels and underneath three focal species (*Picea abies, Juniperus communis* and *Vaccinium myrtillus*) we measured two soil processes linked to erosion mitigation (soil aggregate stability and water infiltration) and root traits (biomass, morphological and chemical traits) measured both at the community and species level. We tested the following hypotheses: (1) shifts in plant community composition along the elevation gradient induce strong variation in root traits, (2) variation in root traits influences soil aggregate stability and water infiltration, (3) soil processes are better predicted by root traits of the whole plant community than by root traits of the focal species. At high elevations, where plant growth is limited by temperature and low soil fertility, we observed an increased production of thin roots, a strategy favouring belowground resource acquisition during the short growing season. Roots also had greater tissue density and higher lignin concentration to better resist the biophysical environment. Soil aggregate stability decreased with elevation which was driven by root traits (biomass, lignin, and diameter), whereas the decrease in water infiltration rate at higher elevations was more driven by soil environmental properties (litter and soil organic matter thickness) than by absorptive root traits. Our study contributes to a better mechanistic understanding of plant community composition effects on soil erodibility via the modification of litter properties and root traits of the whole plant community.

ID 136

Format Poster Presentation with lightening Talk

Theme Species composition and diversity

Mixed-species forests enhance biodiversity of understorey vegetation in eastern Fennoscandia

Salemaa, Maija*[1]; Genikova, Nadezdha[2]; Kryshen, Alexander[2]; Merilä, Päivi[1]; Oksanen, Jari[3]; Tikhonova, Elena[4]

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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 (Taiga) vegetation zone. The natural growth conditions (climate, soil) of forests are relatively similar in the both sides of the border, 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 countries to different directions. In this study we analyze the variation in the understorey vegetation of forests on mineral soils in relation to climatic factors, soil fertility, and stand structure in eastern Fennoscandia. 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 plant 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 vegetation of the middle taiga and northern taiga zones in Karelia resembled the southern boreal and middle boreal zones in Finland, respectively. The plots were located along the soil fertility gradient and accordance with the dominating tree species. The most species rich forests were found in areas with high Ca concentration and high pH in soil in both sides of the border. The number of vascular plant and bryophyte species correlated positively with the number of tree species in both countries, Furthermore, the number of vascular plant species increased with increasing proportion of deciduous trees, supporting the view that the mixed-species forests enhance biodiversity and ecosystem services better than forest monocultures.

ID 40

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Vegetation dynamics under low and high grazing intensity in the semi-arid Succulent Karoo of South Africa – results from 19 years of annual in-situ monitoring

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The Succulent Karoo biome of Southern Africa is renowned as a biodiversity hotspot, which is prone to habitat transformation and overgrazing by domestic livestock. Projected future climate change with an unprecedented increase in temperature and change in rainfall patterns may further exacerbate the situation. To understand the long-term impact of land use and climate on the species and life-form composition of the vegetation we implemented a series of standardised long-term monitoring sites, biodiversity observatories, (www.sasscalobservationnet.org) along a subcontinental climatic gradient across southern Africa. Several of the sites represent fence-line contrasts where two observatories represent different land-use intensities. We will present results on the long-term dynamics of the vegetation at a fence-line contrast on the mountain area of the Succulent Karoo (Kamiesberg, Northern Cape Province, South Africa). The site receives about 160 mm MAP, which mainly falls in the cold winter months (May-August), while summers are warm and dry. The observatories are each 1 km² in size and comprise 20 marked 100 m² plots, where we annually assessed abundance values per species, which we classified into major plant life-form types (leaf-, stem-, non-succulent large shrubs, succulent and non-succulent dwarf shrubs, annual forbs and grasses, perennial forbs and grasses, geophytes). We analysed a time series of 19 years (2001-2019) of annual vegetation monitoring data from the two adjacent observatories, exposed to high and low grazing pressure. We applied generalised linear mixed models (glmmTMB) with the quarterly SPEI (Standardised Precipitation-Evapotranspiration Index) as a drought index for the same and the previous year, annual rainfall, rockiness of soil surface, slope position, grazing intensity as fixed effects, plot as random effect, and year as random slope. We also analysed for trends in the climatic variables and diversity over time. Quarterly SPEI and total annual rainfall did not show any trends over time. We found, however, a positive trend in the richness of perennial species (perennial small and large shrubs, perennial herbs and grasses) for both observatories. The abundance of leaf-succulent shrubs was lower and of stem-succulent shrubs and perennial grasses higher under high than under low grazing pressure. We tested for the effect of interannual weather conditions on the vegetation. Moist conditions (moderate temperature and high rainfall, i.e., high SPEI) during June-August of the previous year had the strongest positive effect on the abundance of most of the perennial life-form types (succulent and non-succulent shrubs, perennial grasses). Annual life forms were positively affected by the SPEI at June-August of the same year. All perennial life forms showed a positive or no trend in abundance over time. We will discuss the results against previous findings regarding grazing impact on Succulent Karoo and climate change projections.

ID 22

Format Oral Presentation

Theme Functional traits

Disentangling direct and indirect effects of island area on plant functional trait distributions

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Species richness and functional diversity on islands generally increase with island area. This might arise either from direct effects of island area via neutral processes, or from indirect effects via other geo-environmental factors like habitat diversity or quality that scale positively with island area. Here, we test whether functional trait values of woody plants are directly or indirectly affected by island area. All studied islands were fairly small (between 25 m^2 and 12,000 m^2), had a shared geological history, were of similar age and elevation but differed mainly in terms of habitat quality, forest structure and degree of isolation. We considered plant functional traits linked to species dispersal (seed and fruit mass) or competitive (tree height, leaf mass per area and wood density) strategies. Community-weighted means of seed mass, tree height and chlorophyll content increased with both island area and basal area, while leaf nitrogen concentration decreased with increasing basal area. Fruit mass was not correlated to island area and basal area. Structural equation models indicated that the shifts in competitive strategies could be best understood as caused directly by forest structure, which in turn was explained by both island area and habitat quality. Differences in dispersal strategy among islands were explained by combined effects of forest structure, island area and isolation. Thereby, our results demonstrate that plant community strategies on small islands can be directly linked to forest structure and not island area as often assumed. Simple scaling relationships of trait values along island area did not capture the full breadth of the underlying ecological processes.

ID 80

Format Poster Presentation with lightening Talk

Theme Species composition and diversity

Air humidity control epiphyte distributions even in a narrow spatial scale of equal precipitation: case study in a mature evergreen broadleaf forest of Japan

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Vascular epiphytes represent a substantial portion of forest biodiversity around the world but are also highly susceptible to the effects of anthropogenic land-use and climate change. Understanding the environmental variables controlling the distributions of these plants is therefore fundamental to biodiversity conservation. Water availability is a major determinant of epiphyte growth and richness distributions, yet varies with gradients in precipitation, air humidity, and the occurrence of cloudy fog at broad spatial scales, and it can be highly heterogeneous at local scales due to hydrogeomorphological conditions in topographically variable watersheds. We assessed differences in the occurrence and richness distributions of eight vascular epiphytes along a ridge-valley gradient, reflecting air humidity gradient, within a 52 ha watershed in southwest Japan. The study area included mature conifer and evergreen broadleaf mixed forest within a temperate-humid climate, and the annual precipitation and mean temperature were 2,700 mm and 13 ℃, respectively. Air humidity was measured 2, 6, and 12 m above the ground at three sites (valley bottom, slope, and ridge) during 2020–2021. Epiphyte distributions were assessed against solar radiation and two topographic variables relating air humidity using generalized linear mixed models. Air humidity was lowest at the ridge site and highest at the valley bottom. The occurrence probability of all target epiphytes (four fern and four orchid species) declined with increasing elevation, in tandem with a decrease in humidity. However, the patterns of this decrease varied among species. *Lemmaphyllum microphyllum* was uniformly distributed across the study area, whereas *Eria japonica* and *Loxogramme salicifolia* were biased toward the valley bottom. Species richness was estimated to decrease from valley bottoms to ridges. These results indicate that epiphyte distributions are limited by low water availability, even in small areas of apparently similar precipitation. Differences in species' distribution patterns along the humidity gradient may be reflective of differences in water requirements and drought tolerance among the target species.

