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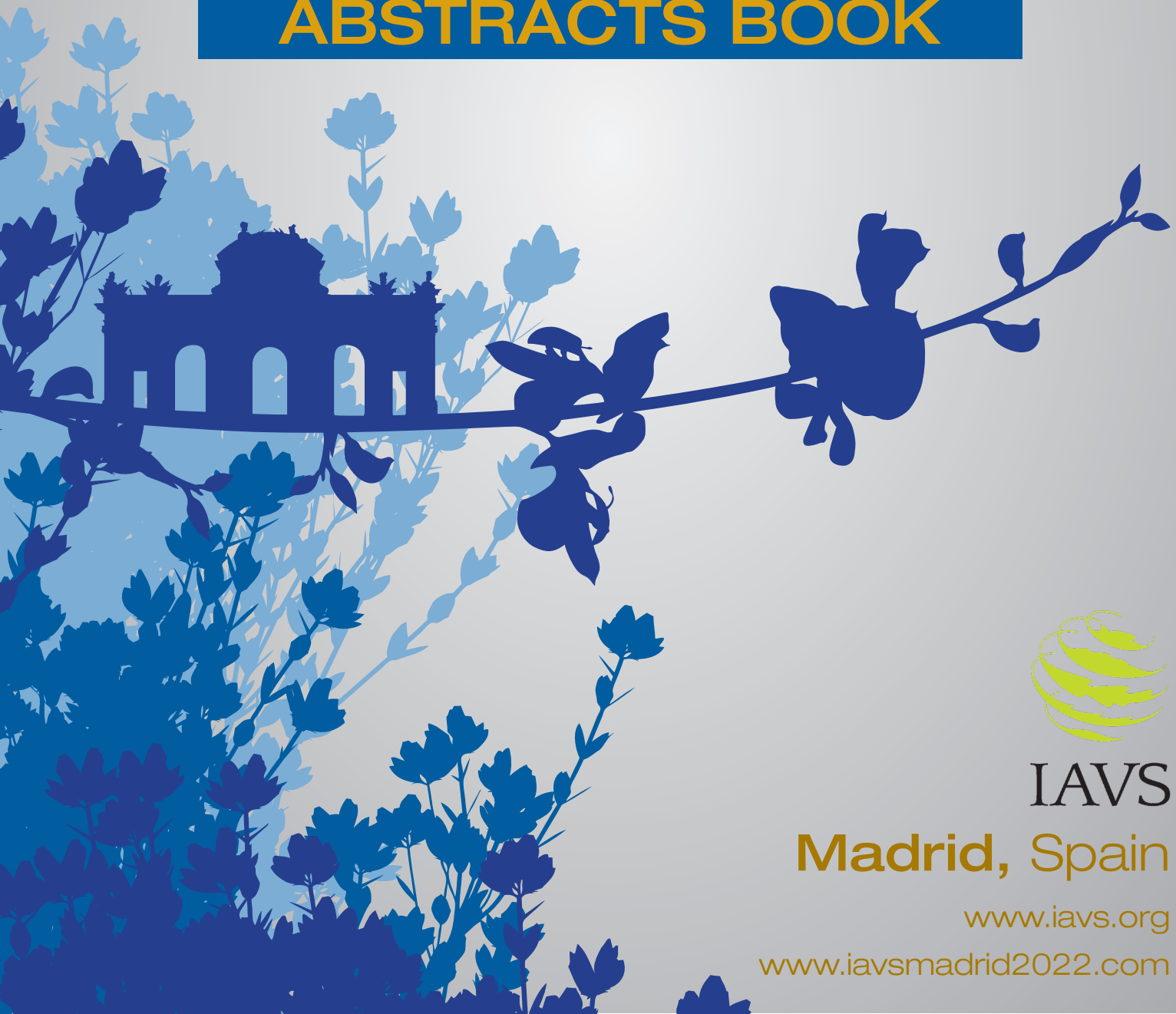
ABSTRACTS BOOK



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Keynote talks and Award lectures

Functional vegetation research with the global plot database sPlot - Where do we stand, where do we want to go?

Prof. Helge Bruelheide[1], The sPlot Consortium

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sPlot is a collaborative initiative to integrate local and national vegetation-plot datasets into a global harmonized database. The overarching scientific goal is the exploration of all aspects of global plant community diversity, including taxonomic, functional and phylogenetic diversity, across biomes, vegetation types, taxonomic or functional guilds and scales. Being currently composed of 252 individual researchers and 164 vegetation-plot databases, sPlot is continuously growing.

The aim of the talk is to both summarize previous sPlot achievements and point out the potentials for future research and applications. A particular strength of sPlot is the fine spatial grain of plot-based plant community data, which, however, can be aggregated at any larger spatial grains. While we would generally assume that fine-scale richness increases with coarse-scale richness, i.e. that with the size of the species pool, this was not generally confirmed. For instance, in a global analysis exploring patterns of species richness at multiple spatial grains, we identified regional scaling anomalies, i.e., areas where local richness is inconsistent across grain sizes, for being high at fine grain but low at coarse grains, or vice-versa. These findings allow weighting the relative importance of local drivers such as biotic interactions and micro-environments against large-scale evolutionary and historical processes, and complement our understanding of the distribution of nature of global hotspots of plant diversity, besides having important conservation and restoration implications.

The current version of sPlot 3.0 has substantially enlarged geographic coverage. To provide a balanced subset across global macro-environments, sPlotOpen as an open-access edition of sPlot has been released. The next frontier and the aim of sPlot 4.0 is to include time-series, i.e., repeated surveys of the same vegetation plots. Adding a temporal dimension will allow transitioning from doing research on global patterns only to research focusing on global trends of biodiversity and its threats.

Biogeography of the Mediterranean vegetation of South America

Federico Luebert[1]

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Mediterranean vegetation refers to vegetation under the influence of Mediterranean-type climate (MTC), characterized by a marked seasonality, with dry-warm summers and cold-humid winters. The geographical extension of MTC in South America has been variously defined. In its broadest sense, it includes lowlands of central Chile and adjacent high-Andean environments of central Chile and Argentina, portions of the Atacama Desert with a winter rainfall regime, and southeastern Patagonia. Here I adopt a definition of MTC that excludes high-Andean environments and Patagonia, thus restraining MTC to the western margin of subtropical South America, within the Chilean territory. This is the most widely accepted view of South American MTC. So defined, Mediterranean vegetation encompasses desert scrub, thorny scrub and (savanna-like) woodland, sclerophyllous woodland and forest, and deciduous forest. The first represents the transition to tropical desert vegetation with summer rainfall, while the last marks the transition to temperate vegetation with regular year-round precipitation. The treeline at the core of South American Mediterranean vegetation is located around 2000 m. Distribution of these vegetation types is mainly controlled by a southwards increase of mean annual precipitation as well as the rain-shadow effect exerted by the coastal mountain range, which reaches elevations above 2000 m, with local variations determined by slope aspect and elevation. Both vascular plant species richness and endemism reach their maximum values in this zoned compared to the rest of the Chilean territory. The historical assembly of the flora, revealed from phylogenetic studies of the dominant elements, appears to be highly idiosyncratic with respect to vegetation type. While portions of the thorny woodlands seem to be of anthropogenic origin, the most humid portions of the sclerophyllous forest have their roots in evolutionary ancient, tropical lineages.

The quest for explanations of trait-divergence patterns in plant communities

Valerio Pillar

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Plant community ecologists search for trait-based patterns of species assembled in communities, and try to predict vegetation responses to driving factors as well as the effects of the communities on ecosystem functions and across trophic levels. Beyond prediction, questions often arise about explanations for the patterns or about mechanisms that are structuring plant communities. Environmental filtering leading to trait convergence has been the most robust explanation for community assembly. But, why communities with so many species showing distinctive functional traits are often found under similar environmental conditions? In this talk, I focus on the search for explanations of trait-divergence patterns in plant communities. I discuss the conditions leading to trait-divergence, which I show can arise from environmental filtering. In community assembly, the units filtered by the factors are whole organisms with traits which cannot be physically separated and are not independent each other. Thus, the selection effect by an environmental factor on an individual based on a given trait may depend on how other traits in the same individual are filtered by the same or by the other factors. Further, environmental factors may interact each other in their selection effects, which is the rule in nature, and there are factors that are hidden, not observable, such as when related to unknown past conditions or affecting community assembly at a finer resolution than the studied grain size. I examine these problems by examples and by showing power analyses using metacommunity data generated by a stochastic, individual-based, spatially explicit model following specified environmental filtering parameters, factor interactions and trait correlations. For the analysis, fuzzy-weighting, Beals transformation and community weighted means are combined to measure beta trait divergence. The evidence indicates that trait divergence can be generated in community assembly by the interacting effects of factors in the selection of individuals based on their traits.

Biodiversity monitoring: past, present and future challenges

Manuela Winkler

GLORIA co-ordination, Department of Integrative Biology and Biodiversity Research, University of Natural Resources and Life Sciences, Vienna (BOKU) & Institute for Interdisciplinary Mountain Research, Austrian Academy of Sciences (ÖAW)

The conservation of terrestrial ecosystems and their biodiversity is an integral part of the UN Sustainable Development Goals (SDG 15: life on land) and the Aichi Biodiversity Targets. To reach these targets, knowledge about the conservation status and development of species and ecosystems is an essential prerequisite. Using the example of the GLORIA network (Global Observation Research Initiative in Alpine Environments, www.gloria.ac.at), which has been operating since 2001 and is today active in ~130 mountain regions on five continents, I show how long-term monitoring has contributed to the understanding of climate change impacts on alpine plant species biodiversity. The high resolution these in-situ observations allow for comes at the cost of lower spatial coverage and of time and financial constraints. Species distribution models, on the other hand, provide insights at larger spatial scales but are challenged by questions of biological realism regarding for instance microclimatic variation and population dynamics. Genetic diversity and evolutionary rescue effects have so far been only addressed to a very limited extent by both approaches. I advocate to link monitoring with predictive models and experimental approaches, and to integrate biodiversity levels from the genetic and species to the functional level to develop robust scenarios for the future of biodiversity under global change.

Oral and Poster presentations

Talk

Effects of long-term removal of sheep-grazing in a series of British upland plant communities of conservation value

Dr. Josu G. Alday[1], Dr. John O'Reilly[1], Dr. Rob J. Rose[1], Prof. Rob Marrs[1]

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Environmental and management pressures are considered a threat for preserving plant communities worldwide. Identification of long-term impacts of changing management practices on plant communities is a major priority to ensure improvement in conservation value. Land abandonment/wilding in uplands and mountainous areas of Northern Europe is one contentious issue where there is little available information on long-term impacts. To address this, here, we describe the long-term trends of four British upland communities (high-level grasslands, intermediate grasslands, blanket bogs and high-level bogs) using 4 replicated long-term experiments designed to assess the effects of sheep-grazing vs. no-sheep-grazing at Moor House (from 1954 to 2016). Our aims were to determine whether the business-as-usual sheep grazing practice was maintaining these communities, and if grazing was to be removed as part of abandonment/wilding strategies, would there be a conservation benefit. Our results showed that there was relatively little compositional change in dominant plant species with most change occurring within sub-dominant species. However, the vegetation temporal trajectories were moving in similar direction in grazed and ungrazed plots at most sites. There was a post-2000 richness and abundance recovery in the grazed and ungrazed plots, with improvements detected for species richness, abundance of vascular plants and mosses. Unfortunately, no improvement was detected for bryophytes (especially liverworts) and lichens. The similar long-term trends in grazed and ungrazed plots found in each plant community suggest that some within-community dynamics can overcome effects of grazing drivers across time. In contrast, the between-plant community differences across time, suggest that some landscape-scale trends such as those caused by a reduction of nutrients depositions are triggering community-dependent recovery. Finally, implementation of a no-stock grazing strategy under a land abandonment/wilding approach will not bring about much plant change in the short-term in the plant communities studied here.

Talk

Vegtable: A standard for sharing and assessing vegetation-plot observations in R

Dr. Miguel Alvarez[1]

[1]*University of Bonn, Bonn, Germany*

The R package vegtable has been developed to format data imported from vegetation-plot databases for its further statistical assessment and aims to fulfill three important tasks: 1) to provide a data structure containing multiple database lists and thus resembling relational databases; 2) to provide functions for the most common data manipulations; and 3) to ensure repeatability by compiling data pre-process in R scripts and R-Markdown documents. This contribution summarizes the basics on the structure of vegtable objects and demonstrates the use of some functions (also known as methods). vegtable is based on the object-oriented system S4 and includes a formal definition of object classes, provides a prototype (i.e. an empty object), and implements validation tests for cross-checking relationships between different tables. Data imported using vegtable is organized in eight slots: 1) “description” for metadata, 2) “samples” containing the records of taxa in plots, 3) “layers” including any form of stratification within plot observations, 4) “header” with variables associated to the single plots, 5) “species” with the taxonomic lists of recorded plants, 6) “relations” including tables related to the header (e.g. description of single classes in categorical variables), 7) “coverconvert” used to transform values from custom cover scales to cover percentage, and 8) “syntax” including hierarchical classifications according to a syntaxonomic approach. Common processes defined as functions are for instance subset building, transformation of cover values, assessment of species attributes at the plot level, and creation of cross-tables (vegetation matrices) for further statistical analysis. Data can be imported from Turboveg 2 databases while scripts or functions may be designed by the users to import data from spreadsheet applications or relational databases, while a function is defined to write tables for their import into the software Juice. Some examples of publications using this package for the data assessment will be also mentioned.

Talk

Documenting syntaxonomy in vegetation-plot databases: The case of Chilean vegetation in “sudamerica”

Dr. Miguel Alvarez[1], Dr. Federico Luebert[1]

[1]*University of Bonn, Bonn, Germany*

The database “sudamerica” contains around 2,000 plot observations recorded in the South American continent. From its origins this database compiles data from bibliographic references, documents syntaxonomic classifications and aims to make the data suitable for meta-analysis and critical reviews. In Chile, the Braun-Blanquet approach has been widely implemented but most of the current surveys are restricted to a small set of vegetation groups or to specific study sites. Thus a revised classification system for the whole country is still missing. We used “sudamerica” to summarize the syntaxonomic classification of the Chilean vegetation and to compare the Braun-Blanquet approach with plant formations following the EcoVeg approach. Plot observations were classified into 29 classes, 43 orders, 66 alliances, and 175 associations according to the Braun-Blanquet approach. The same were assigned to 7 classes, 10 subclasses and 19 formations in the EcoVeg approach. There are several mismatches between phytosociological classes and EcoVeg formations, which indicates some inconsistencies in the current stage of syntaxonomy in Chile. In this contribution we discuss the use of vegetation-plot databases to host multiple syntaxonomic classifications as well as a backup for syntaxonomic references.

Talk

Investigating farmers' preferences for the design and contents of training under grassland-related agri-environmental measures – a case study in Latvia

Ms. Marta Ancāne[1], Ms. Anda Mežgaile[2], Dr. Solvita Rūsiņa[1]

[1]University of Latvia, Riga, Latvia, [2]Vidzeme University of Applied Sciences, Valmiera, Latvia

Semi-natural grassland conservation strongly relies on incentive payments through agri-environmental measures. Training is key to equip farmers with practical skills and confidence to undertake environmental actions. Our aim was to explore farmers' preferences for the design and contents of training programmes in relation to their skills in grassland management. The results draw on two surveys that were undertaken independently. The purpose of the first survey was to ask attendees of training under action-based agri-environmental measure "Maintenance of biodiversity in grasslands" about their perception of training and ability to prepare grassland management plans, and their willingness to continue training and/or participate in result-based agri-environment measure. The purpose of the second survey was to explore farmers' opinion on their level of knowledge and skills in grassland management and their preferences for the design of trainings.

Results of the first survey mostly showed respondents' satisfaction with training design and contents. Nearly half of all participants were willing to enter result-based scheme and majority of them (82%) would prepare grassland management plans. However, only 46% of participants prepared the plan in sufficient quality during the training. More than a half of respondents stated that advisory would be crucial to prepare a plan due to lack of knowledge about plant species and biodiversity-friendly grassland management. The results of the second survey provided additional insight into farmers' opinion on their knowledge in grassland management and preferences for further training. 53% of respondents would choose individual consultations on the field with experts. Though 58% of respondents stated that consultations should be provided for free, 30% stated that consultants need to excel in nature protection issues and 28% stated that consultants should be located in the same region as the respondent.

The study was supported by the LIFE programme integrated project LatViaNature LIFE19IPE/LV/000010.

Talk

Farmers adaptation measures to climate change in Ghana

Mr. Adu-Gyamfi Asamoah[1], Dr. Patrick Opoku[2], Prof. Seungdo Kim[3], Dr. Reginald Tang Guuroh[1], Ms. Eunice Okyere-Agyapong[1]

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Ghanaian farmers have made changes in their farming activities in response to the local climate variations to safeguard their livelihoods. In this regard, this study was conducted in the Berekum west district of Ghana to assess cashew farmers' perception on climate change and adaptation measures adopted. For a detailed analysis to determine whether the cashew farmers are adapting or not adapting to the changing climate, 30 cashew and 30 non-cashew farmers within each of the three (3) major cashew growing communities (Jinijini, Fetentaa, and Nkyenkyemam) were sampled randomly. 180 farmers were supposed to be interviewed, but 183 farmers were administered with structured questionnaires. The results showed that majority of the farmers are aware of climate change. Deforestation was strongly agreed upon by the farmers as the major cause of climate change. The results further indicated that farmers are aware of the effects and impacts of climate change. The community followed by farmer type were the significant predictive factors based on binary logistic regression test to ascertain whether demographic factors would predict adjustment in farming ways in response to climate change. 92.9% of the farmers have not adopted any on-farm adaptation measures to enhance their livelihoods. 7.1% of the farmers have adopted mixed cropping, mulch application, and crop rotation as the means of adjusting their farming practices in response to climate change. The farmers having low adaptive capacities to climate change is a result of the lack of essential facilities and service such as irrigation systems, access to credit among others. This study reveals the importance of assessing how farmers perceive and adapt to climate change at the on-farm level. These findings are useful for providing valuable inputs during policy decision making on climate change.

Talk

How much can we trust species distribution models in biodiversity mapping?

Dr. Vojtěch Barták[1]

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Understanding species-environment relationships is an invaluable source of information for mapping species distribution in space, mapping biodiversity, as well as their projections to the future. Species distribution models are the most common tools for quantifying species responses to the environment, typically in the form of regression-like relationships between the species occurrence/abundance (response) and a set of relevant environmental variables (predictors). This approach is especially appropriate for mapping, as long as the predictor values are available everywhere in the area where the species distribution is to be mapped. It has been recognized, however, that the significant statistical relationships between the species and the environment observed in the data may not necessarily reflect real causal relationships between the two, but may simply arise by accident, as a consequence of strong spatial autocorrelation in both species and environmental data. While these accidental relationships may still provide a valuable source of information for predicting the species occurrence inside the same area where the model was fitted, it will likely lead to completely misleading predictions (i.e. distribution maps) outside that area. This contribution aims at quantifying the uncertainty related to this issue using simulations, demonstrating its possible consequences on some real and simulated examples, as well as providing some guidelines on what to do in practical modeling and mapping.