ID 181

Format Oral Presentation

Theme Remote sensing of vegetation

Exploratory analysis of the spectral reflectance curves of habitat types: a case study on Southern Bug River valley, Ukraine

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Large-scale habitat mapping is challenging, especially for areas barely covered with vegetation relevés. Remote sensing techniques help to optimize the extensive fieldwork, but often suffer from accuracy issues, and face uncertainty in choosing the source of the satellite data and habitat classification system. Commonly used satellite products, such as Sentinel or Landsat, provide multi-band reflectance data, which cover a wide wavelength range between ultraviolet and far-infrared light. Although only a fraction of that spectrum is typically used for calculating vegetation indices (e.g., visible and near-infrared bands), most of the modern machine learning techniques utilize the full set of available spectral data for the purposes of supervised classification of vegetation. Furthermore, highly similar habitat types (e.g., different types of grasslands, floodplain habitats) may have similar reflectance values during one season and different for another, so time-series reflectance data are also needed. Without the preliminary selection of the most discriminating satellite bands for given habitat types in given conditions, the models become overfitted and require extensive machine resources for calculation. Consequently, remote habitat mapping requires a tool for quick investigation of the given habitat types within a given territory, across available wavelength bands and seasons. To address this issue, we produced a replicable workflow with JavaScript (for Google Earth Engine platform) and R codes to obtain and process 10-meter resolution spectral data, and draw spectral reflectance curves for given habitat training data. We tested this workflow on the example of the Buzkyi Gard National Park, located in Southern Bug valley (south-western Ukraine). For the habitat classification, we used EUNIS classification as the main source. In total, we defined 32 habitat types for the National Park, but 10 habitat types were not suitable for mapping in our scale, because of the small areas covered by them. The final dataset consisted of 700 training polygons, belonging to 22 habitat types. We visually explored the variability of the spectral reflectance of defined habitat types, in particular, across different seasons. Using visual assessment, we identified groups of habitats that are similar in spectral reflectance characteristics and focused further work on them. Detecting the most distinguishable satellite bands and seasons allows us to decrease the number of satellite data used for Random Forest classification twice without loss in overall classification accuracy (93.8-94.3 %), what we showed by example of fuzzy and intermixed habitat types: Continental dry grassland (true steppe), Low steppic scrub, Temperate and Submediterranea thorn scrub, and the transitional complex habitat - Wooded steppes. Therefore, we propose our approach to be used as a standardized workflow for the initial visual assessment of habitat data for remote sensing purposes.

ID 99

Format Oral Presentation

Theme Functional traits

Performance landscapes for temperate trees across a climatic gradient

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An individual's traits determine its demographic performance within its environmental context, and the resulting performance differences scale up to drive population and community dynamics. Performance landscapes, which describe the relationship between traits and demographic rates, are thus a powerful conceptual tool in evolutionary biology and community ecology, but empirically estimating them and how they vary with the environment is challenging, especially for multiple species and trait dimensions. Here, we estimate 2-dimensional performance landscapes for multispecies communities using flexible, interpretable, and theory-motivated Gaussian functions within hierarchical Bayesian models. We fit models describing survival and growth landscapes using combinations of four functional traits (wood density, specific leaf area, maximum height, and seed mass) for temperate trees across a temperature gradient in the eastern US. Estimated survival landscapes showed that survival peaked at medium to high values of maximum height in all environments and at low values of wood density and specific leaf area in cold environments, though these effects were relatively weak (i.e., survival landscapes were nearly flat). Traits had stronger effects on growth, with growth peaking at low values of wood density and high values of maximum height in all environments and at high values of seed mass in cold environments. The strength of selection varied with temperature, with stronger selection on wood density in cold environments and stronger selection on seed mass in warm environments. Growth landscapes also showed strong positive interactions (i.e., correlational selection) between wood density, maximum height, and seed mass, indicating selection for multivariate trait combinations. These results demonstrate how estimation of multidimensional performance landscapes can shed light on the impact of traits on performance in different environments, leading to better predictions of species and community responses to environmental variation.

ID 67

Format Poster Presentation

Theme Invasive species

Effect of standing vegetation on seed persistence of selected invasive species

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Invasive species are often characterized by large and long-term persistent seed banks. Besides being highly species-specific, seed bank persistence is influenced by a variety of environmental factors. The standing vegetation can have major effects on seed persistence in the soil via its indirect effects on the availability of light, nutrients, and microclimate. Yet, its role in burial experiments has been largely neglected. Here we assess the effect of the standing vegetation on seed persistence for six invasive species that are known to form persistent soil seed banks and require active management after their removal to prevent new recruitment from seeds: annual species and common agricultural weeds (*Ambrosia artemisiifolia, Galinsoga parviflora, Amaranthus retroflexus*), and perennial species with major impacts on natural communities (*Rumex alpinus, Lupinus polyphyllus, Heracleum mantegazzianum*). Seeds of these invaders were buried under three cover mixtures (*Medicago sativa*; grass mixture; grass and herb mixture; and a control treatment) simulating spontaneous successional or agricultural communities. We present preliminary findings based on the exhumation of seeds buried in 2019. We discuss the relevance of these findings to the control of invasive plants and evaluate whether certain vegetation types might promote seed persistence of invasive plants and thus their invasiveness.

ID 125

Format Oral Presentation

Theme Vegetation dynamics and succession

Land-use modulates the influence of different diversity facets on ecosystem stability

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Ecosystem stability is essential for sustaining and supporting multiple ecosystem functions and services over time. Understanding its driving forces is thus a fundamental goal for biodiversity conservation and for the management of natural resources. Multiple biodiversity facets are expected to drive several biotic factors influencing stability. Whereas species richness has been traditionally considered as the main stability driver (see the “diversity begets stability” hypothesis), recent studies highlighted the importance of biotic mechanisms including i) expected compensatory dynamics occurring among ecologically different species in a community; ii) dominance of conservative strategies in a community (i.e., species displaying more conservative traits). So far, most of the literature attempting at clarifying the influence of these mechanisms on ecosystem stability relied on short time series (< 4 years) and/or focused on artificial grassland communities, leaving open the questions of whether current findings a) hold true for longer-times scales, b) are valid for natural communities and c) are consistent across different natural habitat types (e.g., forest understorey and grasslands). In this context, it also remains unclear whether and how the relationship between the above-mentioned biotic mechanisms and ecosystem stability is modulated by land-use. We tested the influence of a composite set of drivers belonging to three diversity facets (species richness, synchrony, functional and phylogenetic diversity, variability in the community weighted mean values of traits summarizing the acquisitive-conservative trade-off), on the stability (measured as the mean total cover of the community divided by its standard deviation in time) of 300 permanent vegetation plots. These plots, belonging to the extensive sampling scheme of the German Biodiversity Exploratories, include both grasslands and forest understoreys covering a gradient of land-use intensity, that were sampled annually for 12 years in three German regions. Our findings reveal that compensatory dynamics, prevalence of conservative strategies and species richness, together with functional and phylogenetic diversity, are important drivers of ecosystem stability. At the same time, their influence on ecosystem stability appears to be strongly dependent on land-use intensity, which is able to modulate these relationships or even reversing them. Observed results suggest that the information on species ecological strategies provides an important added value in the prediction of ecological stability, but that the prevailing land-use can dramatically alter potential biotic mechanisms underpinning ecosystem stability.

ID 157

Format Oral Presentation

Theme Macroecology of vegetation

Determinants of biogeographical distribution of grasses in grasslands of South America

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Grasslands in southeastern South America (SESA grasslands) are one of the most extensive grassland regions in South America. The climate in this region presents a wide range of mean annual temperature (13 °C to 20 °C) and annual precipitation (777 mm to 2027 mm). The region is characterized by the coexistence of C3 and C4 grasses, with changes in their proportion along the latitudinal gradient. We aimed to understand compositional and evolutionary patterns of grass communities, as well as the distribution of grass functional types along 666 sites located in latitudinal gradient ranging from 26 °S to 38 °S in SESA grasslands (Argentina, Brazil and Uruguay). We explored the latitudinal pattern of grasses functional types and investigated which environmental and historical variables are driving the proportions of C4 and C3 grasses and the contribution of each subfamily of *Poaceae* along gradients. We found 266 species distributed in six subfamilies and 73 genera. *Pooideae* (C3 exclusively) and *Panicoideae* (both C3 and C4 species) are the dominant subfamilies (207 species). We found a correlation with latitude, with an increase of C3 species' proportion towards the south ($R^2 = 0.51$, $p < 0.001$). The generalized linear model revealed that annual mean temperature, historical temperature stability and soil variables (clay content and fertility) were the most important drivers of C3 grass species' proportion ($R^2 = 0.46$, $p < 0.001$). C3 species are more likely to occur in colder areas with higher historical temperature stability, reflecting lineages have specialized and radiated in cold environments. Climatically stable areas are the coldest, while unstable areas include hotter habitats, which enabled colonization by C4 species. Regarding soil conditions, C3 grasses are more likely to occur in more fertile soils and with a low capacity to retain water. Compositional changes along the latitudinal gradient were evaluated with principal component analysis (PCA). PCA axes were extracted and subsequently used in generalized linear models. We focused on Axis 2, which was represented by *Pooideae* and *Panicoideae*. A visible separation between subfamilies was driven by annual mean temperature, precipitation seasonality, historical temperature stability and soil variables ($R^2 = 0.52$, $p < 0.001$). Overall, *Pooideae* follows patterns of C3 distribution, dominating in colder, drier areas. Precipitation drives C4 lineages of *Panicoideae*, and high precipitation overlaps with the global peak in fire frequency. The distribution of grass clades across the SESA grasslands is indicative of the environmental gradients found in this region between temperate and tropical zones, describing a climate space where disturbance driven feedbacks play a major role in maintaining open vegetation. Our results contribute to the understanding of ecological heterogeneity in the region that up to now has been poorly described.

ID 94

Format Poster Presentation with lightening Talk

Theme Climate change

The vegetation dynamics of Dashueiku and Syue mountain areas in Taiwan under climate change

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Global ecological systems have encountered severe impacts under climate change, especially the sensitive alpine ecosystems. This study was a descendant of the previous alpine monitoring project initiated in 2008, which was based on the standard approach of GLobal Observation Research Initiative Alpine environments (GLORIA) funded by MAVA Foundation for Nature Conservation in 2000. The monitoring plots were established in fifteen alpine summits in Taiwan, and each monitoring cycle was every five to ten years. The monitoring task of each summit includes vegetation composition, habitat condition, and hourly soil temperature. Three monitoring cycles on six summit sites have been accomplished during the past eleven years in the Dashueiku Mountain and the Syue Mountain areas. This study used Enhanced Vegetation Index derived from the NASA Terra satellite and the temperature and precipitation data interpolated from European Centre for Medium-Range Weather Forecasts to analyze and predict the trends of vegetation productivity and climate change. This study also applied the occurrence data from GBIF and downscaling climate data from the CHELSA database to calculate the species climate niche, thermophilization indicator, and moistphilization indicator, then interpreted the potential influencing factors of species composition change. Regarding the effects of climate change, the temperature was gradually increased over the six summits and has a significantly increasing trend in fall and winter, while the precipitation has gradually decreased and accompanied with concentration temporally. The EVI values of the summit plots also have a trend of gradually increasing, especially in fall and winter, resulting in extending the growing season. The results of species composition showed the expansion of *Yushania niitakayamensis* in the plots and indirectly reflected the EVI values, which also has a negative effect on species numbers, biodiversity loss, and exclusion of other species. The climatic niche analysis results showed the thermophilization indicator did not increase significantly when the temperature increased, but the moistphilization indicator showed a decreasing trend significantly. Meanwhile, the climatic probability density diagrams revealed that most of the summit vegetation composition tends to have thermophilic and drought-resistant species. In addition to temperature increase affecting the vegetation composition of alpine summits, moisture and species competition would also play a key role, and long-term monitoring is necessary to understand how alpine vegetation affected by climate change. Key words: alpine vegetation, enhanced vegetation index (EVI), GLORIA, climate change, Taiwan

ID 142

Format Oral Presentation

Theme Special session: Community ecology belowground

Fire promotes carbon stock in belowground organs and fine root biomass on tropical old-growth grassland

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Although fire is associated with carbon emission, fire-prone ecosystems, such as tropical open savannas, store significant amounts of carbon primarily belowground. However, the influence of fire on belowground C stocks in open savannas is not yet clear. Our aim was to understand the effect of fire on belowground carbon stock in tropical fire-prone open ecosystems. To quantify belowground C stock, we measured plant biomass in the belowground compartments according to two fire frequencies (biennial fire, fire exclusion for > 10y) at two tropical old-growth grasslands (OGG) types: open savannas and campos rupestres. We sorted out belowground biomass as: (1) belowground organs, (2) coarse (>2mm), and (3) fine roots (<2 mm). We also estimated the proxy of carbon content on belowground biomass by multiplying total biomass values by 0.47 as suggested by literature for herbaceous vegetation. We found that in tropical open savannas, frequent fires led to higher belowground organs biomass and overall carbon stock compared to fire exclusion. There is no difference in belowground biomass and C stocks in campos rupestres according to fire history. At frequent fires, fine roots biomass increased by 51 % at open savannas, but no difference was found in campos rupestres. Coarse root biomass increased respectively by 69 % and 33 % at open savannas and campos rupestres, both at frequent fires. Fleshy and woody rhizomes were the belowground organs most abundant in both tropical open savannas and campos rupestres. At open savannas, fleshy rhizomes increased by 51% at frequent fires compared to fire exclusion, and there is no difference at campos rupestres according to fire history. Woody rhizomes biomass increased by 87 % in open savanna and by 98 % in campos rupestre both at frequent fires. Xylopodia also increased at both sites at frequent fire (99 % at open savanna and 25 % at campo rupestre). Woody gemmiferous roots and taproot tuber were associated with open savannas under fire exclusion, and both were not found in campos rupestres. Our results show that higher fire frequencies increased overall belowground biomass and carbon stock mainly at open savanna. Although we did not find significant effects of fire at campos rupestres, there is a tendency to decrease overall belowground biomass and carbon stock under fire exclusion. At campos rupestres, it may be that in that case, higher fire exclusion intervals will be necessary to notice significant differences between fire histories. Fire, by removing aboveground biomass, leads to belowground stable carbon, in the opposite way fire exclusion should lead towards lower belowground carbon input at both ecosystems.

ID 162

Format Oral Presentation

Theme Conservation and restoration

Species richness and phylogenetic distance control plant growth during early restoration of a riparian forest in a semi-arid environment

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Little attention has been paid to the effects of phylogenetic diversity on the success of restoration projects. Because the phylogenetic distances among plants can be considered as a surrogate for ecological differences, its consideration could alleviate plant competition at early stages and help improving restoration outcomes. This study investigates the effects of species richness and plant phylogenetic relatedness on the early restoration of a riparian forest between Atlantic Forest and semi-arid ecosystems in NE Brazil. The restoration experiment was established along a perennial stream in Monte Alegre, testing the effects of species richness and phylogenetic diversity on plant survival and growth. We used phylogenetic information on 47 tree species naturally occurring at the study site. The resulting phylogenetic tree had a basal node with three major clades. Three species from each clade were randomly selected, resulting in nine species (from five families) to implement the experiment. We defined five levels of diversity: (i) no planting, (ii) monoculture, (iii) three phylogenetically related species (same clade), (iv) three phylogenetically distant species (different clades), and (v) nine species. The experiment consisted of 96 (12 m x 10 m) plots established along the two margins of the stream. Overall, 1656 saplings (20–50 cm) were planted in September 2015 (184 per species). We tested the effects of species richness and of the calculated mean phylogenetic distance of each community on plant survival and growth. We assessed plant mortality and growth during two consecutive years (2016 and 2017). Survival was negatively affected but average height increased when plants occurred near the stream. Communities with higher species number and greater phylogenetic distance produced significantly taller plants along time. Diversity treatments did not influence plant survival, while initial size determined plant survival and growth. Our findings confirm that species and phylogenetic diversity allow plant communities to produce more biomass possibly due to the presence of functionally divergent species, thus complementarily using resources. Therefore, plant phylogenetic distance should be considered alongside to the number of species planted to increase the success of future restoration projects.