Talk

Impacts of fruiting neighborhoods on avian seed dispersal in coastal wetlands along the northern Gulf of Mexico

Mr. William Sipek, **Dr. Loretta Battaglia**[1]

[1]Texas A&M University Corpus Christi, Corpus Christi, United States, [2]Indiana Dunes National Park, Porter, United States

Frugivorous birds and fruit-bearing plants have an important mutualistic relationship that can be disrupted by introduction of exotic species to an ecosystem. While foraging, these birds will often consume fruit, move to another plant, and then deposit the seeds of that fruit beneath another plant's canopy. Many factors affect this relationship including fruit availability, canopy cover on the plant underneath which dispersal occurs and the number and variety of fruit-bearing neighbors to this focal plant. Our main objective was to test for impacts of an individual plant's fruiting neighborhood, and species of focal plant, on characteristics of propagules dispersed beneath its canopy. We expected that seed rain and fruiting neighborhood for each focal plant would differ, and that seed rain composition would differ from that of the fruiting neighborhood, due to disproportionately greater dispersal of exotic species beyond their neighborhoods. Seed traps were installed beneath native and exotic winter-fruiting bird-dispersed plants at two coastal sites along the northern Gulf of Mexico. The fruiting neighborhood surrounding each focal plant was characterized, and traps were sampled once per month (September 2017 - August 2018). Native and exotic focal plants had significantly different neighborhood and seed rain compositions. Exotic focal species (Triadica sebifera and Cinnamomum camphora) exhibited more traffic and were generally more active hubs for dispersal of exotics than native species (Myrica cerifera and Persea palustris). We found only one single instance of an exotic species being dispersed beneath a native species. Our work suggests that invasive focal plants play an active role in arrival of new propagules into these coastal systems and may accelerate additional invasions. Further research could determine the extent of facilitative relationships between exotic and native bird-dispersed plants in coastal ecosystems of the northern Gulf Coast.

Talk

Beta diversity of restored grasslands: plant diversity can profit from spatio-temporal variability

Mr. Markus Bauer[1], Jakob Huber[1], Prof. Dr. Johannes Kollmann[1]

[1]*Technichal University Of Munich, Freising, Germany*

Spatio-temporal variability needs more attention during ecosystem management since it can increase beta diversity and therefore could be beneficial for biodiversity. Balanced turnover should be aimed to foster biodiversity and increase ecosystem stability. Nestedness should be avoided because a richness gradient among restored sites is detrimental to biodiversity. In addition to the detection of beta-diversity patterns, it is important for restoration management to identify the main drivers of beta diversity.

We studied dike grasslands 4–19 years after restoration at River Danube in Germany over five years (2017–2021). We calculated beta-diversity indices for temporal turnover and spatial variation and their additive componentns gains and losses, or replacement and nestedness. We analysed the effects of local site characteristics like exposition or soil, spatial factors, and historic factors over time.

Temporal turnover caused a significant year-to-year change in species composition (37 ± 11%). Turnover varied over time and in space. Gains and losses were balanced over time, though from year-to-year gains or losses changed in prevalence which was most pronounced on south-exposed slopes.

The analysis of spatial variation revealed no homogenisation or fluctuation over the years by temporal turnover and was largely dominated by replacement-driven dissimilarity. The drivers of replacement changed over time, though it was mainly affected by exposition and space. Historic contingencies were less important.

In conclusion, restoration outcomes can profit from spatio-temporal variability which are induced by weather fluctuations, spatial heterogeneity, slightly varying management regime for practical and economical reasons, or other stochastic biotic effects. We suggest avoiding to define restoration targets as a single state, rather as an average state with a certain variation in species composition. This approach would account for spatio-temporal dynamics of biodiversity which can be important for conservation and ecosystem functioning.

Talk

The devil is in the details: plant spectral diversity from high-resolution imagery captures taxonomic and functional diversity facets in coastal dune communities

Ms. Eleonora Beccari[1], Prof. Carlos P. Carmona[1], Dr. Enrico Tordoni[1], Dr. Francesco Petruzzellis[2], Dr. Davide Martinucci[2], Dr. Giulia Casagrande[2], Mr. Nicola Pavanetto[3], Prof. Duccio Rocchini[4], Dr. Marco D'Antraccoli[5], Prof Daniela Ciccarelli[5], Prof Giovanni Bacaro[2]

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Global change is occurring at an unprecedented rate, calling for spatially continuous monitoring of its possible impacts on biodiversity. In this sense, remote sensing is considered a fundamental tool to monitor biodiversity over large spatial extent, being also potentially able to capture its different facets, such as taxonomic (TD) and functional diversity (FD). However, it is still not clear whether spectral diversity (SD - variation of spectral response across a set of pixels) may represent a fast and reliable proxy for different biodiversity facets across spatial scales. Here, we used fine resolution (3 cm) multispectral imagery on coastal dune communities in NE Italy i) to explore SD pattern across scales using additive partitioning (i.e. plot, transect, and the whole study area), ii) to assess how SD relates to TD and FD, and iii) to test the robustness of these relations along the sea-inland gradient (SIG). TD was computed as species richness. SD and FD were measured using a novel approach which computes trait probability densities based on pixels and species position within sampling units (i.e., plots, transects) in the multivariate space. We compared diversity patterns in space occupation, and related within-plots SD as a function of TD and FD independently, using generalized additive models. Functional and spectral dissimilarities, measured as overlap-based dissimilarity, were related using quantile regressions and where further decomposed in turnover and nestedness components. Additive partitioning showed that the highest variation of TD and SD was at transect level, while most of FD variation happened at plot level. FD and SD showed similar patterns in space occupation and significant relations were found within and between plots and along the SIG. TD showed no significant relationships with SD. Plant spectral properties proved to capture variation in FD, highlighting the potential of remote sensing tools to monitor ongoing biodiversity changes.

Talk

Effect of hay transfer and management on functional and taxonomic restoration of plant communities in a floodplain grassland

Dr. Marie-Lise Benot[1,2], Prof Didier Alard[1,2], Mr Alix Lafitte[1,2], Dr Virgil Fievet[1,2], Ms Jennifer Dudit[1,2], Prof Emmanuel Corcket[1,2,3]

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Drivers of community dynamics are key study subjects in community ecology which are increasingly taken up in ecological restoration in order to influence ecosystem trajectories. Understanding restoration processes is still challenging and requires both taxonomic and functional monitoring approaches as they reflect different dimensions of biodiversity recovering.

We used a field experiment of floodplain grassland restoration on a former arable land near the Garonne river (France) to test for the effect of management (different grazing and mowing treatments) on early plant community trajectories after hay transfer. We expected the temporal dynamics of standing vegetation to be affected by the management treatment due to contrasting effects on regeneration niches and biomass removal.

Hay from a donor site was transferred four years after the grassland has been rehabilitated by the sowing of a paucispecific grassland species mixture. Mowing and soil harrowing were applied just before hay transfer in order to limit competition by standing vegetation. Plant species composition has been surveyed every two years for seven years after hay transfer. Species-level plant functional traits were extracted from public databases or measured on several individuals collected in the study site. In all management treatments, hay transfer increased species richness and diversity, and modified species composition. However, no strong differences among management treatments were observed. If any, they were transient and rather limited to the first experimental years. Most functional indices, but not structural ones, were already in the range of the reference before hay transfer and even diverged from the reference during the course of the experiment. This suggests that the rehabilitation of a grassland vegetation matrix prior to hay transfer has rapidly led to the restoration of the main functional grassland properties. However, the restoration of taxonomic aspects seems less predictable since compositional trajectories are multidirectional.

Talk

Intraspecific variability of plant functional traits along the South-Western French Atlantic coast: spatial structure and link with environmental gradients

Dr. Marie-Lise Benot[1,2], Dr Catherine Bodénès[1,2], Ms Céline Gire[2,3], Ms Catherine Lambrot[2], Mr Audric Argillier[1], Mr François Druyer[1], Ms Mathilde Chevillot[1,4], Dr Olivier Lepais[1,2], Dr Maya Gonzalez[2,3]

[1]University of Bordeaux, Bordeaux, France, [2]INRAE, Bordeaux, France, [3]Bordeaux Sciences Agro, Bordeaux, France, [4]Bordeaux INP, Bordeaux, France

Plant communities are shaped by several ecological processes acting at different spatio-temporal scales. Characterizing these processes and their relative importance on species distribution still remains crucial in order to understand how communities will respond to ongoing and forecasted environmental changes. Sand dunes are highly constrained ecosystems exposed to complex combinations of stress and disturbances. By addressing plant responses to environmental factors, the functional approach offers the opportunity to disentangle the relative importance of these factors on plant communities.

The aim of this study was to determine the spatial structure of a set of functional traits for four plant species commonly found in sand dune communities, and their response to environmental variables. A total of 72 to 82 individuals per species were collected along the local beach-inland gradient and regional North-South gradient along the 200km of the South-Western French Atlantic sand dune. Several functional, morphological and anatomical traits (whole plant, leaf, stem and root traits) were measured on each plant. For each plant, we also characterized local biotic (species composition) and abiotic (soil properties) environment. Regional climatic variables were retrieved from available databases. Preliminary analyses on two species among the four tend to reveal a significant effect of regional climatic variations on some functional traits. For Ammophila arenaria, leaf thickness, which is rather expected to increase in response to drought, appeared to be positively explained by rainfall and maximal summer air temperature, suggesting that summer heat may have a more important effect on drought than rainfall on the studied sandy soils. For Convolvulus soldanella, wind speed was found to favor more exploitative strategies, which may be more efficient to cope with wind-induced sand burial or abrasion. Further analyses including other traits, environmental variables and the two remaining species (Elytrigia juncea and Helichrysum stoechas) are still carried out to complete this study.

Talk

Fire frequency causes intraspecific variation in the belowground bud bank from herbaceous Cerrado species

Dr Aline Bombo[1], Bsc Raquel Martins[1], Dr Beatriz Appezzato-da-Glória[2], Dr Alessandra Fidelis[1]

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The presence of belowground bud banks (BBB) is a mandatory trait for perennial plants from the herbaceous stratum in fire-prone systems. The BBB size usually responds to environmental conditions and can be affected by frequent disturbances. They are found on organs with diverse morphologies and their type also defines the resprouting and/or clonal growth capacity of a species, being important for storage, nutrient acquisition, and competitive ability. We described the belowground organs of eight abundant species in the herbaceous layer from an open savanna community and investigated intraspecific bud bank variation after experimental fires, considering different fire frequencies. We expected to identify morphological types associated with fire-driven communities, such as xylopodia and root crowns, and higher bud bank densities at the annual treatment of prescribed fire, followed by biennial, while fire exclusion would lead to a decrease in the bud bank density. Three individuals from each species were excavated in each treatment, live buds were counted, and the organs were classified considering morphological and anatomical aspects. All eight species presented a xylopodium as the bud-bearing organ, which varied between a globular type with fine roots (three species) or an elongated xylopodium associated with a tuberous taproot (five species). The bud bank was significantly increased under higher fire frequency for three species, and the bud accumulation was benefited by fire exclusion in only one species. For the other four species, three of them showed a tendency of higher bud banks at higher fire frequencies, and one species showed the opposite tendency. Xylopodia are belowground bud-bearing organs exclusively related to the resprout ability of plants and highly associated with open savannas frequently burned. Fire exclusion is damaging for these types of structures that can disappear from the system after long fire-free intervals.

Talk

Classification and ecology of Pinus nigra forest vegetation

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Forests dominated by Pinus nigra are naturally distributed in mountain regions of (sub-)Mediterranean Europe, Anatolia, and partly North Africa. The ecology, and in part the distribution, of these vegetation types are shared with forests dominated by Pinus sylvestris. The preservation of natural Pinus nigra-dominated relic communities has a high conservation significance as these communities are part of the 92/43/EEC Habitats Directive. Past classifications of Pinus nigra forests lack a formal, broad-scale approach, which hinders progress in developing a better ecological understanding of these communities. Our study investigates Pinus nigra forest vegetation of Temperate and (sub-)Mediterranean Europe with the aim of providing the first large-scale classification and a formalized classification system of these types. We complemented pine vegetation data in the CircumMed forest database with >50 missing publications and unpublished data, resulting in >2500 Pinus nigra-dominated vegetation plots. We expect a clear distinction between planted and natural forests in the first division of our TWINSPAN analysis. Also, we expect Pinus nigra afforestations of temperate European lowlands outside the native distribution range of the species to have 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 and possibly of higher vegetation units, enabling automatic classification of relevés from Temperate and (sub-)Mediterranean Europe and Anatolia. The standardization 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, further taking into account the role of pine plantations. This study will offer insights for the prioritization of habitats for conservation.

Talk

Carbon Sequestration and the Contribution of Created Forests

Prof. Elgene Box[1]

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In the 1970s the main natural carbon fluxes in the global budget (primary production and dark respiration) could be estimated, and in the 1980s the natural terrestrial source-sink geography of these fluxes could be simulated seasonally. By the mid-1990s it became possible to estimate the climatic potential maximum standing biomass (i.e. carbon storage) on the land areas and its geography; the difference between this potential and current actual standing biomass represents the “capacity” to store additional emitted carbon in land biomass (forests) – if the world’s land areas were not paved, cropped, overpopulated, or otherwise limiting to primary production. This carbon uptake “capacity” was about the same as the amount of additional carbon in the often used doubled-CO2 scenarios. At global scale the effect of local forests is barely a “drop in the bucket” – but there can be beneficial effects. Methods for estimating C-sequestration have been devised for: 1) tree plantations and reforestations at moderate scale; 2) Miyawaki-style, “green screen” and other retro-fittings in local built-up settings; and 3) “tiny forests” in quite small spaces, even for individual trees and gardens.

Talk

Nomenclatural and syntaxonomical remarks on the Thero-Salicornietea strictae class

Dr. Salvatore Cambria[1], Prof. Salvatore Brullo[1], Prof. Pietro Minissale[1], Dr. Saverio Sciandrello[1], Dr. Gianmarco Tavilla[1], Prof. Gianpietro Giusso del Galdo[1]

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Braun-Blanquet & Tüxen (1943), Braun-Blanquet (1947) and Braun-Blanquet et al. (1952) gathered all the annual and perennial plant communities dominated by succulents occurring in the salt marshes in only one class, namely Salicornietea. Later, Pignatti (1953) proposed to separate the annual communities from the perennial ones, proposing the new class Cakileto-Therosalicornietea, recognizing within it two new subclasses, Therosalicornienea (sub Therosalicornietea) and Cakilenea maritimae (sub Cakiletea maritimae). In particular, the Therosalicornienea comprised a new order, the Therosalicornietalia with some alliances, among them the Therosalicornion Br.-Bl. 1933, which represents the lectotypus of this order. According to the Art. 2 of the ICPN, these syntaxa are validly described. Afterwards, Tüxen (1955) published as nomina nuda (Art. 4) the following syntaxa: Thero-Salicornietea, Thero-Salicornietalia and Thero-Salicornion. Tüxen & Oberdorfer (1958) also reported a similar arrangement, proposing Thero-Salicornietea strictae and Thero-Salicornietalia strictae, with a single alliance, represented by Thero-Salicornion strictae (Br.-Bl. 1933) Tx. 1954. The latter was validly described by Braun-Blanquet (1933) as Thero-Salicornion, including within it four associations. This alliance was typified by Dengler et al. (2004), who designated the Salsolo sodae-Suaedetum splendentis as lectotype. In the relevés of this southern France association Salicornia emerici, species with a Mediterranean distribution, is well represented. This is in contrast with the Art. 43 of the IPCN, since Salicornia strictae is a species growing along the European Atlantic coasts, which is not stated in the relevés of the original diagnosis. Therefore, the names Thero-Salicornietea strictae and Thero-Salicornietalia strictae have to be corrected into Thero-Salicornietea emerici and Thero-Salicornietalia emerici. Previously, Loidi et al. (1999) and Rivas-Martinez et al. (2001) erroneously considered these two syntaxa as invalid name basing on the Art. 3f. Regarding the Thero-Salicornion strictae proposed by Tüxen & Oberdorfer (1958), it was changed without reason, and the name originally proposed by Braun-Blanquet (1933), Thero-Salicornion, must be restored.

Talk

The floristic continuum of interfluvial Cerrado grasslands

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Despite being one of the most diverse biomes in the world, Cerrado grasslands and savannas of Brazil are threatened by biological invasions, suppression of natural disturbances, and agriculture expansion. Added to that, the poor knowledge about the structure and floristic composition of Cerrado grasslands is a major constraint hampering their conservation and ecological restoration. Phytogeographical patterns exist for Cerrado trees, but that has not been explored for grasses and forbs. Aiming to fill this gap, we sampled 15 interfluvial Cerrado grasslands in four different states of Brazil (SP, PR, MG and GO), representing the broad range of environmental conditions (climate and soil properties) where these ecosystems occur. The ground layer plant community of each site was sampled in 30 circular 1m² plots. We performed a permutational multivariate analysis of variance using distance matrices with 10,000 permutations. We also ran an ordination based on the presence/absence matrix of species per plot in each site, using nonmetric multidimensional scaling (NMDS) with scores built by the Bray-Curtis dissimilarity index, and 95% confidence interval ellipses. Plant species composition differed between sites ($F= 14.85$, $r^2 = 0.32$, $p<0.001$), but the factor “site” explained only 32% of the variation found. The ellipses in the NMDS indicate some overlapping sites, evidencing that the floristic composition is not completely different and that groups of species shared by two or more sites exist. However, differently from what happens with tree species, the fifteen sites sampled formed a floristic gradient instead of biogeographical groups of sites. This continuum is likely driven by environmental gradients combined with ecological plasticity of the species defining their range of occurrence. Knowing this floristic gradient is crucial to inform plant diversity conservation and restoration of Cerrado grasslands.

Talk

Invasion dynamics of alien species in Mediterranean Europe

Dr. Luigi Cao Pinna[1], Dr. Alicia Teresa Rosario Acosta[1], Dr. Marta Carboni[1]

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Alien species are a primary cause of biodiversity loss but represent a unique opportunity to study biogeography in action. In a niche perspective (i.e. considering the relationship between a species and its environment) alien species respond to their novel environments in several ways. At an initial stage of invasion, an alien species may have yet to occupy all the favourable conditions it could encounter (unfilling), e.g. because of dispersal limitation. Oppositely, at an advanced stage, some alien species may have occupied environments that were not occupied or didn't even exist in the native range (expansion), e.g. because of rapid local adaptation. In this framework, we analysed 93 alien species introduced in the Mediterranean Basin to disentangle the dynamics of niche shift between the native and invaded range. This niche comparison allows testing for species' characteristics that promote adaptability and to profile the ideal invader.

To compare native and invasive niches, we analysed presences data and background environments in a multivariate niche dynamic analysis (Broennimann et al., 2012). Specifically, we tested different metrics of environmental equilibrium (i.e. stability, unfilling and expansion). We finally questioned how species adapt to novel environments during stages of invasion, investigating their characteristics (i.e. SLA, plant height, seed mass, dispersal syndrome), introduction history (recent or old) and adaptability (i.e. traits variability).