ID 183

Format Oral Presentation

Theme Invasive species

Sand dropseed (*Sporobolus cryptandrus*) – A new pest in Eurasian sand areas?

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For the effective control of an invasive species, gathering as much information as possible on its ecology, establishment and persistence in the subjected communities is of utmost importance. We aimed to review the current distribution and characteristics of *Sporobolus cryptandrus* (sand dropseed), an invasive C4 grass species of North American origin recently discovered in Hungary. We aimed to provide information on (i) its current distribution paying special attention to its invasion in Eurasia; (ii) the characteristics of the invaded habitats in Central Europe; (iii) seed bank formation and germination characteristics, crucial factors in early establishment; and (iv) the effects of its increasing cover on vegetation composition. Finally, we aimed to (v) point out further research directions that could enable us to understand the invasion success of this potential invasive species. Field surveys uncovered large stands of the species in Central and Eastern Hungary with most of the locations in the former, especially the Kiskunság region. The species invaded disturbed stands of dry and open sand grasslands, closed dune slack grasslands and it also penetrates into natural open sand grasslands from neighbouring disturbed habitats. Increasing cover of *Sporobolus cryptandrus* caused a decline in species richness and abundance of subordinate species both in the vegetation and seed banks, but a low density of *Sporobolus cryptandrus* can even have a weak positive effect on these characteristics. Viable seeds of *Sporobolus* were detected from all soil layers (2.5 cm layers measured from the surface to 10 cm in depth), which indicates that the species is able to form a persistent seed bank (1,114 to 3,077 seeds/m2 with increasing scores towards the higher abundance of the species in vegetation). Germination of *Sporobolus cryptandrus* was negatively affected by both litter cover and 1 cm deep soil burial. To sum up, *Sporobolus cryptandrus* can be considered as a transformer invasive species, whose spread forms a high risk for dry sand and steppe grasslands in Eurasia. We can conclude that for the effective suppression of the species it is necessary: (i) to clarify the origin of the detected populations; (ii) to assess its competitive ability including its potential allelopathic effects; (iii) to assess its seed bank formation potential in habitats with different abiotic conditions; and (iv) to assess the possibility of its suppression by natural enemies and management techniques such as mowing or livestock grazing.

ID 43

Format Oral Presentation

Theme Special session: The legacy of invasions

Direct and indirect interactions promote the accumulation of nonnative plants after invasive species removal

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Multiple nonnative species co-occur in most ecosystems, and understanding their interaction can be fundamental to explain nonnative invasion success and guide management strategies. Co-occurring invaders can facilitate each other leading to the accumulation of nonnative species in communities or they can compete with each other hindering further invasions. Interactions among nonnatives can be highly dynamic as their strength and even sign is affected by the environmental context in which they occur. In this context, the experimental removal of invasive species can be an important tool to help quantify the sign and strength of nonnative interactions while providing insights into the reassembly of multiple-invaded communities. To quantify nonnative interactions and their consequences on community assembly, we evaluated the community reassembly after selective removals of two highly invasive plant species, the sweetbriar rose (*Rosa rubiginosa*) and the scotch broom (*Cytisus scoparius*) (both target species), at two different times – early and late removal - in field communities in Isla Victoria, Patagonia, Argentina. Target species showed negative asymmetric interactions that were dependent on the temporal context. While the scotch broom benefited from the sweetbriar rose's early removal, the performance of the sweetbriar rose was independent of the abundance of the scotch broom. Removal of both target species resulted in communities with a higher abundance of nonnative species. Rose removal negatively affected native species, likely mediated by the release of the broom from competition. This suggests an indirect interaction between the rose and native species. In contrast, removal of the broom had a direct positive effect on nonnatives, which increased their representation in the community, an effect that was stronger during early removals. Overall, our results suggest that both direct and indirect interactions among plant species underlie multiple-invaded reassembly trajectories either by hindering native species performance or by specifically promoting nonnative species. Understanding the nonnative interaction network and its temporal dynamics can be an important tool to design management strategies aimed at reducing the accumulation of nonnative species.

ID 93

Format Poster Presentation with lightening Talk

Theme Species composition and diversity

Do subtropical montane cloud forests in Taiwan act as insular systems for woody species?

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Frequent fog immersion results in a lower temperature and solar radiation, higher air and soil humidity, as well as obvious nutrient limitation of subtropical montane cloud forest (SMCF). This makes SMCF different from surrounding habitats, such as submontane evergreen broadleaved forests or upper-montane coniferous forests. Several studies focused on fragmentation and conservation of montane cloud forests in tropical regions, while studies aimed to understand their insularity are lacking. Here, we aim to explore whether SMCF acts as an insular terrestrial habitat system. As a case study we used SMCF distributed in Taiwan (1500–2500 m a.s.l.), which has been shown to be highly fragmented into isolated patches of various areas. Previous studies focusing on terrestrial habitat islands applied the theory of island biogeography to test whether they behave as true (marine) islands. Theory predicts that the number of species at the island positively relates to its area and negatively to its isolation. In the case of habitat islands, this applies only to species specialized to given habitat and not to generalists that are not affected by habitat differences. Since it is often not feasible to survey the species richness of the whole habitat island (a fragment of SMCF in our case), but the prediction of the theory is related to the species richness of the whole island, we additionally assume a positive link between richness of the entire island and the fixed surveyed area of a vegetation plot. To investigate whether the richness of woody species in SMCF is related to the fragment area, we used the National Vegetation Database of Taiwan (AS-TW-001) to calculate the species richness of each vegetation plot (20 m × 20 m), and the distribution map of SMCF in Taiwan to estimate the area of SMCF around this plot (using circular buffer zones with a fixed radius of 3 km). We also identified which woody species are cloud forest specialists. Results showed a significant positive relationship between the species richness of cloud specialists in the plot and the proportion of the surrounding SMCF area around each plot, indicating that SMCF may act as an insular system. Surprisingly, the relationship became significantly negative if all species were considered, including habitat generalists. This may be due to smaller islands having a higher chance to gain species through dispersal from the neighboring areas since a larger proportion of other habitats surrounds them. In conclusion, our results are in line with our assumption that the SMCF in Taiwan behaves as an insular system. This is important from a theoretical perspective (making SMCF a suitable system to study the effect of fragmentation) and also a practical perspective (e.g., for suggesting sustainable conservation strategies in the context of ongoing climate change likely further increasing its fragmentation). We plan to do more investigations on other island properties of SMCF.