Preliminary results show high variability in niche shifts for alien species in the Mediterranean Basin. Some species are expanding in environments that differ from those occupied in the native range, and represent species developing concerning local adaptations potentially leading to uncontrolled expansion. We find evidence of a relationship between introduction time and niche filling, suggesting that species residence time combined with species' characteristics are good predictors of niche shift. Thereby, we can define the characteristics that promote niche shift and ultimately invasion success in Mediterranean Europe.

Talk

Comparing supervised classification methods to predict and identify vegetation-types of Macaronesia

Dr. Jorge Capelo[1,2,3], Sandra Mesquita[3], Roberto Jardim[3], Manuela Gouveia[3,4], Carlos Góis-Marques[3], Miguel Menezes de Sequeira[3,4]

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Given a set of previously classified vegetation relevés, supervised classification procedures can be then applied to either: i) assign new relevés to vegetation-types or ii) to predict vegetation-type's occurrence. In assigning vegetation-types, floristic-abundance data is parsed; while in predicting environmental information associated to relevés, if available, is used instead.

We compare several methods of supervised classification to classify and predict woody vegetation types in Macaronesia - the set of the Azores, Madeira, Salvage, Canary, and Cape Verde archipelagos in NE Atlantic Ocean. Methods include both i) rule-explicit producing, such as classification trees (CART), induced classification rules or COKTAIL 'family' (Tichý, 2002); ii) and 'black-box'or learners. An initial training-set of 90 synthetic tables expressing syntaxonomy is used. A set of ca. 1200 relevés is then classified by rule-based (CART, COCKTAIL) and 'black-box' methods (random forests, gradient boost, SVM, naïve Bayes) or combinations of the later.

By weighing quantitative and practical trade-offs of all methods, we found that 'black box learners' may be more accurate at times, but rule-explicit expert systems are easier to implement and have interpretative value. We come to propose an-easy-to-use rule-based expert-system for Macaronesian vegetation.

Talk

A review on the mechanisms of expansion and regeneration of the Araucaria Mixed Forest

M. B. Carlucci

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The Araucaria Mixed Forest (AMF) is the main forest type in highlands of southern Brazil, also occurring in Argentina. This forest type is characterized by the dominance of the iconic candelabra-shaped conifer Araucaria angustifolia, which coexists with the conifer Podocarpus lambertii, arborescent ferns and many angiosperm tree species. AMF presents complex dynamics, which has caused long-lasting debates in the literature, especially regarding the necessity of major disturbances and full light for the regeneration of A. angustifolia and assembly of AMF communities. AMF dynamics has been studied through the lenses of two approaches: the forest-grassland dynamics approach and the forest interior dynamics approach. The former focuses on the mechanisms of forest expansion over grasslands, while the later addresses whether A. angustifolia requires major disturbances and full light to regenerate massively or whether it regenerates well in the forest interior via slow growth and treefall gap dynamics. Here I review the literature to synthesize what are the well-supported evidences and what are the knowledge gaps related to mechanisms underlying AMF expansion over grasslands and AMF understory regeneration. On one hand, I found strong evidences on the role of A. angustifolia as a nurse plant promoting forest expansion through nucleation and edge dynamics. On the other hand, I found controversial information on the capacity of A. angustifolia to regenerate under the low light of understories. The main knowledge gaps related to AMF dynamics are: (1) what is the role of fire on A. angustifolia regeneration? (2) may cattle grazing increase A. angustifolia dominance in AMF stands because of cattle avoidance of spiny needles? (3) is A. angustifolia capable of growing slowly in AMF understory and reach the canopy following treefall dynamics? I hope this review will stimulate further studies to fill current knowledge gaps and solve existing controversies in the literature.

Talk

Global observed and dark functional diversity in DarkDivNet

Dr. Carlos P. Carmona[1], Dr. Riin Tamme[1], Professor Meelis Pärtel[1], D DarkDivNet Consortium

[1]*University Of Tartu, Tartu, Estonia*

Dark diversity (the portion of regional biodiversity suitable in a given site but absent in the moment of sampling) has improved our understanding about why and how biodiversity changes in space and time. However, analyses of dark diversity have been restricted to the taxonomic facet of diversity. Expanding analyses of dark diversity to include functional diversity allows us to discern which features make some species to be absent, and how the functioning of communities varies in space and time.

Here, we present the results from DarkDivNet, an initiative to characterize dark diversity in >100 globally distributed study regions. In each of these regions we studied 30-90 10x10m natural and anthropogenic plots (>4,000 plots in total) and characterized which species were present. We estimated, for each plot, the probability that the species from the region that were locally absent belong to the local dark diversity. We placed the species within the global spectrum of plant form and function (>4,400 species), and estimated the functional structure (i.e. how the species in a community occupy the functional space) for observed and dark diversity.

We found differences between observed and dark diversity, both in average trait values and in the amount of functional space occupied. Observed diversity consistently showed higher functional richness than dark diversity, which can be attributed to functional redundancy among species. In addition, anthropogenic effects were more consistent for functional than for taxonomic diversity. In particular, anthropization favoured smaller species in both observed and dark diversity, and species with conservative leaves in observed diversity. These results suggest that human actions lead to functional homogenization of local species pools by selecting for smaller species. Examining how environmental and global change factors affect differently the traits of observed and dark diversity will help us to predict future changes on biodiversity.

Talk

Landform-vegetation units in karstic depressions (dolines) evaluated by indicator plant species and Ellenberg indicator values

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The objects of research were circular and concave karstic depressions, called dolines. All these negative topographic anomalies were previously recognized as safe havens for cool-adapted species. However, the high geodiversity of doline landforms does not ensure that all dolines are safe havens. We propose the use of indicator species to identify different dolines' "sections" and their overall types to identify dolines with high conservation value for cool-adapted species. We aimed to divide dolines into landform-vegetation units (LVU) according to basic geomorphic characteristics (depth, shape, diameter) and indicator plant species.

We carried out sampling of vegetation plots in different dolines ranging from 20 m–100 m in diameter and from 2 m–20 m in depth. Each doline was classified into a maximum of four LVUs: bottom, lower slope, upper slope and top. The diversity of plant communities was sampled along N–S transects from one side of the doline over the bottom to the other side. Geodiversity parameters of individual dolines were calculated using a high-resolution digital elevation model (Lidar) and their significance was established by permutation test in CCA ordination analysis. The floristic gradient was established by the first axis of PCoA and shows the species turn-over along the trajectory. Discrete plant communities were determined by TWINSPAN classification. Based on this analysis, transects were disintegrated into four LVUs. Communities within LVUs were compared by Ellenberg indicator values and according to habitat preference of species. The indicator plant species were calculated by fidelity measure and related to ecological conditions along transects.

We found that all four LVUs appear only in dolines that are at least 13.5 meters deep and those can serve as a good safe haven for cool-adapted species in foreseen climatic change. We also confirmed that doline depth is the most important factors influencing the plant community composition.

Talk

Impact of the invasive shrub Rhododendron ponticum on the herb layer in Atlantic French forests

Ms. Marion Casati[1], Mr Fabien Spicher[1], Dr Thomas Kichey[1], Pr Guillaume Decocq[1]

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Invasion by non-native species is a threat for biodiversity. In forest ecosystems, alien invaders can impact species richness and composition, but few studies have explored the underlying mechanisms. Pontic Rhododendron (Rhododendron ponticum L.), a shade-tolerant shrub native to Iberian Peninsula, is an expanding invasive species in the forests of North-West France. Here, we investigated the effects of this tall shrub on vegetation and habitat features within French Atlantic forests. We selected 32 invaded plots along a climatic gradient, which were paired to 32 control plots (i.e. uninvaded stand located nearby, in the same habitat conditions). We surveyed the cover-abundance of vascular plant species and soil features in a 400m2 quadrat, as well as stand characteristics within and around the quadrat. This resulted in a 64 plots x 41 environmental variables matrix and a 64 plots x 55 species matrix (only species occurring in >3 plots were retained). A 55 species x 12 traits matrix was built, using the TRY database. Simple diversity descriptors were compared between invaded and control plots. Then, we ran a RLQ analysis to link the three matrices and relate species' life history traits to environmental factors. We found a lower species richness of the ground flora in invaded plots. The first RLQ axis matched a gradient of light intensity at the forest floor, whereas the second axis clearly separated invaded plots from controls. R. ponticum sorted traits like a vernal or evergreen leaf phenology and a reproduction by seed. Dense populations of R. ponticum seem to create a new forest understory environment where shade-adapted species are promoted. We conclude that R. ponticum invasion is associated with a decreased plant species in the understory with a shift towards plant communities that are more tolerant to shade and a thick litter layer.

Talk

Ghostplantsters: Mapping undiscovered tree species worldwide

Prof. Roberto Cazzolla Gatti[1]

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Two of the most fundamental questions in ecology are how many species inhabit the Earth and where they are. However, due to important logistical, economic and time limitations and the relevant taxonomic difficulties to classify and locate rare species, the global numbers of species and their geography, including well-studied life forms such as trees, is still largely unknown. Recently, in an attempt to answer the first of these two seminal questions, with the help of global ground-sourced data and the most complete datasets known to science, we estimated the total tree species richness at global, continental and biome levels. These results indicated that there might be 73,000 tree species on our planet, whose 9,000 are yet to be discovered. We also found that almost half of all tree species may be rare, with very low populations and limited spatial distribution. Moreover, we were able to detect that roughly half of the undiscovered tree species are in South America, particularly in the Amazonian and Andean regions. These findings highlighted the importance to map, with the highest accuracy, the location where these “ghost” tree species may be living on Earth, in order to improve their conservation before anthropogenic changes in land use and climate threaten or, even worse, wipe them out from our biosphere. Some future developments towards the achievement of this goal are provided here. A combination of additional field studies in the most likely locations and new technologies (such as remote sensing, drones, high-resolution hyperspectral satellite images, and robots) will help to answer the second question on where these “ghost” trees species are hidden.

Talk

Supporting vegetation conservation by the development of seed transfer zones of herbaceous species in Hungary

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In the implementation of restoration projects, in cases of severe degradation native seeds are used, however, restoration practitioners have a lack of knowledge regarding how far native seeds of herbaceous species can be transferred from the origin to the target site without fitness consequences. Such guidance is the seed transfer zones which are areas within which seeds can be transferred with low or without risk of maladaptation. In Hungary in absence of scientific-based zonation the administrative units NUTS 2 were adopted as seed zones by the current legislation, however, they are not scientifically based. The main aim of this study is the delineation of seed transfer zones for herbaceous species and further testing by seed traits. This new evidence-based map can potentially replace the one adopted by the legislation.

The seed zones map for Hungary is the first step in the regulation and certification of the native seed market that is still absent in Hungary. This approach is an important tool for ecological restoration upscaling in the Pannonian biogeographical region, contributing to vegetation conservation in Europe.

Talk

A future scenario influences neotropic savana's seedling growth

Dr. Adalgisa Maria Chaib[1], Dr Fabian Borghetti[1]

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The impacts of climate changes on the growth of native species have been overlooked in neotropic savannas. We investigated the impacts of simulated current and future climate scenarios on the growth of seedlings of four widely distributed tree species from the Cerrado: Qualea grandiflora (Qualea), Hymenaea stignocarpa (Hymenaea), Tabebuia aurea (Tabebuia) and Kielmeyera coriacea (Kielmeyera). Seedlings were raised for 30 days in pots filled with Red Latosol and sand (3:1) under irrigation at 28°C and 12h photoperiod. After, the seedlings were divided in groups of 30 for initial measures and for experiments in phytotrons set for two climate scenarios. For experiments in the phytotrons, the seedlings were transferred to plastic tubes 1m high and 0.1 m wide and irrigated every two days. One phytotron was set to provide a thermal period of 28°C/18°C (day/night), 12h photoperiod and [CO2] of 420 ppm (current scenario); another one was set to provide a thermal period of 30.5°C/20.5°C (day/night), 12h photoperiod and [CO2] of 860 ppm. After 120 days, plants were uprooted, had their stem base diameter, height, leaf area and root length measured, and dried at 70°C. We measured root and shoot biomass, calculated root and shoot mass fraction, relative growth rate, specific leaf area and specific tap root length. Under a future scenario, all four species showed significant increase in shoot biomass, yet Qualea and Tabebuia had no significant increase in root biomass, presenting biomass partition inversion. In addition, species presented higher specific leaf area (except for Qualea), faster growth rate (except for Tabebuia), plant hight increase (except for Kielmeyera), and no increment on steam thickness (except for Qualea). Qualea and Hymenaea invested more in root thickening then in root length, under a future scenario. In conclusion, a future climate scenario can influence seedlings growth, but response can vary among species.

Talk

Hummock Grasslands of the Mosquito Creek Basin

Dr. Shane Chalwell[1]

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Hummock grasslands are the most widely distributed biome on the Australian continent. They are characterised by the endemic Australian genus Triodia, which dominates the arid and semi-arid regions of central and western Australia. Within the wider Pilbara bioregion of north western Australia lies the mesoarchaean (ca. 2.9 Ga) Mosquito Creek Basin. Its turbiditic sedimentary composition contrasts with that of the adjacent Granitoid-Greenstone geological units. The distinctive environment forms a centre of local endemism within the Pilbara bioregion, with some of the endemics abundant and dominant. This study sought to understand the vegetation patterns and the plant-soil relationships within the Mosquito Creek Basin.

The project area covered approximately 7000 ha. The vegetation was sampled in 209 stratified-random plots, with the cover of all vascular plants recorded. Bulked topsoil samples were collected from each plot and an environmental dataset compiled comprising 25 edaphic factors, as well as other geomorphological parameters.

Plant associations were identified by flexible-beta clustering and silhouette analysis, and ordinated by NMDS. The environmental gradients influencing plant association distribution were analysed with MANOVA. The relationship of individual species with environmental variables was analysed with Generalised Linear (GLMs) and Generalised Additive Models (GAMs), where appropriate.

After initial analysis, the dataset was divided into five consistent classification sections, which broadly aligned with the major geomorphological units of the Mosquito Creek Basin. Cluster analysis within these sections identified a total of 21 plant associations. The major gradients explaining the distribution of associations included soil depth, plant-available phosphorus, organic carbon, salinity and sodicity. Modelling for the dominant Triodia species in the Mosquito Creek Basin also showed a strong relationship with edaphic factors. The importance of confirming the results cluster analysis with explanatory gradients will be discussed.

Talk

Mixing distributions: the colorist R package applied to community distribution estimate

Msc. Ludovico Chieffallo[1], Prof. Duccio Rocchini[1], Msc. Elisa Marchetto[1], Dr. Enrico Tordoni[2]

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Describing how, when and why species are present in a given territory is becoming more and more important in a world that changes very quickly. This is particularly true when studying how species interact as an ecological community and how these balances can change with the introduction of other species due, among other factors, to the climate change that forces many species to move towards more hospitable territories. We aimed at using the colorist R package to represent the dynamics of ecological communities. Based on the presence- absence of virtual species, a community distribution model was developed by GLMs and graphically represented by the colorist package. Thanks to the use of colors, it was possible to see which portions of space were shared by different species and which ones were more specific to a species. The use of colors based on the HCL palette, and precisely on the colors taken from the viridis palette, is important because it allows an effective reading of the representations even for people with color vision deficiency. The use of this package was therefore crucial for data representation and it might become a useful tool for studying ecological communities; this will allow us to enhance conservation aspects of endangered species.

Talk

Fire and shade filter woody communities according to their bark production in the Cerrado

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The rate of bark production is of great importance for woody species from fire-prone ecosystems. Bark allows species to survive fire, protecting their inner tissues and allowing new branches to resprout from aerial buds. Across the tropics, contrasting environments with different fire frequencies and light availability are find coexisting as mosaics of forests and savannas, questioning how these conditions filter species according to their bark production. We sampled 123 species (4,123 individuals) from savannas and forests in the Cerrado and tested whether a) species from areas with higher fire frequencies have a faster bark production, b) bark growth rate differed between trees and shrubs; c) generalists differed from specialist species, and d) a fast bark production resulted in a better aerial bud protection. Species from savannas produced bark c. 3 times faster than forest species. A minimal threshold of 0.13 mm/year of bark production differentiated woody communities. Shrubs and trees did not differ in terms of bark growth rate. Generalist species in savannas were able to produce bark above the threshold, while when present in forests, they produced bark below the threshold. A higher bark growth rate accounted for better aerial bud protection. The relationship between aerial bud protection and bark growth rate suggests that the speed of bark production plays an important role in protecting the dormant buds from fire. Generalist species are likely capable of displaying plasticity on their bark production, possibly being important for their success in contrasting environments such as savannas and forests.

Talk

Halophytic vegetation in the northwestern Pannonian region: a story of dramatic decline and partial restoration

Dr. Milan Chytrý[1], Jiří Danihelka[1], Kryštof Chytrý[1,2], Martin Harásek[1], Petr Hubatka[1], Klára Klinkovská[1], Filip Kratoš[1], Anna Kučerová[1], Karolína Slachová[1], Daniel Szokala[1], Helena Prokešová[1], Eva Šmerdová[1], Martin Večeřa[1]

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Background: The northwestern part of the Pannonian region (SE Czech Republic and NE Austria) has historically contained rich vegetation of inland halophytes associated with salt lakes and mineral springs. However, this vegetation declined dramatically, and its last remnants are in need of conservation management. We studied its history since the early 19th century and documented its current condition.

Methods: We reviewed botanical literature from the beginning of floristic research in the 1820s to the present, herbarium specimens of halophytes and historical vegetation plots. We conducted a field survey of the flora and vegetation at all sites with remnants of halophytic vegetation. We paid particular attention to sites where halophytic vegetation has recently been restored. We summarized all floristic and vegetation data statistically.

Results: Halophytic flora and vegetation in the study area gradually declined over the entire study period. The main causes were the draining of salt lakes, river regulation and the use of subsurface pipe drainage on farmland. Remnants of saline habitats persisted at many drained sites due to livestock and poultry grazing. However, livestock disappeared from the landscape due to political and socio-economic changes after World War II, and halophyte habitats declined at most historical sites due to the spread of reeds and other competitive non-halophytic plants. Succulent halophytes became regionally extinct, and population sizes of other halophytes declined dramatically. The last remnants were preserved in protected areas. However, in the last two decades, some sites have been successfully restored by clearing stands of competitive plants, bulldozing shallow pools and reintroducing traditional management.

Conclusions: Inland halophytic habitats in central Europe are sensitive to drainage and grazing cessation. At many sites subjected to such changes, they disappeared or their habitat quality was reduced. However, recent experience shows that they can be partially restored by relatively simple measures.

Talk

Past land uses: Soils don't forget!

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The aim of this exploratory study was to assess whether soils keep the chemical memory of past land uses. For this purpose, we select a suite of sites differing by their current and former past land uses (all combinations between forest, pasture or arable land). Using old maps we identified land use changes over the last 150 years in the same natural region (Thiérache, northern France) and on the same soil type (luvisol). We sampled soil at a depth of 5, 25, 45 and 95 cm to analyse (i) physico-chemical properties, (ii) secondary compound content, and (iii) organic matter by Near Infrared Spectroscopy (NIS). Sites with the same current vegetation cover (oak-hornbeam forest, pastured grasslands, cereal cropland) exhibit the same soil characteristics in the first 5 cm, irrespective past land use. The impact of past land-use on soil features became visible at 25cm-depth and below layer. Soil chemical properties tended to converge for a same past land-use at 45cm-depth, irrespective of the current vegetation cover. NIS also discriminated the soil layers according to their past land-use. Secondary compound content (e.g. polyphenols, alcaloids and triterpenic saponins) were still present in the different layers, even in deeper soil layers. Our results show that even more than one century after land conversion, the past vegetation still affects the chemical features of the soil.

Talk

Biodiversity change destabilizes secondary forest productivity across spatial scales in a human-dominated tropical landscape

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At local scales, the interplay between global change drivers and ecological processes shape temporal changes in biodiversity, with potentially cascading effects on ecosystem functioning over time and across space. Here, we assess the impacts of biodiversity change on ecosystem functioning over time and their underlying ecological mechanisms on tropical secondary forests across a human-dominated landscape. Using eight years of data from secondary tropical forests of varying ages (0-30 years) embedded in a human-dominated landscape, we examine the effects of temporal biodiversity change (taxonomic and functional) on the temporal stability of forest productivity at two spatial scales (0.1 and 0.2 ha). Furthermore, we determine if the influence of temporal biodiversity change acts via associated ecological mechanisms, i.e., species asynchrony or/and species stability, or through alternative pathways. At both spatial scales, we found that biodiversity change - principally increases in species diversity - destabilizes forest productivity directly and indirectly. SEMs show that rapid increases in species diversity following land abandonment reduce both species stability and asynchrony, but that only species asynchrony lowers temporal stability. While the indirect effects of biodiversity change on temporal stability are consistent across spatial scales, its direct, negative effects increase with spatial scale. The stabilizing effects of trait diversity on forest productivity, however, only partially counteract the destabilizing effects of biodiversity change. Yet, the expected positive effects of trait dominance on temporal stability are not detected, or are overwhelmed by the effects of biodiversity change. Our analysis reveals that biodiversity change - in response to land-use change - consistently alters ecological mechanisms that mediate ecosystem functioning over time across spatial scales. By slowing the pace of biodiversity change, conserving young secondary forests may enhance the provisioning of ecosystem functions over time in tropical forests.

Talk

Milkweed (Asclepias syriaca) invasion cannot be controlled based on trait similarity in sandy grasslands due to strong environmental filtering

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As invasive species pose an increasing threat to native communities, there is a growing need to use nature-based solutions to control them. Based on the limiting similarity hypothesis, using native species functionally similar to targeted invaders in seed mixtures could result in restored communities that are resistant to invasions. To investigate this possibility, we studied the correlation between spatial association and the trait similarity of common milkweed (Asclepias syriaca L.) and native grassland plant species. We had two alternative hypotheses: (1) if limiting similarity plays an important role then the more associated species are less similar in trait space, or (2) if environmental filtering is more important, the more associated species are also more similar based on functional traits. In addition, we hypothesized that these relationships may also depend on the studied traits.

We used a regional survey including primary and secondary grasslands, where vegetation was sampled in 5m x 5m plots (n=161). We described the strength of spatial association between native species and milkweed by linear correlation of their abundances. We used “gawer”-distance and a total of 12 traits to describe the trait similarity of species to milkweed. We considered three trait groups in the analysis: (1) all traits together, (2) traits connected to establishment and (3) traits connected to persistence. Finally, the rank correlation between spatial association and trait similarity were tested by Kendall’s tau.

We found no significant correlation between the strength of spatial association and similarity when all traits or traits connected to establishment were considered. However, we found a strong positive correlation between the association and similarity based on persistence traits. This suggests that environmental filtering is more important in the studied grasslands than limiting similarity, therefore, prevention or control of invasive milkweed is unlikely by sowing native species with similar plant traits.

Talk

sPlot 4.0: a call for researchers from the Global South

Dr. Gabriella Damasceno[1,2], Dr. Francesco Sabatini[3], Prof. Idoia Biurun[4], Prof. Milan Chytrý[5], Dr. Borja Jiménez-Alfaro[6], Dr. Susan Wiser[7], Prof. Helge Bruelheide[2,1]

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Despite being the biggest vegetation database in the world, sPlot still has many white spots with unique biodiversity in the Global South. The majority of the 2.9 million plots registered in the database is from Northern ecosystems, reflecting the biases found in ecology and science in general. Moreover, beyond the lack of data, these biases are also reflected in the human component of the consortium. From 245 members, only 23 (0.09%) are based in the Global South: four members in Africa, five in the Oceania and 14 in South America. Also, from the total of 42 projects being developed with sPlot data, only two (0.048%) are led by authors based at the Global South: one in Brazil and other in Colombia.

Nevertheless, the sPlot consortium aims to achieve global representativeness, both by aggregating worldwide data to explain global patterns in taxonomic, functional and phylogenetic diversity and by building a network of researcher across the globe. Therefore, there is a clear urgency in promoting the integration of researchers from the Global South into the consortium and we hope to increase equality in vegetation science by fostering collaborations among scientists worldwide.

This is the reason why the sPlot team is actively looking to foment these collaborations in the call for sPlot 4.0. This new version of sPlot intends to expand the geographical and temporal extent of the database, since it will also include temporal series, i.e., repeated surveys of the same vegetation plots. Adding a temporal dimension will allow transitioning from doing research on global patterns only to research focusing on global trends of biodiversity and its threats.

Talk

Differences in trait-environment relationships: implications for 'Community Weighted Means' (CWMs) tests

Prof. Francesco de Bello[1], Professor Jan Lepš[2]

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The relationships between environment and functional traits underlie our understanding of species distribution along environmental gradients, biodiversity assembly and ecosystem functioning. A popular approach to assess trait-environment relationships, albeit not the only one, is using Community Weighted Means (CWMs), i.e. testing changes in average trait values of communities along gradients. This approach, however, is being questioned as leading to optimistic results (inflated Type I error rates) particularly in cases of low species turnover. Specific null-models has been proposed for "correcting" such effects. However, as suggested by Zeleny (JVS 2018), different tests assume different ecological null-hypotheses. Building on Zeleny's work we explore the diversity of trait-environment relationships assessed by different CWM tests and the so-called species-level analyses (in which each data point is a species not a plot like in with CWMs). Using different types of simulations, we show some parallelisms between "correcting" CWMs by specific null-models and species-level analyses, as briefly hypothesized by Zeleny. The coherence between these approaches, however, varied abundantly, depending on the way species abundances are taken into account (i.e. on computing community trait averages or different computations of environmental preferences in species-level analyses). Combining these observations with examples from real plant communities we conclude that: (1) there is a rich variety of trait-environment relationships with a corresponding great variety of null-hypotheses being assessed; (2) caution is necessary as for the need for "corrections" to CWMs, which could prevent researchers from understanding the turnover mechanisms of dominant species along gradients and loose signal of traits actually causing such ecologically fundamental replacements with implications for ecosystem functioning; (3) ideally several methods, including basic analyses of CWMs without "corrective" approaches, can be combined in understanding the diversity of trait-environment relationship, while moving beyond the idea of p-values inflation and that some trait-environment analyses are more optimistic than others.

Talk

Experiences with the Miyawaki method in Belgium and France

Mr. Nicolas de Brabandere[1]

[1]*Urban Forest Europe SRL, Rue Vivier-del-haie, 40, Belgium*

Urban Forests is a company created in 2016 that is specialized in the creation of Miyawaki forests using the Miyawaki method of afforestation. As to February 2022, we have created 53 Miyawaki forests in Belgium and France covering a total surface 24485m2 with 72158 native trees planted by 6703 people. We present our experience in many different contexts of soil conditions and geographical area, in private gardens, schools, company land and public spaces. We present our results in terms of forest profiles, success rates, perception by the local community and challenges on the fields for the realization and maintenance of the forests over a period of 5 years.

Talk

Colonization of the coleoptera in Miyawaki forests

Mr. Loïc Dahan[1], Mr. Nicolas de Brabandere[1]

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Miyawaki forests have the potential to increase biodiversity. Tree diversity and habitat complexity are said to provide a wide variety of niche opportunities for organisms to colonize the forest. The Miyawaki method also implies a sound preparation of the soil. Soil biology and structure are restored so to mimic a natural forest. The combination of native tree species diversity and soil restoration should boost biodiversity levels in the ecosystem. How is the entomofauna reacting in Miyawaki forests? Is colonization happening? Is diversity higher than in the surrounding area? Miyawaki forests in Belgium offer the opportunity to study the way Coleoptera are colonizing a new habitat and how populations evolve.

Talk

Is riparian vegetation differentially affected by alien species and environmental factors according to its structure?

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Riparian areas are defined as environmentally heterogeneous zones of transition between terrestrial and aquatic ecosystems. Native riparian vegetation hosts high levels of biological diversity, contributing unevenly to regional biodiversity. Unfortunately, riparian zones are often colonized by invasive alien species. The invasion process has a considerable impact on native vegetation and implies preceding human or natural disturbances. We conducted a vegetation survey on a 65 km tributary river in Tuscany (Italy) to investigate whether alien species have a differential impact on riparian native plant assemblages according to different structures of native vegetation (woodlands, shrublands and herbaceous communities). The sampling was systematic along the entire river length: 32 500m-long areas were selected. Within each bank of selected areas, plots were placed randomly in a 40 m transversal strip stratifying according to a threshold distance of 20 m. In addition to species cover, four groups of environmental variables were measured for each plot. They were related to transversal gradient, topography and pedology, disturbance, and alien species. Response variables were native species richness, H' diversity index, evenness, and community composition. We partitioned the variance of each analysis to disentangle the magnitude of variation explained by four groups of predictors. We found that 27 out of 508 species were alien (5.3%). Species richness and Shannon diversity were significantly explained by the overall analysis for woodlands and herbaceous communities, but not for shrublands. The independent effect of topography and pedology and alien species was significant for species richness of herbaceous communities but not for woodlands. Same independent group portions were significant in explaining the diversity of woodlands and herbaceous communities. Community composition was significantly and differentially explained by each group of predictors only in woodlands. In conclusion, riparian woodlands resulted more affected by alien plant invasion, hence they require higher level of conservation management.

Talk

Landscape history matters in explaining current patterns of species and genetic diversity within forest plant metacommunities

Prof. Guillaume Decocq[1], Prof. Annie Guiller[1], Dr. Thomas Kichey[1], Dr. Kathreen Van de Pitte[2], Mrs Emilie Gallet-Moron[1], Prof. Olivier Honnay[2], Dr. Déborah Closset[1]

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Habitat fragmentation and land use intensification are major threats to biodiversity worldwide, affecting both species (SD) and genetic (GD) diversity. It remains unclear whether SD and GD respond to the same components of landscape changes and to what extent they correlate in fragmented systems. In this study, we investigated the role of current and past patch and landscape features on SD and GD in and between forest fragments, along a gradient of landscape matrix permeability. Within three contrasted agricultural landscapes of northern France, we assessed vascular plant SD and the GD of two plant species with contrasted life history traits in all forest fragments, namely the forest specialist Primula elatior and the generalist Geum urbanum. Species richness and expected heterozygosity were taken as proxies for SD and GD respectively. Using regression and correlation analyses, we sought relationships between SD and GD on the one side and local, landscape and historical factors on the other side; as well as between SD and GD. We found that when landscape permeability is above a certain threshold, SD and GD appear to be patterned by the same processes, which results in a positive SD-GD correlation. This permeability threshold is species-specific, depending upon species' dispersal traits and niche width. The SD-GD correlation depends upon current and past landscape permeability, so that the lack of correlation emerges as the rule in weakly permeable landscape matrices. We conclude that landscape matrix permeability drives SD and GD of vascular plants within and between forest fragments. A generalist, fast-colonizing species better reflects diversity patterns in agricultural landscapes.

Talk

Mycorrhizae and plant assemblages in a Neotropical hotspot: the Andean páramo

Ms. María Díaz[1], Ms. Daniela León[2], Dr. Gwendolyn Peyre[1]

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The páramo belongs to the Tropical Andes biodiversity hotspot and figures as a unique high-mountain ecosystem with important plant richness and endemism. Nevertheless, it is seriously threatened by human activities and climate change. The páramo microbial diversity remains vastly understudied despite their crucial importance in community ecology and biogeography. Our study aims at modelling the current distribution of mycorrhizae communities in the Colombian páramo using their host plants as proxy. We set two specific objectives: i) predict the current distribution of mycorrhizal plants, altogether and per mycorrhizal type, as well as non-mycorrhizal plants, and ii) characterize the mycorrhizae patterns along the elevation gradient. We performed species distribution models for 507 plant species representative of the Colombian páramo using 8 climatic and edaphic variables. We classified species according to their main mycorrhizal type (Arbuscular, Orchid, Ericoid, Ectomycorrhizal, Non-mycorrhizal), considering their mycorrhizal status coefficient. We stacked the models per mycorrhizal type, altogether and non-mycorrhizal. Finally, we density-ranked each cathegory along the elevation gradient (3.000-5.000m). We identified that the Colombian western cordillera, even though the smallest, is generally more diverse in mycorrhizae in terms of types and abundance, whereas the drier paramos of the eastern cordillera such as Cocuy were less diverse. Moreover, we could identify type specificities, for instance, Orchid showed little representation in the northern paramos of Santa Marta. Overall, we observed a decreasing gradient in mycorrhizae presence with elevation. At low elevations, diverse mycorrhizae at the community level could relate to vegetation complexity and competition, whereas at high elevations, mycorrhization could mean facilitation and better use of resources. In conclusion, our results contribute to our understanding of mycorrhizae biogeography and ecology in the Colombian páramo, and can be furthermore used to generate alternatives for conservation and management.

Talk

Early establishment and seed bank of Sporobolus cryptandrus (Poaceae) – a new invasive species in sand grasslands of Hungary

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Sporobolus cryptandrus (sand dropseed), a perennial C4 bunchgrass native to North America is considered an invasive species in Europe. In Hungary, widespread stands of Sporobolus cryptandrus were discovered at over 620 individual locations in the Kiskunság and Nyírség regions between 2016 and 2020. Our aim was to study the current distribution, the germination and seed bank formation of the species. The effects of soil burial and litter covering on the germination of the species were studied in a germination experiment. We also assessed the density and vertical distribution of its seed bank, by collecting intact soil cores (10-cm-deep, 4cm diameter) from grassland stands with different levels of invasion. Germination of Sporobolus cryptandrus was negatively affected by both litter cover and 1-cm-deep soil burial. On the other hand, we found that the increasing cover of S. cryptandrus significantly affected the species richness and abundance of subordinate species, besides viable seeds of S. cryptandrus 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 likely form a persistent seed bank. The persistence of the species suggest that it spread form a threat for dry sand grasslands and steppes in Eurasia. We can conclude that for developing an appropriate strategy for its suppression, we need further information on the following crucial aspects of its life history: its competitive ability including its potential allelopathic effects; its seed bank formation potential in habitats with different abiotic conditions; and possibility of its suppression by natural enemies and management techniques such as mowing or livestock grazing. Nevertheless, we have to pay more attention with the forecasted climate change scenarios, which are working in favour for its establishment and spread in other sandy areas in more northern regions.

Talk

Functional response of the macrophyte species Limosella australis R.Br. to combined biotic interactions and thermal stress. Consequences for aquatic ecosystem productivity and nutrient cycles

Ms. P. Douce[1], Mr. L. Simon[1], Mr. F. Mermillod-Blondin[1], Mr. D. Renault[2,3], Ms. F. Colas[1], Ms. C. Sulmon[2], Mr. R. Dubreucque[1], Mr. T. Guiguitant[1], Ms. M. Couty[1], Ms. A.-K. Bittebiere[1]

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All climatic scenarios predict that both temperatures and their variations should increase in the forthcoming decades, with side-effects on plant growth that should ultimately affect interactions between species and ecosystem functioning. Climate change effects are especially severe in aquatic plants (i.e. macrophytes). Plant traits of response to biotic and thermal constraints of their habitat could constitute effect traits i.e. influence the aquatic ecosystem functioning. Indeed, these responses rely on variations in foliar traits and nutrient or biomass allocations within the individual, which could then influence at the ecosystem scale, productivity and nutrient cycling. We tested this hypothesis through a two phases experiment in mesocosms, using the macrophyte species Limosella australis as target. First, individuals were cultivated under three temperatures (13°C, 18°C, 23°C) and three competition modalities (no-competition control, intraspecific competition, interspecific competition) (nine treatments in total). We assessed their functional responses to combined thermal stress and interactions. Second, litter bags were prepared from these individual biomasses, and decomposed with an individual of L. australis under the same three temperatures in mesocosms. Nutrient flows within the ecosystem between plants, sediments, water, and litter were assessed through 13C et 15N isotopes tracing. Preliminary results show that plants Leaf Dry Matter Content (LDMC) decreases under thermal constraints but increases under intraspecific competition. The effect of the LDMC variation on the quality of the litter produced is being analyzed. The second phase of the experiment is still running but we expect a stimulation of the nutrient's fluxes under rising temperatures and an increase of the plant growth in return.

Talk

Forests in transition: lessons learned from large data on forest dynamics

Dr. Adriane Esquivel Muelbert[1], Prof David Galbraith[2], Prof Oliver Phillips[2], Rainfor network

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- Background

Natural systems are suffering pervasive alterations as a consequence of global change.

These changes are likely to be slower in ecosystems with long-living individuals, such as forests. In these systems, large-scale mortality events will significantly affect the system's stability. Long-term records of inventories of vegetation allow us to quantify these changes and assess their drivers.

- Material and methods

We assessed data from over 30 years of forest monitoring across the Amazon, the largest and most diverse tropical forest on Earth, to investigate the changes in forest dynamics, structure and community composition, both functional and floristic. Following a fingerprinting approach, we used these data to evaluate the potential drivers of the observed changes in vegetation.

- Results

We observed significant changes in abundance for major Amazonian taxonomic groups and community shifts toward larger taxa. Recruitment within drought-tolerant taxa has increased relative to the overall community, whilst we observed an increase in the mortality of drought-vulnerable taxa, particularly in those areas where dry climatic events have intensified over the last 30 years. Forest structure has been changing favouring larger individuals. Tree mortality has increased mostly in the Southern regions of the Basin, which is both the warmest and driest of all regions.

- Conclusions

Intact Amazonian forests are changing significantly, likely as a consequence of increased atmospheric CO2 concentrations and droughts. Although changes seem to be pervasive, the Southern region of the basin has changed the most, reflecting the dramatic changes in climate and landscape observed for this region. If current trends continue into the future, this region is likely to shift to a new stable state.