ID 83

Format Poster Presentation with lightening Talk

Theme Vegetation inventory and mapping

Using satellite data to detect changes in habitat extent

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Ipoly is one of the last rivers in Hungary, which is less affected by water management. The survey presents habitat maps of Ipoly Valley floodplains of two different years in 2020 and 2021 by satellite imageries. Habitat maps were compared in different years thus they were researched in drier (2020) and wetter (2021) periods. ÁNÉR category system was used as a control by field sampling using hand-held GPS equipment. Satellite data and precipitation data makes it possible to measure the interpretation of maps. The aim of the study was to find an answer to the question of how can we isolate habitats most easily in the studied periods. The categories were compared with the satellite images of Sentinel-2A to look for possible correlations. Different vegetation and water indexes were generated for quantitative evaluation and monitoring of the current state of the vegetation. The results show that some habitat categories can be significantly distinguished using the satellite data, especially in urban versus natural areas and the dry grasslands. Keywords: Habitat maps, Vegetation indexes, Climate change

ID 147

Format Oral Presentation

Theme Vegetation dynamics and succession

Regeneration in uneven-aged spruce-fir-beech forests in the French Alps relative to global changes

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INRAE, Grenoble[1]; INRAE, Clermont-Ferrand[2]

In this symposium, we report the results of environmental factors affecting regeneration densities and growths of *Picea abies, Abies alba* and *Fagus sylvatica* in the French Alps and Jura mountains, and explore the role of ungulate browsing in regeneration of the three species. Global environmental changes play an important role in determining forest structures, regeneration, and thus future forest composition. The immediate, as well as possible long-term effects of these changes on forest regeneration, are little studied. In this study, we attempted to understand the effects of environmental factors on regeneration densities and growths of *Picea abies, Abies alba* and *Fagus sylvatica* in the French Alps and Jura mountains, and explore the role of ungulate browsing in regeneration of the three species. We recorded sapling height increment and density of *Picea abies, Abies alba* and *Fagus sylvatica* in 152 plots across the French Alps and Jura mountains, and compared them across biotic and abiotic factors known to affect regeneration, namely altitude, slope, aspect, light availability, soil characteristics, temperature, precipitation and ungulate browsing, by non-linear mixed models. All results are consistent with a negative impact of ongoing water shortages on sapling growth and density. An increase of ungulate populations leading to increased browsing could be especially detrimental to fir saplings. This study, one of the first in our knowledge to be reporting these combined issues at such a large scale, provides important insights regarding the vulnerability of forest regeneration to water availability and ungulate presence to researchers, as well as gives valuable perception to forest managers about adapting and improving forest management strategies to mitigate these adverse effects.

ID 23

Format Oral Presentation

Theme Species composition and diversity

Effects of habitat type and city size on the diversity of urban vegetation in Kazakhstan

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Masaryk University[1]; University of Alberta[2]

Plant species diversity strongly depends on habitat attributes. In urban settings, habitats are frequently disturbed and often modified in their species composition. While they usually contain few indigenous species known from natural areas, they have a high percentage of alien and apophyte species, with the latter encompassing native species that prefer sites with human disturbance. In contrast to European or North American urban areas, no empirical studies from Central and North Asia have quantified plant diversity comparing different habitat types across cities. Our study aims to fill this gap by studying the effects of habitat type, city size and macroclimate on species richness and composition of urban habitats in the dry steppe and forested steppe zone of central and north-eastern Kazakhstan. Based on standardized sampling protocols, we recorded species composition of spontaneously occurring vascular plants in 1-ha plots in seven habitat types (central square, boulevard, residential area, park, early successional vacant site, mid-successional vacant site and railway station site) in 10 large (> 100,000 inhabitants) and small (< 100,000 inhabitants) cities. All recorded species were classified according to their status as alien, apophytes and indigenous. Average species richness per plot within each habitat type was used to quantify plant diversity. We analysed the effects of habitat type and city size on species composition using ordination methods. Differences in species composition among urban habitats were described by statistically determined diagnostic species. Additionally, we considered macroclimatic parameters as explanatory variables of species composition. According to our results, plant richness differed significantly among urban habitat types, with lowest values found in city squares, and highest at railway stations, successional sites and in residential areas. Species rich plots harboured large numbers of apophyte and alien plants. Most of the variation in alien, apophyte and indigenous species richness was found at the habitat level (85.3 %, 70.6 %, 66.5 % of variation, respectively) rather than at the city level (14.7 %, 29.4 %, 33.5 %). Ordinations strongly contrasted species composition of disturbed sites in city centres (squares and boulevards) against early successional, mid-successional and railway station sites. Similarly, large and small cities clearly differed in plant species composition. We detected the alien species *Amaranthus retroflexus* and *Portulaca oleracea* as diagnostic species for residential areas, and *Cyclachaena xanthiifolia* for mid-successional sites. Railway sites hosted the largest number of diagnostic species, including the characteristic indigenous species *Corispermum orientale* and *Gypsophila paniculata*, the apophytes *Artemisia absinthium* and *Sedobassia sedoides* typical for early-successional sites, and the alien *Ambrosia artemisiifolia*. Macroclimatic parameters did not affect urban plant diversity.

ID 111

Format Oral Presentation

Theme Special session: Progress in plant ecology and vegetation science research in Africa

Revisiting Protea Atlas Project plots in the Agulhas Plain, South Africa: Has invasions changed things?

van der Colff, Dewidine*[1]; Foden, Wendy; Kumschick, Sabrina; Rebelo, Tony; Wilson, John R. U.

SANBI, South Africa[1]

Invasive alien plant (IAP) species have many impacts on native species and in the communities they invade. In some cases, support has been found for both positive and negative impacts of these species. How these impacts change overtime and the factors influencing these changes will be investigated here. We are examining the type of data collected and how useful this data can be to monitor invasive alien species impacts. The Protea Atlas Project database will be used as a baseline and sampled plots will be re-visited. *Proteaceae* species and woody invasive species presence (richness), estimated abundance, dispersion, and height will be recorded and compared to previous collections. Environmental factors such as veld fire age, vegetation type, altitude, type of site (private vs protected area), alien clearing activity, presence of biological control agents, and evidence of cut flower collections will be recorded. These variables will be used to identify whether changes observed in the native species are related to natural processes, other disturbances or whether it was influenced by the presence and abundances of IAP species. The data will be analysed using mixed generalized linear models, with plots and dates as random effects as well as analysis of transitions between plots. We expect that areas that were heavily invaded in the past will be in a similar or worse condition, where there has been no other disturbances or interventions e.g., fire, alien clearing activities, or the use of biological control agents. In these sites, we expect IAP species abundance to remain unchanged or increase, while the native species would decrease. These invaded sites might be dominated by the identified IAP species and potential secondary invasions could have taken place. Further, sites that had low or no IAP species present, might have an increase or new introductions of IAP species if no other interventions have taken place. While the change in native *Proteaceae* species in uninvaded sites is expected to be strongly linked to time since last fire. Native species are expected to decrease in their abundance and richness depending on the type and abundance of invasive alien species if other disturbances have been accounted for. Here we present the preliminary findings as well as discuss some of the complications of revisiting historical sites and attempting to collect similar data.

ID 35

Format Oral Presentation

Theme Theory and methods in vegetation science

Tree abundance patterns in the light of the Law of the Minimum

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Describing the effect of environmental gradients on tree abundance and distribution is a central theme in vegetation ecology. Species' numbers vary significantly across their range of distribution, reflecting populations' response to limiting conditions. The abundance-environment relationships often show polygonal patterns characterized by a point cloud scattered from zero to a maximum abundance limit. The upper limits of this point cloud reflect the limiting effect imposed by the environmental gradient under study. We propose a new approach to the study of these limiting relationships based on Liebig's Law of the Minimum, which predicts that species' abundance at a specific point in time and space does not depend on multiple environmental factors but on the most limiting factor. We analyze abundance-climate relationships in 98 tree species in continental US, and find that patterns compatible with the Law of the Minimum are widespread among species. We also explore the role of recruitment and mortality as the mechanisms underlying these abundance patterns and find that they respond to the expectancies made by the Law of the Minimum. Finally, we apply quantile regressions to estimate the limitation imposed by temperature and precipitation on the maximum abundance of the studied species, and use these models to predict shifts on species distributions under future climate change scenarios. We find that the restrictions imposed by climate will modify the maximum abundance that species can reach at each location, which will potentially shift species abundance patterns and drive relevant changes on future communities' composition. Our results highlight the interest of the Law of the Minimum in vegetation ecology, and open new perspectives to study limiting relationships in the context of global climate change.