Talk

Phylogenetic diversity is a weak proxy for functional diversity but both contribute to community assembly patterns in temperate vegetation types

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Ecological differences among species – and communities – can be determined by considering measures of functional and phylogenetic differences in a complementary way. Here, we studied the relationship between functional (FD) and phylogenetic diversity (PD) in communities of 28 temperate vegetation types using plant functional traits that take into account multiple dimensions of plant strategy (leaf, floral and reproductive, clonal and bud bank traits). We tested whether (i) PD was correlated with FD within and across traits and vegetation types, (ii) the PD-FD correlation depended on the phylogenetic conservatism of the traits, as well as whether (iii) functional similarity or dissimilarity of co-existing species changed when accounting for their phylogenetic relatedness. We used Pearson correlations to assess PD-FD relationships and tested whether the strength of the phylogenetic signal (Pagel's lambda and Blomberg's K) can predict these correlations. We computed the 'decoupled FD' (i.e. 'pure' functional diversity, variation unrelated to phylogenetic distances) to quantify ecological differences across species within communities. We found that the correlation between FD and PD was mostly significant but rarely strong; and largely depended on the studied functional traits and vegetation types. The strength of the phylogenetic signal did not explain consistently the strength or the direction of the PD-FD correlation. Community assembly patterns within vegetation types tended to shift from under-dispersion towards over-dispersion when the phylogenetic and functional distances were decoupled; however, we found the opposite patterns for floral and belowground traits. Therefore, instead of focusing on the correlation, i.e. 'overlap' between phylogenetic and functional information, it might be more revealing to tease apart the unique contribution of the two facets of ecological differences between species. Decoupling functional and phylogenetic differences, in fact, might provide further insight into the hidden patterns (and processes) of plant community assembly.

Talk

Links between soil properties and plant community composition in nutrient-poor habitats

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How is the availability of different nutrients influencing plant species composition in threatened nutrient-poor habitats? We asked this question in order to better understand the role of nitrogen deposition for vegetation change, focusing on three protected European nutrient-poor habitats: dry acidic grassland, European heath and calcareous grassland. We were particularly interested in whether soil nitrogen availability was linked to species composition and to the number of characteristic species within these habitats. Vegetation surveys were conducted in 108 field plots across southwestern Germany. Additionally, samples from the topsoil (0-10 cm) were collected and analyzed for extractable mineral N, phosphate-P, K, Ca, Mg, Fe, Al, total N and organic C concentrations (Corg) and pH. Links to community composition were analyzed using Mantel tests while links to the richness of different species groups were analyzed using generalized linear models.

In acidic dry grassland, differences in species composition were mainly driven by pH, Ca and the ratio of available nitrogen to available phosphorus concentrations (N:P ratio). The number of characteristic poor-soil specialists was negatively related to Corg. In European heath communities, species composition was influenced by pH and nitrate availability with poor-soil specialists being positively related to Corg and negatively to N:P ratios. In contrast, we found only weak relationships between soil properties and variation in community composition for the investigated calcareous grassland sites. Instead, observed differences were related to slope and climatic variation at broader scales.

For acidic dry grassland and European heath, our results suggest a sensitivity of community composition to nitrogen intake. The results for calcareous grassland sites suggest a greater influence of water availability in comparison to nutrients. We discuss methodical limitations and how the observed links can be interpreted in terms of succession, disturbance and management practice.

Talk

Are global carbon sinks destabilising?

Dr. Marcos Fernández Martínez[1,2,3], Prof. Josep Peñuelas[2,4], Dr. Frederic Chevallier[5], Dr. Philippe Ciais[5], Dr. Michael Obersteiner[6,7], Dr. Christian Rödenbeck[8], Dr. Jordi Sardans[2,4], Dr. Sara Vicca[1], Dr. Hui Yang[5], Dr. Stephen Sitch[9], Dr. Pierre Friedlingstein[10], Dr. Vivek Arora[11], Dr. Daniel Goll[5], Dr. Atul Jain[12], Dr. Danica Lombardozzi[13], Dr. Patrick McGuire[14], Prof. Ivan Janssens[1]

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Global net biome production (NBP), or net land carbon uptake, has been repeatedly shown to increase during recent decades. However, whether the temporal variability and autocorrelation of NBP has changed during this period remains elusive. Answering this question is particularly relevant given that an increase in both could indicate destabilising C sinks and potentially lead to abrupt changes. We investigated the trends and controls of net land C uptake and its temporal variability and autocorrelation, from 1981 to 2018, using two atmospheric inversion models, the amplitude of the seasonal cycle of atmospheric CO2 derived from nine monitoring stations distributed across the Pacific Ocean, and 12 dynamic global vegetation models. Spatially, we found that plant biodiversity presented a convex parabolic relationship with NBP and its temporal variability at the global scale while nitrogen deposition generally increased annual NBP. Our analyses showed that, globally, annual NBP and its temporal variability increased during the study period. Globally, temporal autocorrelation did not consistently change. Nonetheless, we observed that regions characterized by destabilising NBP (i.e., where temporal variability and autocorrelation concomitantly increased), which were associated with increasing climate variability, showed lower annual NBP and weaker trends than regions where NBP became more stable, which showed higher annual NBP and stronger trends. Increasing temperature and its temporal variability appeared as the most important drivers of declining and destabilizing NBP. Our results highlight different regions of the planet where NBP is destabilising, and points out to climate change as the most likely cause for the observed destabilisation.

Talk

Microspatial models of plant extinctions within an alpine species pool

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In alpine landscapes, topography creates a mosaic of microclimatic niches which might buffer macroclimatic warming, preventing local and regional plant extinctions. However, the conservation of a given alpine species pool by microclimatic buffering will depend on the availability of suitable microniches for each species and the maintenance of microniches under climate change.

We measured temporal (10 years) and spatial (10 m transects) changes in soil temperatures and plant species composition within a long-term monitoring of the alpine landscape of Picos de Europa (Spain), a mountain massif at the transition between temperate and Mediterranean climates. With the temporal survey, we created four climate change scenarios based on the assumption that current extreme years would become the new normal. With the spatial survey, we fitted GLMs of species presence as a function of soil microclimate and employed them to predict species extinction probability in each scenario.

Spatial changes in temperature and species composition were reduced into two axes of variation: increased annual accumulation of growing degrees-day (GDD) and freezing degrees-day (FDD). Based on this, we established four climate change scenarios: hot-snowy, hot-frozen, cold-snowy and cold-frozen. GLMs predicting species presence as a function of GDD and FDD were fitted for 16 species with significant effects, out of 86 in the system. The scenario with the highest number of extinctions was hot-frozen (9), followed by hot-snowy (6), cold-frozen (6) and cold-snowy (1).

Our results suggest that microspatial surveys are necessary to identify which alpine species are associated to specific topographic microniches. In our study, a change towards oromediterranean conditions (hot summers and snow-free, frosty winters) involved the highest number of presumed extinctions. Assuming that annual temperature is bound to rise, future precipitation will determine whether the study system follows a snow-free or a snowy scenario, ultimately affecting the persistence of the local species pool.

Talk

Designing communities for trait-based-biodiversity-experiments: new tools to explore functional trait effects on ecosystem stability

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Biodiversity experiments are a widespread tool to understand key mechanisms on how natural and semi-natural communities respond to climate change and the role of biodiversity on ecosystem functions and stability. More recently, experiments have also taken into account species` functional traits, although specific care is needed in designing trait-based-biodiversity-experiments (TBBE). Indeed, the design should not only aim for maximizing the range of communities´ functional metrics but also consider issues such as a) non-independence between functional diversity (FD) and dominant traits values estimated by Community Weighted Means (CWMs); b) natural and random assembly processes taking place and possibly shifting the intended sown communities, via different rates of dominance, germination/death, and intraspecific trait variations, thus altering FD and CWMs. So far, no standardized method exists for designing TBBEs considering those issues. We propose here an R package that aids in designing TBBEs, by the means of two functions: 1) maxtraits, which suggests the best combinations of species to be sown in each artificial community to maximize the range of FD and CWMs while minimizing their collinearity; 2) rabast, which explores different scenarios of mortality rates, dominance, and intra-specific trait variation. We applied the functions to simulated data to test the premises and robustness of the experimental design and then compared the results to real data from a 1-year greenhouse experiment. rabast showed that each scenario of different levels of intraspecific trait variation, dominance, and mortality, produce different shifts in CWM and FD metrics, but generally did not invalidate proposed communities from maxtraits, especially in richer communities. Similar results were obtained with real experiment data, where we observed a relevant shift in community characteristics between the intended (sown) and the resulting combinations, however maintaining suitable ranges of the experimental variables (CWM, FD) and the lack of dependence among them.

Talk

Is ash an important cue to the germination of fire-stimulated Cerrado species?

Mr. Hudson Fontenele[1,2], Dr. Heloisa Miranda[2]

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Fire-stimulated flowering is a common strategy found in plants from fire-prone ecosystems. In some cases, individuals are triggered to resprout and flower within weeks after fire, dispersing seeds in the recently burned area. Reproduction benefits from the post-fire conditions as pollination and seed dispersal are increased, competition is reduced, and vegetation gaps are cleared. The seeds may also interact with byproducts derived from plant burning such as ash and charred wood, and these chemical fire-cues may stimulate the germination of physiologically dormant seeds. In the Cerrado ecoregion, many species from the ground layer are fire-stimulated but their seeds are rarely investigated. To address this knowledge gap, we examined the quality and the germination of 13 species (three forbs, three subshrubs, and seven graminoids) that disperse seeds within three months after fire. We estimated the amount of empty, filled, and predated seeds for each species, and also tested the germination with or without ash. All grass species produced <15% filled seeds and no signs of pre-dispersal predation were observed. Dicots produced over 35% filled seeds, but showed 1–15% predation rates. Most of the studied species had non-dormant seeds (10 out of 13 species). Ash stimulated the germination of two species with dormant seeds, but inhibited the germination of four non-dormant species. Overall, the seeds produced in response to fire are an important source of genetic variability in an ecosystem that has resprouting as the main persistence strategy. Although dicots produced better quality seeds, grasses tend to produce larger seed sets, suggesting different reproductive strategies. As most species are non-dormant, ash is not important to the percent germination of most fire-stimulated species. Ash may also be completely washed away by rains before seeds are dispersed and may not have any effect under field conditions.

Talk

Species' Suite Shifts to Disturbance and Climate Regime Shifts

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Forecasting community responses to disturbance has always been a central tenet of ecology. Numerous studies have shown species-specific responses to climate change and disturbance; however, species in a community may respond as a unit due to analogously evolved strategies for particular conditions and interspecific dependency. We examined this possibility with two case studies: a flooding disturbance gradient of the Mississippi River, and a 700 m elevation gradient of Colorado Front Range forests. The objective of this research was to determine if shifts in the disturbance regime (Mississippi River Islands) or climate (Colorado Front Range) result in predictable shifts in plant communities. For each case study, we assessed elevational shifts based on vegetation data from two sampling times using similarity indices and tested for significance with permutation analyses. We hypothesized that a shift in disturbance or climate regime up the elevation gradient would be mirrored by an upward shift in plant communities adapted to that regime, and that shifts would depend on site-specific conditions (thalweg vs. backwater for Mississippi Islands, mesic vs. xeric for Colorado Front Range forests). Although dominant trends were either a lack of change or species-specific responses (i.e., Gleasonian or individual phase shifts), we found some evidence of community phase shifts (i.e., Clementsian) in both data sets, partially supporting our hypothesis. Although dissimilarities were generally lowest between plots at the same elevation for the Colorado Front Range data, the vegetation in mesic sites from 1973/74 at 2440 to 2515 m elevation was more similar to the vegetation from 2013/14 at 2515-2590 m elevation, and this similarity was higher than by chance suggesting an upslope community phase shift. For the Mississippi River Islands data, highest dissimilarities were observed between plots at mid-elevations where species richness was highest. The only evidence for community phase shifts was on channel side vegetation.

Talk

Decoupling dark diversity affinities of species and sites using Bayesian method: what accounts for absences of suitable taxa?

Dr. Junichi Fujinuma[1], Dr. Meelis Pärtel[1]

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Biodiversity in any site is ultimately limited by its specific species pool size. In addition, many species from the pool are still absent and form the dark diversity of that site. But why a species in a site is in dark diversity? Some species traits and site characteristics have been considered important, but separate analyses on species or sites might be confounded. The situation is even more complicated if we consider dark diversity a fuzzy set (probabilistic memberships). Here, we proposed a conceptual measure, dark diversity affinity (DDA), which scales the tendency of individual species to belong to and sites to have dark diversity, regardless of site-specific suitabilities for species. We developed a Bayesian model that interrelated four datasets: species x sites matrices of occurrence and suitability, species traits, and site characteristics. In the model, species and site DDAs were associated with site-specific suitability to predict presence/absence of each species at each site. Furthermore, DDAs of species and sites were independently predicted by logistic regression sub-models to explore the effects of species traits and site characteristics shaping their DDAs.We applied the model to three empirical and contrasting datasets of plant metacommunities from CESTES database. The results detected certain species traits and site characteristics had consistent effects on their DDAs across different datasets. Namely, plant height and long lifespan of species reduced species DDAs and older sites showed less site DDAs, whereas other factors contributed differently, depending on taxonomic group and site network properties. Our modeling approach efficiently decoupled species and site DDAs, providing more information than conventional methods which, for example, assessed site age separately from species traits potentially confounding plant and vegetation height with site DDA. The new method can identify underlying processes of dark diversity, advancing both the theory of community ecology and biodiversity conservation.

Talk

Can creation of natural forests by the Miyawaki method contribute to human life?

Prof. Kazue Fujiwara[1]

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Introduction: The creation and/or restoration of natural forests by the Miyawaki method began in the 1970's and thus has a 50-year history. We aim to create forests that will last for thousands of years, through dense planting, mixed planting, and random planting using seedlings of natural forest composition. The rapid growth due to dense planting not only fixes carbon dioxide but also supports various forest functions such as habitat for mammals and birds, mitigation of disasters (fire, tsunami, flood, etc.), and protection against wind, salt splay, sand, noise, dust, etc. Methodology involves measurement of growth rate and CO2 sequestration, newcomer natural species, checking fire disaster area, flooding effect, etc. Results: carbon-dioxide fixation, natural newcomer species, soil development, and temperature control were assessed through growth surveys. Target: Introducing examples of warm-temperate broad-leaved forests, temperate deciduous broad-leaved forests, and tropical forests of various ages. Conclusion: Dense planting is effective even with a width of 1 m, but edge effect can be minimized by having a width from 5 m. The effects of mini-forests have been confirmed, but the maximum effect can be obtained by making the forests as wide as possible.

Talk

Long-term post-fire dynamics of alternative vegetation states in a seasonally dry subtropical forest

Prof. Melisa A. Giorgis[1], PhD Pedro Jaureguiberry[1], PhD Lucrecia Lipoma[1,2,3], PhD Seballos Zeballos[1], Prof. Ana M. Cingolani[1]

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Background

Fire is a key factor maintaining alternative biome states in tropical and subtropical seasonal climates, potentially covered by forest. Several studies have explored the short-term dynamics of contrasting vegetation physiognomies following fire; while very few have tracked such responses in the longer term. Our aim was to evaluate how floristic composition and physiognomy vary over time in treeless physiognomies and forest patches with different fire histories in a subtropical dry forest.

Material and methods

In 2008 we selected 35 plots in forests, shrublands and grasslands, resulting from different fire histories and other environmental factors. In September 2011 a fire burned 16 plots, including one forest and several shrublands and grasslands. Floristic and physiognomic surveys were performed at the end of each growing season in 2008, five months after the 2011 fire and subsequently every two years until 2020.

Results

Burned shrublands recovered the pre-fire floristic composition after three growing seasons and their physiognomy after five seasons. Burned grassland recovered their pre-fire floristic composition after five growing seasons and their physiognomy after only one season. The burned forest plot was transformed into a shrubland, and remained as such over time. Floristic composition and physiognomies of plots that did not burn in 2011 changed over time, but the changes were always less pronounced than in the burned sites.

Conclusions

Our 12-year tracking study shows that fire can have long lasting effects in forest patches, transforming them into shrublands. Burned grasslands and shrublands can return to the pre-fire state in a short time, differing in the recovery times for floristic composition and physiognomy. Our results have important implications for fire management and the conservation of the different physiognomies in the region, where highly fragmented forest patches only account for 5% of the landscape cover, compared to 30 % for shrublands.

Talk

Invasive plants use similar seed banking strategies at home and abroad

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Predicting the main drivers of invasions by alien plants is critical to preventing potentially harmful introductions in an era of globalization and global environmental changes. The ability to form reserves of seeds that can persist in the soil over multiple regeneration seasons is a strategy that allows a species to persist in the soil under adverse conditions for growth and development, while spreading mortality risks through time. Yet, global assessments of whether naturalized flowering plants use similar seed banking strategies in the native and alien range and the conditions required to form persistent seed banks are lacking. To address this issue, we used global soil seed bank data (GloSSBank) to test two hypotheses, in a phylogenetic framework. First, we used local seed banks data for 223 naturalized species at 5,345 sites, to test whether these species use a similar seed banking strategies (transience versus persistence) and form seed banks of comparable densities at home and abroad. Then, we tested the effect of seed bank properties, species traits (seed dormancy, seed mass, and life form), and local environmental conditions on the probability of 2,350 native species to become naturalized (naturalization incidence) and the extent (number of regions) of naturalization, at 11,893 sites. Overall, local seed bank type and densities of invasive species were similar in the native and alien range. The ability of forming persistent seed banks affected naturalization incidence and extent directly, while seasonal precipitation and temperature had indirect effects via seed bank properties and seed traits. These findings suggest that the ability to form persistent (versus transient) seed banks is a useful preadaptation leading to naturalization in the alien range. They also provide new insights into relationships between environmental variables, seed bank and species properties, with naturalization incidence and extent.

Talk

Applying coexistence theory to restoration: Overview and empirical examples.

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A common procedure to evaluate whether a restoration action was successful is to focus on species abundances after a short period of time. However, such changes do not inform often of the long-term restoration dynamics. Here, I present an overview of how we can use theory of species coexistence to better inform the degree of success in a restoration action. This overview stems from long discussion that an ample group of researchers, from theoreticians to practitioners, have had during the last two years. Rather than focusing on changes in species abundance, the combination of theory with population models posits that low-density growth rates (i.e. the ability of a species to increase when rare) is a better metric than species abundances to predict the long-term trajectories of a restored community. This is because the low-density growth rate of a population is directly related with their extinction probability.

This ability of coexistence theory to inform restoration processes is in addition exemplified with the restoration of a native annual plant species in vernal pools of California. These pools have been invaded by several exotic species. The comparison of natural (reference) pools versus constructed (restored) pools indicates that the restored species did not persist in the restored pools after an initial increment is species abundances because it experienced multiple years of negative low-density growth rates. Because the models allow assessing the strength of species interactions between the native restored species and the exotic, we identified the threshold needed of exotic removal to revert this situation. In sum coexistence theory can better inform whether a restoration action is successful, and if not, it can give guidance to change restoration outcomes.