ID 37

Format Oral Presentation

Theme Invasive species

Patterns and drivers of non-native plant invasions in northern prairie grasslands

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Native prairie grasslands are a fundamental part of Canada's natural heritage, but these formerly extensive ecosystems have undergone declines due to grassland conversion and fragmentation. In addition, remaining native grasslands are threatened by invasive non-native plants, which can outcompete native flora and negatively impact ecological functioning. Although several studies have reported invasions in northern prairie grasslands, only some have investigated overall patterns across a large gradient, and few have tested their relationship with environmental predictors and anthropogenic disturbance. We surveyed 140 plots across a southeast to northwest 700km latitudinal gradient in prairie grasslands of Alberta in order to (1) identify the most frequent and abundant non-native species, (2) test whether levels of non-native plant invasions are linked to environmental factors or anthropogenic disturbance, and (3) inspect whether these relationships exist across all grasslands or differ between mesic and semi-arid grasslands. Data were analyzed using generalized additive models and commonality coefficient analysis. Our results show that Kentucky bluegrass (*Poa pratensis* subsp. *angustifolia*), introduced from Eurasia, is by far the most frequent and abundant non-native plant in Alberta prairie grasslands. Across all plots, abundance and richness of non-native plants were positively linked to a shared effect by aridity, soil texture, and agricultural activity with mesic loamy grasslands having the highest levels of invasion. Furthermore, the importance of predictors differed between mesic and semi-arid grasslands. In mesic grasslands, non-native plant abundance and richness was highest in areas with high agricultural activity and fine-textured soils. By contrast, topography explained most variation in the levels of invasion in the semi-arid prairie. In summary, our results suggest that climatic conditions, and to some extent agricultural activity and topography, best explain the patterns of non-native plants in Alberta grasslands. Future avenues for native grassland research need to tease out the factors that drive the differences in levels of invasion across mesic and semi-arid prairie grasslands.

ID 61

Format Poster Presentation with lightening Talk

Theme Disturbance ecology

Cumulative vegetation impacts of a gravel road and climate change in an ice-wedge polygon landscape, Prudhoe Bay, Alaska

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Environmental impact assessments for new Arctic infrastructure in areas with ice-rich permafrost do not adequately consider the likely long-term cumulative effects of climate change and the indirect impacts of proposed infrastructure to terrain and vegetation. This is due in part to the scarcity of historical case studies that document changes after the infrastructure was built. Here, we present a vegetation analysis that supports a case study that examined the long-term changes in a network of low-centered ice-wedge polygons along a heavily traveled road, in the Prudhoe Bay Oilfield (PBO), AK. The goals of the vegetation analysis were: (1) Map and compare the present-day distribution of the vegetation at the Colleen site to that which existed shortly after construction of the Spine Road in 1969. (2) Compare the present-day structure and species composition of the dominant vegetation types at the Colleen site to that in comparable vegetation types sampled during the 1970s using plot data. (3) Analyse the impacts of the road and responses of key site factors along transects perpendicular to the road at the Colleen site. (4) Compare a road impacted site with a site that was comparably affected by climate change but relatively unaffected by road-related impacts. We present a short review of baseline data collected in the 1970s, followed by the methods and primary results used of the vegetation mapping, vegetation-plot and transect analyses. We examined four trajectories of change that involved increasing levels of impacts due to climate change and infrastructure between 1949 and 2020. Climate-related impacts included changes to shrub abundance and factors related to increased numbers of thermokarst ponds, including changes to thaw depths, ice-wedge-polygon morphology, and dominant vegetation types. Road-related impacts included reduced species richness due to dust and altered productivity due to flooding that are overlaid on the climate-driven impacts. We conclude with recommendations for future environmental assessments for infrastructure in areas with ice-rich permafrost. The combined datasets provide unique insights into the rate and extent of ecological disturbances associated with infrastructure affected permafrost landscapes under decades of climate warming.

ID 115

Format Oral Presentation

Theme Climate change

Where does the water come from? Quantifying water-uptake depths of plants in changing grasslands.

Weides, Sophie*[1]; Hájek, Tomáš[1]; Herberich, Maximiliane[1]; Liancourt, Pierre[2]; Kramp, Rosa[3]; Tielbörger, Katja[1]; Májeková, Maria[2]

University of Tübingen[1]; Institute of Botany, Czech Academy of Science[2]; Institute of Botany, BOKU Vienna[3]

Quantifying from which depths plants take up water, i.e., the belowground water partitioning, could be key to understand how species coexist under stressful hydrological conditions. A crucial response could be a re-allocation of roots to greater depth or a dynamic rooting system. However, physically recovering roots from soil in the field and investigating water uptake is a difficult - if not impossible - task and studies are generally scarce. Still, this would be especially important to know under the current scenarios of climate change, where drought intensity is predicted to increase. Here, we present an indirect method to explicitly quantify from which depths plants take up water by using stable isotopes. Specifically, a prolonged dry period causes the upper soil layers to become enriched in water containing heavier isotopes of hydrogen and oxygen, 2H and 18O, because water containing the common lighter ones, H and 16O, evaporates more easily. This fractionation process results in a vertical gradient of isotopic signature in the soil profile. Since there is no further fractionation occurring in the plant after water is taken in the roots and the root crown, water obtained from these tissues will match the isotopic signature of soil water from the depth the plants took it up. Here, we used the stable isotope approach to quantify plant's water-uptake depths under ambient conditions and under experimentally imposed extreme drought conditions in eight dominant herbaceous species from temperate mesic grasslands. We sampled the four grass species *Dactylis glomerata* agg., *Festuca rubra* agg., *Lolium perenne* and *Arrhenatherum elatius* and the four forb species *Taraxacum* sect. *Ruderalia*, *Plantago lanceolata*, *Galium mollugo* agg. and *Ranunculus acris*. Our aim was to (1) determine from which depths co-occurring species take their water up in ambient conditions, and (2) whether the water-uptake depths are altered under four-years long extreme drought conditions. In this study, we were showed that there is a significant difference between water uptake depth between our eight species under ambient conditions. While some of them relied on the upper five centimeters of the soil, some took the water froma maximum depth of about 15 cm. The responses to the drought treatment were mixed. In one of our sites the deeper-rooted plants switched their water uptake depth under drought conditions to significantly shallower soil layers while the plants that were in those layers under normal conditions stayed there. In this site there are no difference between the water uptake depth between the species under drought conditions. In our other site the species also shift slightly to shallower soil layers under drought conditions, but the differences between the species mainly remain. Thus, we conclude that there is a reallocation of roots under drought conditions, probably to make use of the surface water after small rain pulses.

ID 39

Format Oral Presentation

Theme Vegetation inventory and mapping

Spatial depiction of vegetation types in a species-rich oceanic temperate forest: a repeatable approach for regional vegetation classification and mapping

Wiser, Susan*[1]; McCarthy, James[1]; Bellingham, Peter[1]; Jolly, Ben[1]; Shepherd, James[1]; Meiforth, Jane[1]

Manaaki Whenua -- Landcare Research[1]

There is an ongoing need for consistent approaches to vegetation classification and mapping at regional and local scales. Concurrently, the availability of increasingly detailed remotely sensed data enhances our ability to extrapolate vegetation patterns quantified from ground-based plot data across the landscape. We introduce a repeatable approach to extend and map vegetation classifications using Warawara forest, New Zealand as a case study. We ask 1) Can a national vegetation classification be extended to depict variation in vegetation composition at the regional scale? 2) Does including remotely sensed parameters improve the ability to delineate vegetation types over use of environmental predictors alone; 3) Are Lidar-generated canopy structure parameters more useful for distinguishing vegetation types than spectral imagery? 4) Does accounting for the fuzzy nature of vegetation types increase map accuracy over mapping discrete vegetation types? Using the semi-supervised classification approach of fuzzy noise clustering, we assigned 45 of 205 vegetation plots to six of 79 national woody vegetation associations. 147 plots were used to define two new forest associations. The residual 13 plots were designated as outliers. Boosted regression tree models were developed for each association using i) the defuzzied membership (a plot belongs to one association only, i.e., a ‘crisp’ classification); and ii) the fuzzy membership value for that association calculated for each of the 205 plots as the response variable in the model. Because of low plot numbers all shrubland associations were combined for modelling. Predictor variables included 12 describing environment and human influence, 11 canopy reflectance variables from a Sentinel-2 time series and 16 canopy structure variables derived from airborne Lidar. Including remotely sensed variables markedly improved predictions, and for four of the five models reflectance variables were more informative than canopy structure variables. We used two approaches to create a composite map. First, we assigned each location on the map to the association with the highest probability of occurrence across the individual boosted regression tree models. This produced mapped units with discrete boundaries as in traditional vegetation maps. Second, we employed fuzzy visualization to retain the predicted occurrence probabilities for all modeled vegetation types. We evaluated these maps using traditional and fuzzy confusion matrices. We found the combination of a crisp classification and discrete mapped classes resulted in the highest overall accuracy and kappa statistics for the map and the highest producer and user accuracies for the individual associations. In answering our questions, we present a vegetation classification and map for Warawara forest and a repeatable approach for extending and mapping classifications that can be applied elsewhere in the world.