Talk

From light to shadows: long-term shifts among the forest vegetation communities in the Czech Republic

Dr. Radim Hédl[1,2], Dr. Ondřej Vild[1], Dr. Markéta Chudomelová[1], Dr. Petr Halas[3], Dr. Martin Kopecký[1,4], Dr. Martin Macek[1], Dr. Petr Petřík[1], Jindřich Prach[5,6], Dr. Jan Šebesta[7], Marie Smyčková[4], Martin Vojík[8]

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Plant communities worldwide have undergone significant anthropogenic changes in the past decades. The relevant processes have been studied mainly with a focus on changes in diversity and composition. We asked whether similar shifts can be traced at the level of plant community types. This approach not only has scientific potential, but it can provide irreplaceable information for conservation and management.

We compiled a database of vegetation-plot samples resurveyed in average after five decades. The plots represent temperate forest communities in the Czech Republic, thus reflecting the situation in central Europe. The baseline and resurvey samples were classified into vegetation types using an automated expert system developed for vegetation classification in the Czech Republic. The resulting fine classification was aggregated into eight broadly defined forest types and pairwise shifts at the vegetation plot level were analysed. Support for ecological interpretations was provided by Ellenberg indicator values as well as changes in diagnostic species.

The observed trend shows a shift from oligotrophic open-canopy forest types to nutrient-rich closed-canopy communities. This successional dynamics is not uniform along its gradient: open-canopy forest types on poor soils, mainly pine and various types of oak forests, have undergone major shifts, while at the other end of the spectrum, represented mainly by beech, ravine and floodplain forests, they have remained relatively stable or gained in abundance.

The observed changes corroborate and widen current views on long-term anthropogenic trends in forest plant communities. The approach of analysing changes in community and habitat types provides a new perspective following the best traditions of vegetation science. We believe that similar studies can be carried out at a continental level and in other vegetation types.

Talk

How rare are rare events and how they look like?

Dr. Tomas Herben[1], Dr Frantisek Krahulec[1], Dr Vera Hadincova[1], Dr Sylvie Pechackova[1], Dr Hana Skalova[1]

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Abundance fluctuations are ubiquitous phenomenon in population biology. Any long-term monitoring of plant populations shows fluctuations in population sizes, although their causes are often unclear. We used a 35 years long data on numbers of individuals in permanent plots in a mountain grassland to determine how common such fluctuations are, whether they are spatially correlated, what are typical time scales at which they are found, and to search for general mechanisms behind these fluctuations. As spatial correlation is the key signature of environmentally driven abundance fluctuations, we distinguished spatially uncorrelated fluctuations which are likely to be due to different drivers than climate. We are further using Fourier analysis of their time series to find their typical time scales. Finally, we are asking whether spatially uncorrelated species increases or declines are exponential in nature. Cases of exponential increase are likely to be driven by short-term releases of population control and loss of density-dependence and thus loss of negative feedback in species abundance. Our data show that such events constitute majority of species increases. Similarly, exponential decreases is likely to be driven by a sudden appearance of such controlling agent; however in contrast to increasing events, declines are typically are not exponential, indicating still a different mechanism.

Talk

Taxonomical and functional changes in dry grassland vegetation after 30 years

Ms. Susanne Horka[1,2], Dr. Ute Jandt[1,2], Prof. Dr. Helge Bruelheide[1,2]

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Dry grasslands on porphyry outcrops in Central Germany are part of the Natura 2000 habitat system and extremely rich in plant species, but have suffered from increasingly frequent drought events, variation in grazing management and intensification of agricultural use of the surrounding landscape. To explore how plant diversity has changed taxonomically and functionally in the last decades we resurveyed 151 plots that were originally recorded in 1993. To asses changes of species frequency, we calculated taxonomic (species richness, community composition) and functional changes (community-weighted mean traits). Furthermore, we measured microtopography (aspect, slope) and soil variables (depth, texture, pH, C, N) and related it to the resurveyed vegetation data. On average, we found increased species richness in plots with lower mean vegetation cover, mainly due to annual species, as well as a considerable shift in species composition, mainly brought about by ruderal species. Regarding top soil properties, plant community distribution was mainly affected by soil pH and C/N ratio as well as a low water-holding capacity caused by sandy soil texture. Abandoned sheep grazing benefitted certain species, such as grasses. Among sites, the former variation of species richness and beta diversity decreased, most notably between the sites surrounded by arable fields. Changes in land-use have significantly affected the species composition of grassland communities on porphyry outcrops in Central Germany. While dispersal of species with certain characteristics seems to be promoted by the surrounding landscape matrix, the spread of rare characteristic grassland species seems to be impeded. This resulted in maintenance of plant diversity at the local scale but declines at the landscape scale. These findings highlight the importance of biodiversity change assessments at different spatial scales.

Talk

A global assessment on the effects of plant functional redundancy on grassland ecosystem' stability during climatic anomalies

Dr. Daniela Hoss[1,2], Thore Engel[1], Eduardo Vélez-Martin[4], Francesco Sabatini[5,3,1], Helge Bruelheide[3,1], Valério Pillar[2]

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Biodiversity may provide stability on ecosystem functions during climatic anomalies. The relationship between biodiversity and ecosystem functioning under climate change, however, has mainly been studied through fine-scale experimental approaches, and under a limited set of climatic conditions, while a global analysis across continents is lacking. Here we evaluate whether plant communities with higher diversity and redundancy provide increased ecosystem stability, measured both as resistance and resilience to change, under climatic anomalies in grassland ecosystems worldwide. We derived data on functional community structure from sPlot, the global vegetation plot database, and plant trait data from the database TRY. For each plot location, we extracted a 18-year (2000-2018) monthly time series of NDVI at a spatial resolution of 250 m using the MODIS product MOD13Q. We identified climatic anomalies using the SPEI index, which quantifies temporal variations in water balance at a 0.5-degree spatial resolution. After calculating the baseline as the mean monthly NDVI observed in normal SPEI months, for each plot we quantified resistance as the relative change of NDVI from its baseline, and resilience as the rate of return to the baseline. Based on linear mixed effects models, we found that plant biodiversity is predictive of resistance and resilience in grassland ecosystems worldwide, but the direction and strength of these effects depend on the evaluated diversity metric, the community functional structure, and the direction and intensity of the climatic anomaly.

Talk

Preliminary vegetation macrogroups for the Northern Territory, Australia based on an analysis of a large plot-based dataset

Dr. John Hunter[1], Dr Donna Lewis, Dr Eda Addicott, Dr Sarah Luxton, Dr Ian Cowie, Dr Ben Sparrow, Dr Emrys Leitch

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The Northern Territory of Australia covers an area of 1.42 million square kilometres, almost 20% of Australia's land mass. Broadly, the Northern Territory comprises three distinct climatic zones including tropical (savanna and rainforest), subtropical and arid vegetation types. Using 45,710 plots we used semi-supervised classification methods to define an interim classification of the vegetation of the Northern Territory at the International Vegetation Classification division (level 4) and macrogroup (level 5). We propose 21 macrogroups based on the results of floristic analysis and place these within higher thematic levels of the International Vegetation Classification. We found that the International Vegetation Classification hierarchy and associated standard procedures and protocols provide a useful classification tool for Australian ecosystems. The divisions and macrogroups provide a valid framework for defining Northern Territory vegetation types at the detailed levels of the International Vegetation Classification, including group (level 6), alliance (level 7) and association (level 8). A consistent typology for the Northern Territory (and hopefully in future, Australia) has numerous benefits, in that they can be used for various applications using a well-structured, systematic and authoritative description and classification that is placed in a continental and global context easily enabling the one system to be used in studies from the local to global level.

Talk

Reproductive patterns of snowbed specialists and alpine generalists in Pyrenean snowbeds in years with contrasted snowpack duration

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Predicted effects of climate change in the Pyrenees point to an increase of mean temperatures and a reduction of rainfall, which may lead to a reduction of snowpack duration. In alpine areas, snowbed communities thrive in places where snow lasts until mid-summer. Snowbed specialists are adapted to complete their reproductive cycle in a short period of time, but they may be threatened by alpine generalists from the surrounding grasslands if these latter species succeed in establishing and reproducing in snowbeds. Within this context, our aim was to study the phenological development of a set of snowbed specialists and alpine generalists in 11 Pyrenean acidic snowbeds and unveil if alpine generalists are able to successfully complete their reproductive cycle in snowbed environments in contrasted years concerning snow cover duration.

In the study sites, we established 3 permanent plots subdivided into 12 50x50 subplots, where in 3-4 visits throughout the summer between years 2017 and 2021 we monitored the main phenological stages of the most advanced individual for all species present. We then computed the mean phenological value al plot level for each visit date and related it to the number of days from snowmelt, in order to establish the developmental rate of the different sets of species depending on the year condition.

Snowbed specialists achieved seed dispersal faster than alpine generalists and did not show significant differences in the duration of their reproductive cycle between years with contrasted snow cover duration. On the contrary, alpine generalists developed faster the year with longer snow cover duration, adapting to varying growing season lengths. Moreover, according to our predictions, many of them may be able to currently reach seed dispersal the years with longer snowpack, representing a real threat for snowbed specialists if they succeed in colonizing snowbed environments.

Talk

Climate drivers of biodiversity in European fen vegetation

Dr. Borja Jiménez-Alfaro[1,2], Michal Hájek[2], Teemu Tahvanainen[3], Tomáš Peterka[2], Florian Jansen[4], Aarón Pérez-Haase[5], Emmanuel Garbolino[6], Michele Carbognani[7], Tina Kolari[3], Petra Hájková[2,8], Ute Jandt[9,10], Liene Aunina[11], Pawel Pawlikowski[12], Tatiana Ivchenko[13], Marcello Tomaselli[7], Daniel Dítě[2,14], Zuzana Plesková[2], Petraglia Alessandro[7], Ondra Hájek[2]

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The predicted effects of a warming climate on mire ecosystems are related to changes in the length of the growing season and the disruption of local niches of plant specialists. However, understanding these effects at large scales is challenging due to the buffer effects of soil water and soil water pH and calcium. Here, we focused on European fens to address large-scale relationships between climate, soil properties and three Essential Biodiversity Variables: ecosystem distribution, taxonomic diversity and community composition. We hypothesized that climate effects differ across fen typologies defined by indicator species as a result of distinct ecological settings. We used a comprehensive vegetation database consisting of 27,556 plots assigned to eight EUNIS habitat or ecosystem types. To address the influence of climate and water soil factors on the distribution of discrete units, we computed Ecosystem Distribution Models using a Random Forest algorithm. The climatic drivers of community richness and composition of vascular plant and bryophyte fen specialists were evaluated by fitting Boosted Regression Trees and Community Dissimilarity Models, respectively. We found that European fen ecosystems, as defined by EUNIS typologies, are differently driven by climate and soil variables. By accounting for the effects of water pH, water calcium, and spatial distances, community richness and composition of fen specialists were similarly driven by temperature and precipitation, with specific responses of vascular plants and bryophytes for each habitat type. Our results provide evidence of climate effects on the biodiversity of mire ecosystems as a guide for assessing the potential impacts of climate change. However, these impacts will affect differently fen ecosystems differentiated by indicator species, with habitat-specific responses of vascular plants and bryophytes to changes in temperature and precipitation.

Talk

Habitat-specificity of climate-trait relationships in vascular plants

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Ecological theory of environmental filtering predicts close local relationships between microclimatic gradients and functional traits. Yet, on the global scale, climatic gradients are only weakly related to the trait composition of local plant communities, suggesting additional non-climatic factors are at play. To shed more light on this, we may need to investigate climate-trait relationships in more narrowly defined habitats.

We used generalized additive models to quantify the relationships between two major climatic gradients (Mediterranean and temperature gradient) and four key functional plant traits (plant height, specific leaf area, seed mass and specific root length) across > 300,000 European vegetation plots, each one assigned to a hierarchy from broad to more narrowly defined habitats (based on the EUNIS classification).

We found that the predictive power of climate increased from broader to more narrowly defined habitats for two out of the four traits (specific leaf area and root length). Although the two climatic gradients were significantly related to all four traits, these relationships varied with the width of the habitat definition and we found the highest degree of habitat-specific relationships in the most narrowly defined habitats.

We conclude that climate and local environmental factors jointly drive the functional composition of plant communities. As the relationships between climate and plant traits are not generalizable, the effects of climate change might play out differently, depending on the habitat investigated. Thus, predictions of the effects of climate on plant communities must account for habitat-specificity and how habitats are defined.

Talk

Leaf functional traits of *Rhododendron ponticum* invasive populations along an environmental gradient

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Although alien plant invasions are increasingly frequent, ecophysiological traits of successful invaders are still poorly investigated. Rhododendron ponticum subsp. baeticum is a shade-tolerant evergreen shrub native to the Iberian Peninsula, which has been introduced throughout Europe since the 18th century. It is now a strong invader especially in the British Isles and in forest ecosystems of the Atlantic biogeographic region.

To further our understanding of the species' invasiveness competitive below tree canopies, we measured a set leaf functional trait, including photosynthetic capacities, in 31 populations of R. ponticum distributed along an environmental gradient from Britany to Northern France, comparatively to the native evergreen shrub, Ilex aquifolium (holly). In addition, we explored the genetic diversity of R. ponticum using microsatellite markers and compared the relationship between heterozygosity and ecophysiological traits within and between the invaded and native ranges.

Our results highlight that physiological plasticity and phenotypic variability of rhododendron leaves depend upon light availability in the understorey and the position along the macroclimatic gradient across the invaded range. The photosynthetic capacity (Amax) of R. ponticum is positively impacted by both the canopy openness and low annual thermal amplitudes. In contrast, the native co-occurring species I. aquifolium exhibits a low physiological plasticity. We conclude that under "hyper-Atlantic" climate conditions forest understories provide rhododendron with a thermal stability and a shaded cover that could foster the allocation of foliar resources to photosynthetic functions. The invasiveness of R. ponticum subsp. baeticum can be explained by its ability to adapt to environmental conditions. The development of an approach combining ecophysiological modeling and genetic analyses will greatly improve our understanding of the invasion success of in European forests.

Talk

How to estimate woody aboveground biomass and biomass losses in disturbance-prone ecosystems

Ms. Liana Kindermann[1,2], Mr. Magnus Dobler[1], Ms. Daniela Niedeggen[3], Prof Anja Linstädter[1,2]

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Almost one third of global drylands are open forests and savannas, which are typically shaped by frequent natural and anthropogenic disturbances. Studies on ecosystem functions and services of woody vegetation require robust estimates of aboveground biomass (AGB). However, most methods have been developed for comparatively undisturbed forest ecosystems. As they are not tailored to accurately quantify AGB of small and irregular growth forms, their application on these growth forms may lead to unreliable or even biased AGB estimates in drylands. Moreover, these methods cannot quantify AGB losses caused by disturbance agents. Here we propose a methodology to estimate individual- and stand-level woody AGB in disturbance-prone ecosystems. It consists of flexible field sampling routines and estimation workflows for six growth classes, delineated by size and damage criteria. It also comprises a detailed damage assessment, harnessing the ecological archive of woody growth for past disturbances.

Based on large inventories collected along steep gradients of elephant disturbances in African dryland ecosystems, we compared the AGB estimates generated with our proposed method against estimates from a less adapted forest inventory method. We evaluated the necessary stepwise procedures of method adaptation and analyzed each step's effect on stand-level AGB estimation. We further explored additional advantages of our proposed method with regard to disturbance impact quantification. Disturbance impacts to each disturbance agent were quantified and compared between land-use types and vegetation types. Results indicate that a majority of growth forms and individuals in savanna vegetation could only be assessed if methods of AGB estimation were adapted to the conditions of a disturbance-prone ecosystem. Furthermore, our damage assessment demonstrated that one third to half of all woody AGB was lost to disturbances and that disturbance agents are interacting with each other. Consequently, less adapted methods may be insufficient and are likely to render inaccurate AGB estimations.

Talk

How clonal and bud bank traits may affect ecosystem functions?

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Plant functional traits may not only inform us about plant response to environment (response traits sensu Lavorel and Garnier 2002) but they may at the same time also affect ecosystem functions (effect traits). Leaf dry matter content may serve as example: it reflects plant strategy concerning carbon acquisition/conservation strategy and it also affect decomposition of litter and nutrient cycling. Clonal and bud bunk traits were so far rarely used as effect traits. I will show on several examples, namely along aridity gradient and along gradient of management intensity in temperate grasslands how clonal and bud bank traits may affect soil erosion, carbon sequestration, water and nutrient redistribution, etc. Taking into account clonal and bud bank traits when studying ecosystem functions would enable better understanding of mechanisms behind ecosystem changes due to various perturbations.

Talk

Detailed approach to urban protected areas downgrading, downsizing, degazettment and design of proposals – PA4D

Mr. Vitaly Kryukov[1], Dr. Elena Golubeva[1]

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Urban protected areas (PAs) are specific nature and cultural spaces in cities exposed to particular transformations. Classic 3-component system of PAs negative transformations (PADDD) was expanded (PA4D), an indicator of proposed PAs design was introduced. Detailed negative (PA4D) and positive (PA4P) transformations and its hierarchy of case-study city (Moscow, Russia) were explored through QGIS spatial analysis and remote sensing tools (2000-2021 Landsat images). There is a significant prevalence of negative transformations (53.8% of ever protected area) over positive ones (22.6%). Positive transformations are mostly related to proposals design (49.5%), while the main components of negative transformations are easing of restrictions (60.3%) and design failures of proposed PAs (22.8%). Downsizings are quite rare (7.1%), whereas upsizing to compensate exclusions contributes 20.5% to PA4P. Degazettment is the less important component of negative transformations (5%).

According to NDVI values, the share of barren areas is quite large (5.9%) in proposed PAs, thus suggesting that a lot of them will be not designed finally. Moreover, the significant increase of barren areas (+40.4% of 2000 value) is revealed. Grasslands are the most fragile biotopes in included PAs parts (-38.3%) due to secondary succession and replacing by contemporary parks. Cultural landscapes share is dramatically growing in excluded parts (+86.5%).

The crucial causes of negative changes are: cores downsizing (67.9%), using of mostly distant (75%) green areas while compensating exclusions, decrease of proposed PAs area (25% of total proposed area was excluded), withdrawal from planned PAs and appending to existing PAs (54.4% of planned PAs) and high share of barren areas in lands reserved to PAs establishment (5.9%).

Such detailed method should become an international project due to strong differences between countries and cities. Only global scientific network could provide tools to adopt positive cases of PAs zoning and regulations and to influence on PAs management systems.

Talk

Mechanisms behind stability along a sea-inland environmental gradient

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With biodiversity extensively declining worldwide, one of the main challenges in ecology today is understanding biotic and abiotic mechanisms steering temporal community stability. So far, a large body of evidence suggests that plant diversity ensures community stability by increasing species asynchrony. However, most studies focused on species richness, often neglecting other facets of diversity which also contribute to explaining species response to environmental fluctuations. Moreover, even though diversity patterns are clearly regulated by environmental conditions, how abiotic stress influence ecosystem stability, whether directly or indirectly through changes in biotic drivers, has been poorly investigated. In this light, we aim to examine the intricate environment-diversity-stability relationship in coastal dune ecosystems, dominated by a strong sea-inland environmental gradient defining plant community assemblages.