ID 15

Format Oral Presentation

Theme Theory and methods in vegetation science

Fifteen emerging challenges and opportunities for vegetation science - A horizon scan

Yannelli, Florencia*[1]; Andrade, Bianca[2]; Agbolade Anibaba, Quadr[3]i; Bazzichetto, Manuele[4]; Bonari, Gianmaria[5]; Chelli, Stefano[6]; Conradi, Timo[7]; Ćuk, Mirjana[8]; Damasceno, Gabriella[9]; Fantinato, Edy[10]; Geange, Sonya[11]; Guuroh, Reginald Tang[12]; Musa Holle, Mukhlish Jamal[13]; Küzmič, Filip[14]; Lembrechts, Jonas[15]; Mosyaftiani, Amarizni[16]; Pattison, Zarah[17]; Šikuljak, Tijana[18]; Teixeira, Juliana[19]; Tordoni, Enrico[20]; Pérez-Valladares, Cloe Xochitl[21]; Sperandii, Marta Gaia[22]

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Ecosystems are rapidly changing in response to climate change and other anthropogenic drivers. Vegetation science as a field needs to address the urgency of studying the impacts of these global changes on vegetation patterns and processes. Aiming to identify challenges and opportunities in vegetation science for the next decades, we brought together a group of 22 early-career vegetation scientists from diverse backgrounds. To this end, we performed a horizon scan that resulted in the identification of 24 topics. Here, in this presentation we will showcase a selection of the 15 topics that were ranked by participants as the most emergent and impactful for vegetation science. Among them, we highlight methodological tools such as next generation sequencing, plant spectral imaging, process-based range models, as well as resurveying studies and permanent plots, which we expect will play a critical role in tackling emerging issues by providing ways to unveil new aspects of plant dynamics and community structure. Further, we also highlight the need to integrate long-term monitoring, the study of novel ecosystems, below-ground traits, pollination interactions, and global networks of near-surface microclimate data at fine spatiotemporal resolutions to fully

understand and predict the impacts of climate change on vegetation dynamics. This Horizon scan emphasizes the need to integrate traditional forms of knowledge and a diversity of stakeholders into research, teaching, management, and policy making to advance the field of vegetation science.

ID 74

Format Oral Presentation

Theme Special session: The legacy of invasions

Out of sight out of mind? Soil legacy effects of *Acacia* invasions and their implications for restoration in South Africa's Cape Floristic Region

Yannelli, Florencia*[1]; Keet, Jan-Hendrik[2]; Le Roux, Johannes J. [3]

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Invasive Australian acacias pose a major threat to the species-rich fynbos vegetation of the Cape Floristic Region (CFR) of South Africa. In these highly diverse ecosystems, the belowground soil microbial community is closely linked to aboveground plant community diversity and structure. Therefore, when invasive acacias become dominant in these habitats, they change the composition of plant communities as well as their associated soil microbial communities. Such alterations could lead to plant-soil feedbacks favoring the persistence of acacias, which are likely to persist even after the removal of the *Acacia* plants (so-called legacy effects) and can hinder the recovery of native plant communities. Here we evaluate the impact that invasive acacias have on soil physico-chemical properties and soil microbial communities in the CFR. We seek to disentangle the legacy effects of *Acacia* invasions on the recovery of native vegetation following clearing, by comparing neighboring areas where pristine fynbos, *Acacia saligna*-invaded, and previously-cleared sites were present. We conducted vegetation surveys, sampled soil chemical composition and overall soil bacterial communities. In all areas, we also collected leaves from the widespread native species *Phylica cephalantha* and invasive *A. saligna* to analyze the impact of nitrogen fixed from the atmosphere by the latter on native and invasive species. We found invasive Australian acacias to lower the diversity and the structure of the above-ground plant communities, soil bacteria, and some soil chemical conditions, but these alterations were site specific. Our results showed that the impact of acacia-driven nitrogen fixation can often persist in native and invasive species, even after sites have been cleared. Furthermore, even when acacias are removed from the system, our field study shows that legacy effects of litter and colonisation by secondary invaders can hinder full recovery of native vegetation.

ID 64

Format Poster Presentation

Theme Conservation and restoration

Carbon sequestered by native restoration plantings, southern Port Hills and Quail Island, Canterbury, New Zealand

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Local and national level carbon zero targets and emissions reduction plans involve carbon sequestration from new plantings. To plan accordingly in the reintroduction of trees within our landscapes, supporting evidence of the carbon rates sequestered by our existing plantings is essential. As the debate in New Zealand arises between planting non-natives versus native species we come to realize not enough studies are being carried out within our native restoration plantings. These plantings have been done by the community and local authority groups with different management and planting strategies and where carbon is being sequestered. Quail Island and the southern Port Hills are emblematic areas of Canterbury that possess a growing interest in their expansion and enhancement with more native tree's product of carbon offsets to local emissions. They not only possess the distinctive opportunity to acquire more plantings but to tell us how well our previous restoration efforts have sequestered carbon. With several restoration planting sites 25 plots were measured using a randomized sample plot system to quantify the biomass volume and carbon providing a representation of current carbon volumes and future expectations. Having a total carbon amount for the species diversity present in this area will allow quantifying how much carbon new plantings can be expected to sequester in the first years since planted. Different allometric equations based on shrubs and mature trees were used to interpret the carbon outcomes and look for any relationships between species assemblage, the use of different equations, site elevation, aspect and the rates *Podocarpus totara* can bring to the picture as the most present and successfully established canopy emergent specie in the area. The results from this research will help the planning of our restoration programs by supporting with current evidence the outcomes of young second-growth forests (15-60-year-old plantings) for our carbon sequestration goals.

ID 154

Format Oral Presentation

Theme Conservation and restoration

Do Sacred Natural Sites conserve biodiversity on a national scale? Insights from Italy

Zannini, Piero*[1]; Frascaroli, Fabrizio[2]; Nascimbene, Juri[1]; Di Musciano, Michele[3]; Guarino, Riccardo[4]; Landi, Sara[5]; Pezzi, Giovanna[1]; Buldrini, Fabrizio[1]; Chiarucci, Alessandro[1]

Alma Mater Studiorum - University of Bologna[1]; Lòm Research[2]; University of L'Aquila[3]; University of Palermo[4]; GREENARCO, Spin-Off Company of the Alma Mater Studiorum - University of Bologna[5]

Erosion of biodiversity is increasing at an unprecedented rate, as Earth's biota has entered its sixth mass extinction. Bold targets, calling for the protection of half Earth, are being set to address the current biodiversity crisis. However, the foundation of new large Protected Areas (PA) is often socioeconomically and logistically problematic, or even unrealistic. In this scenario, small PA and other area-based conservation measures can complement large PA, while enhancing the spatial coherence and connectivity of the PA network. Among these, Sacred Natural Sites (SNS) may offer promising opportunities for conservation, but studies on their effective role across Europe are still scanty. We sampled plant assemblages at 30 SNS across Italy and related control areas (Reference Sites, hereafter RS) and compared them in terms of community rarity, exclusive species, alpha, beta and gamma diversity. The dataset comprised 243 plots belonging to four macrohabitats, 6510 occurrences and 1094 taxa. While alpha diversity of SNS and RS were similar, we found that SNS host more rare communities, locally-exclusive species, and higher beta and gamma diversity. However, results were significant only for woodlands and annual crops. The observed patterns are likely due to traditional management practices, social taboos and unique natural features of SNS such as springs and cliffs, calling for legal recognition of SNS for conservation, through innovative policies. Finally, the differences across macrohabitats suggest that conservation measures should be habitat-specific.