To this aim, we analysed vegetation time series of Mediterranean coastal dunes, recorded in 84 permanent plots over the last 12-15 years within the Long-Term Ecological Research (LTER) network in Central Italy. We applied piecewise structural equation modelling to investigate how sea distance, species richness, functional-phylogenetic diversity, dominant species' traits, weighted average population variability, and asynchrony influence community stability, as well as the interplay between these drivers.

Surprisingly, while species and functional-phylogenetic diversity contribute little to stability, the dominance of perennials was a key community trait in regulating community stability by reducing population variability and enhancing asynchrony. Yet, the sea-inland gradient appears as the main force regulating mechanisms behind temporal stability: sea stress alters the complex diversity-stability relationship by shaping community diversity and composition as well as making species more variable in time and synchronized. Overall, our results highlight the importance of examining temporal stability within the environmental context.

Talk

Species losses, gains, and changes in persistent species are associated with distinct effects on ecosystem functioning in global grasslands

Dr. Emma Ladouceur[1], Dr. Shane Blowes[1], Dr. Jonathan M. Chase[1], Dr. Adam Clark[2], Dr. Magda Garbowski[1], Juan Alberti[3], Carlos Alberto Arnillas[4], Jonathan D. Bakker[5], Isabel C. Barrio[16], Siddharth Bharath[28], Elizabeth T. Borer[29], Lars A. Brudvig[30], Marc W. Cadotte[4], Qingqing Chen[6], Scott L. Collins[7], Christopher R. Dickman[8], Ian Donohue[9], Guozhen Du[10], Anne Ebeling[11], Nico Eisenhauer[1], Philip A. Fay[12], Nicole Hagenah[13], Yann Hautier[14], Anke Jentsch[15], Ingibjörg S. Jónsdóttir[16], Kimberly Komatsu[17], Andrew MacDougall[18], Jason P. Martina[19], Joslin L. Moore[20], John W. Morgan[21], Pablo L. Peri[22], Sally A. Power[23], Zhengwei Ren[10], Anita C. Risch[24], Christiana Roscher[1], Max A. Schuchardt[15], Eric W. Seabloom[29], Carly J. Stevens[25], G.F. Ciska Veen[26], Risto Virtanen[27], Glenda M. Wardle[8], Peter A. Wilfahrt[29], W. Stanley Harpole[1]

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Global change drivers such as anthropogenic nutrient inputs simultaneously alter biodiversity, species composition, and ecosystem functions such as aboveground biomass. These changes are interconnected by complex feedbacks among extinction, invasion, and shifting relative abundance. Here, we use a novel temporal application of the Price equation to quantify the functional contributions of species that are lost, gained, and persist under ambient and experimental nutrient addition in 59 global grasslands. Under ambient conditions, compositional and biomass turnover was high, but species losses (i.e., local extinctions) were balanced by gains (i.e. colonization). Under fertilization, there was biomass loss associated with species loss. Few species were gained in fertilized conditions over time but those that were, and species that persisted, contributed to net biomass gains, outweighing biomass loss. These components of community change are key to understanding the relationship between diversity and functioning, particularly in systems that are experiencing anthropogenic change. By partitioning the roles of individual species, this work provides a more detailed understanding of the relationships between biodiversity change and ecosystem function in natural systems and how global change drivers can affect them. This work invites future lines of research to adapt this approach and develop it further. With some adaptation and further work this approach may be directly applicable to quantifying stability as well.

Talk

Shrub cover is weakly related to species richness and composition in a montane grassland: implications for bush encroachment

Ms Tanya Strydom[1,2,3], Prof. Peter le Roux[1]

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Bush encroachment is an important driver of habitat degradation in some systems. Encroaching woody species can create unique abiotic conditions in the sub-canopy habitat, potentially leading to shifts in the herbaceous community by favoring forbs and woodland species. This study examined the effect of Leucosidea sericea (Eckl. & Zeyh.) (Rosaceae) on microclimatic conditions and the grassland plant community in a southern African montane grassland. Leucosidea sericea is one of the few woody species occurring in these grasslands that experience frequent frosts and fires, and is thought to be expanding to higher altitudes. Microclimate and vegetation data were recorded under the shrub canopy and in the adjacent grassland at nine sites. Leucosidea sericea lowered air and soil temperatures, with the magnitude of this cooling being dependent on time of day, canopy coverage and tree density. In contrast, soil moisture was unaffected. Further, L. sericea decreased species richness and cover relative to open plots, with richness being most strongly reduced under greater L. sericea canopy coverage. These impacts were most pronounced for grass cover. Despite these impacts, L. sericea only had a weak, albeit significant, effect on community composition and functional trait expression by dominant species. Therefore, L. sericea affects some microclimatic and vegetation characteristics, with impacts being dependent on individual tree's characteristics and density. The relatively weak impacts of on the grassland plant community may reflect a lack of fire protection for sub-canopy species or that the forb community is already adapted to shading due to their co-occurrence with tall dominant grasses. These results suggest that encroachment will not cause large changes in the herbaceous community, but the consequences of reduced grass cover likely require further investigation.

Talk

Fire promoted underground organ biomass but decreased root biomass and bud bank size in old-growth grassland.

Dr. Soizig Le Stradic[1,2,3], Dr. Aline B. Bombo[3], Dr. Alessandra T. Fidelis[3]

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Fire is a major driver of vegetation structure in disturbance-dependent old-growth grasslands, but its role to shape plant communities in edaphic old-growth grasslands, such as P-impoverished campos rupestres, remain poorly understood. In such grasslands, limited nutrient content in soil impacted greatly root traits and nutrient acquisition strategy. However, fire can also shape vegetation structure and biomass investment belowground especially when fire frequency is high. In this study we tested if higher fire frequency promoted the biomass of both fine roots (<2mm) and underground storage organs, and if it also increased the number of belowground buds and storage organs, modifying belowground organ composition. As plant species need to resprout more often in frequently burned areas than in unburned areas, we expected higher biomass of belowground organs (storage) and fine roots (acquisition) and more buds and belowground bud-bearing organs to ensure resprouting after fires. The study was conducted in three sites of campos rupestres located along a gradient of fire frequency (1, 6, and 10 fires in 34 years). In each site, we quantified belowground organ biomass, fine root biomass, bud bank size, bud bearing organ density and we analyzed the variation in belowground organ composition. Belowground organ biomass increased with increasing fire frequency, whereas the fine root biomass decreased. However, bud bank size and belowground organ density decreased in areas more frequently burned. The proportion of belowground organs like xylopodium and root crown increased with increasing fire frequency, whereas unfrequently areas recorded high proportion of rhizome, especially graminoid fleshy rhizomes. Fire modulated belowground organ composition, even in edaphic old-growth grasslands, favoring heavier organs like xylopodium and root crown that are essential to resprout especially in nutrient-depleted ecosystems. Without fire, numerous but lighter fleshy rhizomes appeared, probably associated with the dominance of graminoid species in such case.

Talk

Trunk spines: a physical defense of trees against bark removal and climbing by mammals?

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Spines are widely assumed to protect leaves, buds or reproductive organs against ground-dwelling mammals but what about species with spines on trunks, which are far from these organs? We proposed four hypothetical functions: (1) these are vestigial structures either of climbing tools (climbers), or (2) of earlier defenses against ground-dwelling leaf-eaters; alternatively, they aren't vestigial and (3) prevent climbing mammals from accessing the canopy or (4) protect the trunk against debarking by mammals. We first analyzed whether trunk spine function can be inferred from the whole spiny architectural strategy in 31 spiny species. Second, we compared the nutritional value of leaves, trunks, and reproductive organs between syndromes and with non-spiny confamilials. Third, we used computer simulations to test whether trunk spines could impact mammal climbing (3) and debarking (4). Fourth, we mapped the geographic distribution of trunk spines syndromes around the world.

Results show stem spines can be split into four syndromes including two related to non-vestigial functions. Nutritional analyses of edible parts suggest no differences between spiny and non-spiny confamilials, nor between different spine syndromes. Simulations indicate the two non-vestigial types are the most efficient at limiting climbing and debarking. These are predominantly distributed in seasonal tropical and sub-tropical environments, where mammals are known to switch to increased bark feeding during the dry seasons, and to have mammal climbers. The combined evidence suggests that trunk spines may be selected on species growing in strongly seasonal environments with historically high herbivory pressures. We discuss additional experiments required to understand this phenomenon.

Talk

Resistance and resilience: it is much easier to destroy species rich meadow than to restore it

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Stability of a community affected by an external perturbation consists of its resistance (ability to remain in the original state when facing the perturbation) and resilience (ability to return to its original state afterwards). Perturbations can be of a pulse type (immediate, short term) or press type (long lasting). We studies the two facets of stability in a species rich meadow community (up to 40 species per m2), originally mown and unfertilized, when subjected to change in management regime (a press type perturbation). Resistance was characterized by species composition change in response to regular fertilization with NPK fertilizer, abandonment of mowing and removal of the dominant species, Molinia caerulea, starting in 1994; resilience by return to the original species composition after cessation of fertilization and re-introduction of regular mowing on 2016. The dominant removal plots were kept without Molinia even after 2016. Regular monitoring during all the years provided species composition (and species richness) on various spatial scales, from 0.01 m2 to 1m2.

The species composition changed rapidly after the introduction of the treatments; both cessation of mowing and introduction of fertilization lead to pronounced decrease of the species richness (up to 50% of the original richness were lost after 20 years). The decrease was particularly fast in fertilized plots; however, the effect was for a limited time mitigated by mowing. Dominant removal had much smaller effect. The return to the original species composition has been slower, particularly in the fertilized plots. It is simpler to destroy species rich community, than to restore it. This slow return (i.e. low resilience) can be partially caused by increased levels of soil phosphorus, remaining elevated even five years after the fertilization was stopped (2021). The permanent change of environmental conditions by a press perturbation can seriously decrease the community resilience.

Talk

An assessment of rangeland condition under different land tenures and biomes in South Africa

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Key words: extensive livestock, farming systems, vegetation, change, pastoralism, ranching

Abstract

South African rangelands are biodiverse and play important ecological and socio-economic roles in rural areas. However, due to an array of factors including overstocking and improper resting periods, some rangelands have become degraded leading to poor livestock production. Thus, rangeland condition assessment is required as a basis to assess the impact of grazing and derive rangeland management interventions. The aims of this study were to assess the rangeland condition score (RCS), species richness and grazing capacity (GC) (LSU/ha) under different land tenures and biome across South Africa. One hundred farms under different land tenure (private, communal and land reform) were selected in five biomes (Grassland, Savanna, Nama-Karoo, Albany Thicket and Succulent Karoo) across South Africa. The Point Centred Quarter and step-point methods were used to assess rangeland condition. Biome had a significant ($p<0.001$) effect on species richness, GC and RCS, with Grassland (6.2±1.3ha/LSU) and Savanna (11.3±1.7 ha/LSU) having higher grazing capacity. This is largely due to the difference in climate and soils in the different biomes. However, land tenure types did not significantly ($p>0.05$) affect species richness, GC and RCS. This is because these farmers use similar livestock management strategies that include destocking before drought to reduce livestock impact and mortalities, and the use of local ecological knowledge. This study recommends that for developing strategies to improve grazing management to combat rangeland degradation, strategies should be biome-specific and not necessarily land tenure types.

Talk

What makes ecosystems resilient? Dependence of ecosystems resilience on taxonomical and functional diversity: A meta-analysis.

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The ability of ecosystems to recover after disturbances is known as resilience. With ongoing climate change and increasing threats to natural ecosystems, predicting ecosystem resilience to future, and potentially novel disturbances, is a great challenge in ecology. According to current theory, resilience can be promoted by different characteristics of plant communities, but how exactly vegetation relates to resilience remains debated. While different mechanisms have been evaluated at the local level, a synthesis of the different sources of resilience at the global scale and across different ecosystems is still lacking. We conducted a systematic review of the published literature and a meta-analysis on the relationship between the taxonomic and functional diversity of plant communities and the resilience of terrestrial ecosystems. We hypothesized that resilience is mainly conferred by functional characteristics of dominant species or the existence of a great variety of functional traits, but which one predominates depends on the system studied. Here, we present the first results of our synthesis. We collected 100 studies that fulfilled pre-stablished criteria, which were the monitoring of ecosystems over time, the use of a clear metric of resilience and a well-defined reference state. Preliminary results show that (1) the great majority of studies that analyse resilience do not quantitatively evaluate it, but (2) those that do measure it, are extended across different ecosystems and evaluate resilience against different disturbances, enabling the development of a synthesis framework. However, (3) there are important challenges associated with the great heterogeneity in the metrics used to measure resilience, the design and the time frame of studies. This synthesis points to the need for efforts towards the development of a common understanding of resilience and its relation with diversity.

Talk

Bioclimatic definition of the world biomes

Professor Javier Loidi[1], Professor Gonzalo Navarro-Sánchez[2], Doctor Denys Vynokurov[1,3]

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The world's biomes of this approach are conceived as broad-scale descriptive units that are dependent on climate.

A biome is a large-scale synthetic concept which includes a series of elements which can be summarized in these four categories:

- All the biological diversity can be found within its limits: plants, animals, fungi, etc.: Biota
- All the forms of assemblages of these living beings: populations, communities: Coenoses.
- All the processes taking place in the frame of the two aforementioned components: ecosystem functioning, disturbances and dynamism, evolution, etc.: Sigmetum
- The spatial distribution patterns occurring within the territory of the biome, which are determined by the ordinary ecological gradients due to local topography, such as the crest-slope-valley zonation and the azonal ecosystems occurring within it.: Geosigmetum

The biome classification in established in four levels: Domain, Ecozone, Biome, Subbiome

Domain. Is the largest division and is characterized by the broad climatic conditions ruling in the four main belts of the earth: temperature and water availability. There are 4 units recognized: A. Severe cold around the poles and in the high mountains -cryocratic-; B. Intermediate conditions in the belt between the Tropics and the cold areas-mesocratic-; C. An aridity belt in the subtropics where the scarcity of moisture is the main factor for living beings -xerocratic-; D. Absence of cold and of thermic seasons between the Tropics -thermocratic-.

Ecozone. Climates are defined at a lower detail with seasoning of the rainfall and temperatures. There are 7 units recognized.

Biome. They are determined by the zonal potential natural vegetation phsyognomy matching with climatic conditions. There are 9 units recognized.

Subbiome. They are sub-units of the biomes responding to similar criteria. There are 20 units recognized.

The climatic typology created tries to match this classification.

Talk

Effect of mixed plantations and neighbouring species in the resistance to ash dieback disease

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The outbreak of pathogenic ash dieback (AD) disease in the European continent from 1992, caused by the fungus Hymenoscyphus fraxineus, has resulted in the death of millions of European ash trees, a species with huge economic, ecological and social relevance due to its versatility, fast growth and tolerance to different environments. H. fraxineus infects all species of ash and no full genetic resistance to the disease has been identified. However, partial resistance has been documented. Here, we report on how mixed species forest plantations affect the expression of resistance. We assessed disease incidence in over 300 ash trees growing in a mixed plantation consisting of 7,000 trees of 23 different species. The results have unravelled different levels of disease resistance to AD in the plantation. Also, we have identified different areas where the damage by AD disease is greater than in others, which coincide with high numbers of ash trees in the vicinity. Tree species identification in the plantation allowed us to study a potential role of neighbouring tree species in disease resistance. We found that disease expression was at its highest when ash trees were neighbouring with Tilia cordata (lime) and at its lowest when ash trees were cohabiting with Prunus avium (cherry). Metabolomics analyses of ash tissue have unravelled signalling pathways and metabolites associated with the enhanced resistance and susceptibility. Further research is needed to elucidate the mechanisms by which these metabolites alter disease resistance to AD disease. Nevertheless, these results provide guidance to policy makers and woodland owners to increase the number of thriving forests in the years to come.

Talk

Vegetation classification in south-western Australia's Mediterranean jarrah forest: new data, old units, and a conservation conundrum.

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Conservation reserve selection is guided by vegetation classification and mapping. New survey data and improvements in the availability of archived data through online data-sharing platforms enable updated classifications and the critique of existing conservation criteria. In the Northern Jarrah Forest Region of south-western Australia, percentage-based targets using 'forest ecosystem units' (15% of each unit) and the systematic conservation planning principles of 'comprehensiveness, adequacy and representativeness' underpin the State's reserve network. To assess the degree of community-level heterogeneity within the forest ecosystem units and test how representative they are, new survey data for the forest (30 000 plots) were classified using a non-hierarchical clustering algorithm. Results were assigned to the National Vegetation Information System, and community groups defined at the Association level (Level V). Significant community level heterogeneity was found, including 15 communities in the dominant 'jarrah woodland' unit, and 13 in the 'shrub, herb and sedgelands' unit. Overall, this research highlights limitations in the current reserve system, including the influence of scale on percentage-based targets and 'representativeness'. A multi-scale approach to reserve selection, based on a quantitative, floristic, hierarchical classification system, would improve the level of scientific rigour underlying decision-making.

Talk

Climate reverses causality in the diversity-abundance relationship in natural plant communities: insights across spatial and temporal sources of variability

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Background: Whether more species are the cause or the consequence of having more individual plants (abundance) represents a major question with direct links to diversity-ecosystem function relationships in nature. Specifically, (1) facilitation and complementarity as positive diversity effects driving plant assembly (richness determines abundance, More Species Hypothesis) and (2) environmental filters sorting species under specific environmental conditions through constraints of population viability via abundance (abundance determines richness, More individual hypothesis). Here, we analyze whether directionality in the richness-abundance relationship is contingent upon spatial/temporal climatic sources of variability in natural plant assemblages.

Material and Methods: We applied structural equation models to plant abundance and number of species in two different datasets: (1) world's natural forests dataset distributed across the five continents (geographical sources of climatic variability), and (2) annual plant assemblages monitored yearly over a 11 years-time window in Mediterranean inner dunes.

Results: Our results support that, in both spatial and temporal case studies, the More Species Hypothesis prevailed towards the most benign climatic conditions whereas the More Individual Hypothesis did so in less productive conditions. These results support the idea that directionality in the richness-abundance relationship in natural plant assemblages can shift across spatio-temporal climatic gradients, and this might represent a general pattern in nature.

Conclusion: Climatic constraints can have a significant influence on the functional significance of species diversity by altering the prevalence of primary mechanisms involved in species assembly. Thus, artificial diversification of both natural and managed ecosystems should consider climatic conditions as to make sure that more species can really enhance plant stocking and functioning.