ID 70

Format Oral Presentation

Theme Functional traits

Extending the community-weighted mean approach to intraspecific trait variation: how to deal with overly optimistic standard parametric tests?

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Community weighted means (CWMs) are widely used to study the relationship between community-level functional traits and environmental variation. However, when relationships between CWM traits and environmental variables are directly assessed using linear regression or ANOVA and tested by standard parametric tests, results are prone to inflated Type I error rates, thus producing overly optimistic results. Previous research has found that this problem can be solved by permutation tests (i.e., the max test). A recent extension of this CWM approach, which allows the inclusion of intraspecific trait variation (ITV) by partitioning information in fixed, site-specific and intraspecific CWMs, has proven popular. However, this raises the question whether the same kind of Type I error rate inflation also exists for site-specific CWM or intraspecific CWM-environment relationships. Using simulated community datasets and a real-world dataset from a subtropical montane cloud forest in Taiwan, we show that site-specific CWM-environment relationships also suffer from Type I error rate inflation, and that the severity of this inflation is negatively related to the relative ITV magnitude. In contrast, for intraspecific CWM-environment relationships, standard parametric tests have the correct Type I error rate, while being somewhat conservative, with reduced statistical power. We introduce an ITV-extended version of the max test for the ITV-extended CWM approach, which can solve the inflation problem for site-specific CWM-environment relationships, and which, without considering ITV, becomes equivalent to the “original” max test used for the CWM approach. On both simulated and real-world data, we show that this new ITV-extended max test works well across the full possible magnitude of ITV. We also provide guidelines and R codes for each needed max test solution for each CWM type and situation. Finally, we suggest recommendations on how to handle the results of previously published studies using the CWM approach without controlling for Type I error rate inflation.

ID 124

Format Virtual Excursion

Theme Virtual Excursion

Lalashan Forest Dynamics Plot: an example of subtropical montane cloud forest in Taiwan

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Subtropical montane cloud forest (SMCF) represents a unique vegetation type with limited distribution in subtropical regions of mountainous areas across the world. In Taiwan, SMCF is distributed mainly in the northern and central part of the island, at elevations between 1500 and 2500 m a.s.l., being replaced by tropical montane cloud forest in the southern part of the island. SMCF in Taiwan is dominated by evergreen broadleaf woody species, with frequent large coniferous trees (e.g., *Chamaecyparis, Taiwania* and *Tsuga*) and an admixture of deciduous species (including relict *Fagus hayatae*). Trees are often covered by abundant epiphytes, mostly ferns and lycophytes, which also dominate forest understory. Frequent fog occurrence results in a peculiar combination of environmental conditions, including lower temperature, reduced solar radiation, higher air humidity and waterlogged soils. These, together with pronounced nutrient limitation, create a unique habitat inviting for deeper ecological understanding. In this Virtual Excursion, we wish to introduce you to our one-hectare Lalashan Forest Dynamics Plot (24°42' N, 121°26' E, elevation 1758-1782 m a.s.l.), established in 2019 at a wide ridge between Lalashan and Tamanshan mountains, inside the Chatianshan Nature Reserve in the northern part of Taiwan. Our forest dynamics plot represents a typical example of *Chamaecyparis* montane mixed cloud forest. Due to its location on the ridge exposed to chronic winds caused by northeastern monsoons, the plot also includes a strong windward-leeward gradient. Within the plot, separated into a grid of 100 10 m × 10 m subplots, we conducted a standard survey of woody species, following the ForestGEO Forest Census Protocol (recording, tagging and mapping all woody individuals, DBH ≥ 1 cm). In addition to woody species, we also surveyed understory (herbs, seedlings of woody species, and lianas), in the permanently delineated 2 m × 2 m quadrats in the centre of each 10 m x 10 m subplot. Data collected within the plot allowed us to prepare a detailed and fine-scale vegetation description of woody and herb species composition. For environmental factors, we collected detailed topographical and soil measurements, including the teabag decomposition experiment. We also set up a completely equipped microclimatic station (100 m from the plot in the open saddle), including also the visibility sensor to estimate the fog frequency. We also focused on leaf functional traits of broadleaf species and studied how is their inter- and intraspecific trait variation related to the effect of chronic wind and heterogeneous topographical and soil conditions. An important aim of our permanent plot is long term vegetation monitoring by repeated resurveys (every five years). Availability of detailed and long-term microclimatic data will allow us to link compositional changes of woody and herb species to climatic trends in a near future.

ID 121

Format Oral Presentation

Theme Macroecology of vegetation

Biodiversity across elevation and latitude in subtropical and tropical forests of China

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China's subtropical and tropical forests account for over 25 % of the total land area, and support for over one third of China's vascular plant species and high levels of endemism. In this talk, I will introduce a regional research network BEST (Biodiversity along Elevational gradients: Shifts and Transitions; https://best-mountains.org). The BEST was initialed in 2017, and is monitoring long-term biodiversity dynamics of multiple taxa (e.g., vascular plants, mosses, soil microbes, and birds) under climate change and land uses. By collaborating with over 15 research teams, we have set up 11 elevational transects in subtropical and tropical forest region of China. I will give a short introduction about this network, and present some preliminary results based on the data of multiple taxa we collected in last four years.

ID 103

Format Oral Presentation

Theme Vegetation dynamics and succession

Capturing vegetation dynamics since 1973: Repeated resurveys reveal shifts in pasture vegetation in the Western Tien-Shan Mountains

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Historically, the heterogeneous vegetation types of mountain pastures in Central Asia were well documented, but resurvey studies investigating vegetation changes potentially driven by long-term grazing and climatic changes are sparse. Despite the many studies focusing on current pasture degradation assessments, understanding how mountain pasture vegetation changes in response to grazing with different management regimes and ongoing climate warming are needed. Using a diachronic approach, we explored the recent trends in six mountain vegetation types in response to management and climate warming in the Western Tien-Shan Mountains, a region with a heterogeneous landscape and a long tradition of pastoralism. We examined the vegetation cover changes in transitional states recorded between 1973 and 1987 categorized as with no changes, or being in transition to invaded states and/or encroached by shrubs, with new relevés annually resurveyed in 2008-2019 on the same plots. We considered species identity, relative abundance cover, functional diversity, management traits, and the ecological characteristics of the plant communities derived from ecological indicator values as well as the life strategies of the species as well as indicators of degradation and environmental changes. We found that changes in composition accelerated over time; the data records during 2008-2019 showed that changes are much faster than estimated changes based on historical results. Based on the annual resurveys we detected continuous and reversible vegetation changes as well as non-reversible transition to new stable vegetation states when thresholds were surpassed.The results in plots formerly associated with shrub encroachment indicated that mesic and mesoxerophytic *Rosa spp*. shrubs became widespread and actively expanded their area and population size downward to other vegetation types that penetrated as separate loci into the grassland zone. The invasive success in invaded plots showed two-fold threshold states: grazing tolerant species with active generative and vegetative reproduction, wide ecological amplitude, efficient use of environmental resources versus transient, grazing tolerant species with better capabilities to adapt environmental changes that replaced invasive species recorded in 1973. Our results have implications for the early detection and management of threshold transitions in mountain pastures, predict further changes in mountain ecosystems and plant communities with ongoing climate change, and call for reassessment of future land-use planning.