Talk

Trade-offs between ecosystem productivity and stability for the grassland biome

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Whether ecosystem productivity and stability are maximized simultaneously or subject to trade-offs remains an ecological enigma. The fact that biodiversity promotes ecosystem productivity and stability suggests synergies between both ecosystem properties along diversity gradients. Conversely, growing evidence shows that nutrient inputs increase ecosystem productivity but reduces its year-to-year stability. Deciphering these relationships across large-scale environmental gradients is therefore crucial to predict long-term dynamics of ecosystem functions and services in response to global changes. Here, we used remotely-sensed vegetation indices and 19,884 grassland plots to analyse the relationships between the productivity of herbaceous communities and two components of their stability, namely constancy and resistance to extreme climatic events, across habitats. We set structural equation models to decipher direct and indirect effects of climate, nitrogen inputs and biotic drivers (diversity and mean trait values of plant communities) on grassland productivity and stability. We found strong positive productivity-constancy but negative productivity-resistance relationships in all habitats, although grassland constancy and resistance were positively related. Climate and nitrogen inputs generally had opposite effects on productivity and stability. Nitrogen input notably exerted a strong, positive control of productivity but reduced both grassland constancy and resistance. By contrast, biotic drivers exerted marginal controls of grassland productivity and stability with effects strongly varying between habitats. For example in calcareous grasslands, mean plant flowering date increased productivity but decreased constancy and resistance while in mountain grasslands, mean plant flowering date decreased productivity but increased the two stability components. These results highlight the importance of considering different habitats within a biome to understand the role of biodiversity on ecosystem functioning and stability. They also confirm that the global enrichment of ecosystems with nutrients caused by human activities disrupts the relationship between ecosystem functioning and stability. Our findings will have strong implications for the long-term management of ecosystem functions and services.

Talk

Local and regional determinants of plant diversity at rocky marine habitats in Uruguay

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Coastal rocky marine habitats are model systems for the study of community assembly under harsh conditions. Low availability of soil, strong winds, wave disturbances, high salinity and extreme temperatures determine a coast-inland gradient of stress that impose a strong filter for species viability, putatively shaping community assemblages. However, rocky environments of the Atlantic coast of Uruguay present up to 427 plant species (15% of the Uruguayan flora) in small areas (<21ha). Here we attempt to advance on the processes associated with this diversity. We first analyzed the vegetation type for reported species. Unexpectedly, 80% of the species are from non-marine environments –grasslands, hydrophilic herblands, forest and disturbed environments. This highlights the role of connections among communities and that environmental filters do not preclude recruitments from other environments. With a random sampling stratified by distance to coast and GLM regressions, we analyzed the local environmental variables associated to trends in diversity within four rocky habitats. Vegetation cover, altitude and distance to the coast promote richness, supporting species filtering by the marine environment as a leading assembly mechanism in rocky plant communities. The availability of substrate was negatively associated with richness, supporting competitive exclusion in plots with more resources and homogeneous microenvironment conditions. Plots with lower cover are typically more heterogeneous, presenting rock emergence and a range of patches of substrates with different sizes and soil availability. Consequently, a balance between opposite gradients in the strength of environmental filters and competition may determine plot diversity in these study systems. Plant biodiversity of coastal rockeries of Uruguay is probably related with a combined effect of local and regional processes. Regionally, propagules from seven vegetation types configure a mass effect that enhances the local representation of biotas. Locally, the filter and competition gradients determine a range of small scale conditions that promote community diversity.

Talk

A transdisciplinary application of vegetation maps: back to the Nuragic Sardinia

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Biodiversity maps are commonly used both to investigate those phenomena pertaining to the natural world and address conservation issues, yet their application to other research fields remains mostly uncharted. In this context, we implemented a transdisciplinary application of biodiversity maps, precisely the Map of Vegetation Series (VS) of Sardinia (Italy). A VS is represented by the dynamically connected set of plant communities present within an environmental unit, characterized by homogeneous abiotic factors, sharing the same potential natural vegetation. With due caution, we here build on the assumption that in Sardinia these units have remained approximately the same during the last 4000 years.

Our specific aim was to enrich the knowledge about the land occupation strategies of Nuragic civilization, flourishing in Sardinia between the 18th and 8th century BCE. About 5000 remains of nuraghe, megalithic edifice distinctive of the Nuragic civilization, are still present on the island and were accurately mapped through a citizen science project coordinated by Nurnet Foundation (https://www.nurnet.net/).

Under a 'complete spatial randomness' scenario, we tested whether nuraghe remains were randomly located across the VS or more (or less) clustered in some units than expected by 'chance.' To further support and integrate the discussion about the occupation strategies of Nuragic people, we also derived the geomorphological and past climatic profiles (3200 BP) of the nuraghe distribution at a regional scale.

According to our results, the occurrence of nuraghes is mostly connected to specific VS, rather than being randomly distributed. In particular, they appear to be related to those located in the thermo-mesomediterranean bioclimatic belt, at low-to-medium altitudes, in flat areas on intrusive magmatic rocks in environmental units characterized by the presence of rivers and ponds.

In light of these findings, we have related the possible use by Nuragic people of the ecosystem services supported by the different VS.

Talk

Favourability can help boosting the prediction of species distributions

Msc. Elisa Marchetto[1], Msc. Daniele Da Re[2], Msc. Simone Celebrin[1], Dr. Enrico Tordoni[3], Dr. Manuele Bazzichetto[4], Dr. Piero Zannini[1], Msc. Ludovico Chieffallo[1], Prof. Duccio Rocchini[1,5]

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Predicting species distributions is intrinsically dependent on the ratio between presences and absences, which is known as prevalence. Indeed, whenever the number of presences and absences is not equal within a sample, predictions deviate towards higher values as prevalence increases, and vice versa. Consequently, probability models of the species occurrences with different prevalence cannot be directly compared. However, to mitigate this issue, the concept of favourability, that is the variation in the probability of occurrence regardless the overall presences/absences ratio, could be useful to obtain comparable predictions despite different degrees of prevalence.

To test this hypothesis, we compared probability-based and favourability-based models for a set of prevalence values. For that purpose, we generated 10000 species distribution models relying on virtual species modelling. According to our results, we proved the tendency of the favourability to remain unchanged across different degrees of prevalence. Further, considering that the favourability distribution can be assumed as the degree of membership of the fuzzy set of areas favourable for a certain species, it was possible to estimate the spatial variations of the suitable environmental conditions for the species presence considering both current and future bioclimatic envelops.

Talk

Himantoglossum metlesicsianum (W. P. Teschner) P. Delforge, (Orchidaceae) a critically endangered orchid and its response to climate change

Prof. Victoria Eugenia Martín Osorio[1], **Graduate Wolf Hermann Wildpret Martín[2],** Graduate Rocío González Negrín[1], Prof. Dr. Wolfredo Wildpret de la Torre[1]

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Himantoglossum metlesicsianum (WP Teschner) P. Delforge, is an orchid declared as "Critically Endangered" by the Spanish Catalog of Endangered Species and by the Canarian Catalog of Protected Species, it is also found as "Endangered" by the Red List of IUCN is also included in Appendix II of the CITES Convention and in Annex I of the Berne Convention.

The potential vegetation surrounding the populations of the Tenerife Orchid, on the four islands studied, corresponds to a dry-humid Thermo-Mesomediterranean Pinus canariensis pine forest, with rainfall between 450-600 mm per year and average annual temperatures of 10-15ºC. , with frost and snow in winter, distributed between 900 and 1400 masl, represented by six Vegetation Series, Sideritido solutae-Pino canariensis sigmetum typicum, Sideritido solutae-Pino canariensis sigmetum ericetosum canariensis, Sideritido solutae-Pino canariensis sigmetum cistetosum canariensis, Pino canariensis sigmetum typicum, Loto hillebrandii-Pino canariensis sigmetum cistetosum symphytifolii typicum, Bystropogono ferrensis-Pino canariensis sigmetum ericetosum canariensis.

The extreme droughts currently affecting the islands may influence the development of the species. In this case, two circumstances can occur: the plant needs a certain precipitation threshold before and during the development cycle, or a specific annual rainfall accumulative range so that it can flower in the following year's cycle.

A bioclimatic analysis has been carried out with the precipitation data from the stations close to the orchid populations to estimate if, over the last few years, it has been affected by the decrease in rainfall or by the change in seasonality. This is intended to study whether there is a correlation between these parameters.

The statistical analysis of the evolution of the number of existing specimens in each population, in each island studied, since reliable data is known, is presented.

Talk

Combining unmanned aerial and satellite data for detecting Non-Native Tree Species: an insight on Acacia saligna invasion in the Mediterranean coast

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Invasive Alien Species (IAS) threaten biodiversity worldwide, thus early detection and timely monitoring tools are still needed.

We explored the potential of Unmanned Aerial Vehicle (UAV) images in providing intermediate reference data able to link IAS field occurrence and satellite information. Specifically, we used ultra-high spatial resolution UAV data depicting A. *saligna* occurrence as calibration data for satellite imagery to predict its spread on Mediterranean coastal dunes.

Starting from two free satellite platforms (PlanetScope and Sentinel-2), we developed a procedure to map A. *saligna* cover following four steps: aggregation of UAV-based ultra-high resolution maps for A. saligna to satellite spatial resolution (3 m and 10 m) by calculating the IAS fractional cover (FCover); selection of monthly multispectral (blue, green, red and near infra-red bands) cloud-free images; calculation of monthly spectral variables depicting leaf and plant characteristics, canopy biomass, soil features and surface water and of Hue, Intensity and Saturation values; prediction of A. saligna FCover and identification of the most important spectral variables using Random Forest model.

RF models calibrated for both satellite platforms showed high predictive performances ($R2 > 0.6$; $RMSE < 0.008$), with accurate spatially-explicit predictions of the invaded areas. While Sentinel-2 performed slightly better, PlanetScope-based model effectively delineated invaded areas edges and small patches. The summer leaf chlorophyll content followed by soil spectral variables resulted the most important variables discriminating A. saligna patches from native vegetation. Such information is consistent with the field-observed phenology of A. saligna as well as the well-documented alterations in leaf litter content and soil organic matter usually occurring in invaded patches.

We presented new evidence of the importance of ultra-high spatial resolution UAV data to fill the gap between field observation of A. saligna and satellite data, offering new tools for detecting and monitoring IAS spread in a cost-effective and timely manner.

Talk

"Baseline turnover" quantifies the natural annual species turnover in different vegetation types

Ms. Leonie Mazalla[1], Prof. Dr. Martin Diekmann[1], Dr. Felícia M. Fischer[2], the LOTVS consortium[3], data contributors

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Dissimilarity indices are commonly used to quantify the change in vegetation (floristic composition) between two or more plots, separated in either time or space. With resurvey studies becoming increasingly popular, such indices are often reported to characterise shifts in species composition over time. However, it is difficult to interpret the ecological meaning of a value of, for example, 30% dissimilarity after 20 years – does it represent a true directional change in species composition, or does it merely reflect natural stochasticity, or is it a methodological artefact? The observed vegetation change captured in a dissimilarity index can be divided into three components. First, true ecological change driven by environmental conditions; second, methodological artefacts such as relocation error; and third, what we here call "baseline turnover". By this, we mean the random temporal fluctuation of species composition in a limited space such as a vegetation plot.

Magnitudes of observer or relocation errors were identified in several studies. In this study, in contrast, we aimed to quantify the magnitude of baseline turnover in different ecosystems, using year-to-year dissimilarities as estimates of change. For this, we collected 68 data sets totalling more than 50,000 samples from truly permanent plots that were re-surveyed annually and were assumed to have a stable vegetation over the sampling period.

The six broad vegetation types classified (evergreen and deciduous forests, temperate grassland, steppe/prairie, desert vegetation, alpine vegetation) showed distinct levels of baseline turnover. Within data sets, increasing plot size reduced baseline turnover, while an observer change increased baseline turnover. Higher shares of annual species also resulted in increased yearly turnover rates. The resulting benchmarks for inter-annual species turnover can be used in resurvey studies to better interpret the ecological meaning of an observed value of dissimilarity.

Talk

Life history- and species-specific plant persistence strategies on edaphic islands

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Isolation and island size are essential parameters defining any insular environment. Insularity can largely influence the genetic composition of island populations, generating distinct eco-evolutionary histories and selecting for distinct functional traits. High spatio-temporal isolation is expected to shape plant reproduction and dispersal strategies favoring local persistence (e.g., enhanced clonal abilities, production of large seeds). On islands experiencing strong insularity, strategies that facilitate offspring to remain close to the parent plant may constitute an advantage, likely offsetting or delaying local extinction. However, the local persistence of plants on islands remains largely understudied. Here, we tackled this task by examining the persistence strategies of 13 species (five clonal and eight non-clonal) specialists of edaphic islands associated with resource-poor shallow-soil temperate dry grasslands on 20 rocky outcrops in the Czech Republic. We investigated relationships between seven persistence-related traits (plant height, belowground organ dry matter content, lateral spread, age, radial growth, storage tissue area, vessel size) and insularity, soil, climate. We quantified the effect of each biogeographic (insularity) and environmental (soil, climate) predictors on single trait patterns for clonal and non-clonal species separately (because these are different life histories), and inter-and intra-specifically. We expected insularity and soil to play a major role in shaping trait patterns towards strategies indicating a higher likelihood to persist locally – e.g., more conservative resource economics, greater ability to occupy space via lateral spread – in more insular and harsher soil conditions. We found support for our expectation; yet, while clonal species exhibited consistent responses, non-clonal plants showed species-specific trait patterns. This suggests that clonal species can be prone to local extinction whether e.g., land-use management abruptly alters the geographic set-up or soil resource status, whereas non-clonal plants may face these challenges differently, with some going extinct while others may persist and be used for conservation-sound restoration.

Talk

Abandoning the concept of succession in vascular epiphytes?

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Succession, a foundational concept in ecology, is theoretically and practically relevant in plant ecology. Its definition fluctuates from a directional and predictable change of species composition in response to disturbance to one that involves only temporal changes without implication of directionality or predictability. In epiphyte research, succession as a path of spatio-temporal dynamics has been hardly studied. Vascular epiphytes are structurally dependent plants, growing on other plants non-parasitically, that contribute substantially to global terrestrial plant diversity. Since they live on three-dimensional dynamic patches (i.e., host plants), newly established trees represent new substrate. Thus, both primary and secondary succession is assumed to occur in epiphytes.

We use the classic concept of succession, where temporal changes imply species replacement reflected by turnover. In lowland trees, saturation of space by epiphytes is unlikely before the host dies; thus, true replacement may not necessarily occur. If temporal dynamics of epiphyte assemblages can be characterized as succession, turnover should be the predominant pattern. We reviewed the literature regarding succession and evaluated the temporal changes of epiphyte assemblages growing on Socratea exorrhiza from a unique eight-census database spanning 19 years.

We found very few (21) studies, most assessed succession via a place-for-time approach, while just two used a direct approach. Most found species accumulation to be more prevalent than replacement. Analyzing the Socratea epiphyte assemblages indicated that turnover is probably less important than nestedness, which varied with the forest's vertical stratification. Temporal turnover was highly dynamic. Individuals of "pioneer" species were more often identified as newcomers than survivors of a previous census.

Our long-term data shows that both nestedness and turnover play a role, with a higher prevalence of nestedness. However, only in a delimited zone turnover may be relevant. Therefore, we suggest a very careful use of "succession" for dynamics of vascular epiphyte assemblages.

Talk

Sampling gaps in plant communities from Brazilian grassy ecosystems

Ms. Luciana Menezes[1], Mr. Rafael Barboza Santos[1], Dr. Sandra Cristina Müller[1], Dr. Gerhard Ernst Overbeck[1]

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Grassy ecosystems, such as grasslands and savannas, cover almost 30% of Brazil's territory. These ecosystems hold enormous biodiversity and endemism. They are historically neglected in science and conservation policy, leading to its threatening by rapid land use conversion. Biodiversity quantitative data is a key information to best preserve and restore all natural ecosystems. Based on quantitative data we can comprehend species relationship with environment and predict responses to climate change, for instance. Here we conducted a bibliographic and data repositories review looking for studies on grassy ecosystems plant communities in Brazil that included the herbaceous layer. We were interested in discovering how much data exists for these ecosystems, if the data is open and comparable in terms of sampling methods, also if site selection was biased by ease of access. We also tracked regions of 'urgent data gaps', characterized as regions of fast land use change and lower coverage of protected areas. From the 13 datasets and 134 papers, 20% had open data. Nine different methods were applied to sample the grassy vegetation, making results not easily comparable. Less than 2% of the sampled sites presented bias due to ease of access. The scarcity of quantitative data for Brazil's grassy ecosystems was evident. The savannas in the northern Cerrado and Pampa grasslands in the South of the country are two regions of special concern regarding current rates of land use change, lack of protected areas and data gaps. Despite good quality (i.e., non-biased), quantitative data on grassy ecosystems in Brazil still is rare and not easily available. Before investing more time and money on surveys we need strategical planning to fill the urgent data gaps. Country level initiatives focused on field data gathering using standardized protocols, such as the National Forest Inventory, urge for the Brazilian grassy ecosystems.

Talk

Disturbance indicator values for European plants

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Ecological indicators are numerical values used to characterize the ecological niche optima of species approximating their maximum occurrence along gradients. While indicator values on climatic and edaphic niches of plant species received considerable attention in ecological research, indicator values on species' optimal positioning along disturbance gradients are less developed.

We established five main continuous indicator values for European plants (disturbance severity, disturbance frequency, mowing frequency, grazing pressure and soil disturbance) based on the analysis of 736,366 European vegetation plots using an expert-based characterization of disturbance regimes in 236 habitat types. Disturbance severity and frequency are provided separately for the whole community and the herb layer. We calculated the indicator values as the average of expert-based estimates of disturbance values in all habitat types in which a species occurs, weighted by the number of plots in which the species occurs within a given habitat type.

Talk

We present a new data set of disturbance indicator values identifying optima along natural and anthropogenic disturbance gradients for 6,382 vascular plant species. In addition, we show how such indicator values can be applied to study plant functional trait responses along disturbance gradients in the European flora and vegetation.

The large number of species and the broad geographic extent covered by our data set can stimulate the integration of plant disturbance relationships in the field of plant ecology and European vegetation monitoring and assessment in both local and large scale studies.

Talk

Response of the alpine and subalpine vegetation of Mt. Field Plateau, Australia to a warming climate

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Climate change is predicted to impact mountain vegetation, causing upward shifts in the altitudinal distributions of plant species and communities. Though the effects of climate change have been studied on mountains in Europe and North America, there has been little research in the southern hemisphere. This research examines changes in the vegetation of the Mt. Field Plateau, Tasmania, an ideal location for this study because there have been minimal impacts from changes in land use, invasive plant species or air pollution and no major disturbance events within the area over the past 40 years. A network of 234 vegetation plots (100-m2) initially surveyed in the summers of 1980-1982 were resampled in February-May 2019. The plots span an altitudinal range of 900 to 1370 m. Ordination of the combined data found two major dimensions of community variation, correlated with altitude ($r=0.88$, $P<0.0001$) and drainage ($r=0.84$, $P<0.0001$). A fitted vector for year within plot ($r=0.39$, $P<0.0001$) was at an angle of 175° to the altitude vector, indicating that, on average, changes in community composition have been towards lower altitude ("warmer") communities. The mean altitude shift was –14.1 m, with a 95% confidence interval of -18.6 m to -9.5 m. Bayesian models of probability of occurrence of species, with altitude, drainage, and year as predictors, found strong support for shifts in species' altitudinal distributions, with a mean upward shift of 20 m (range 3.9 to 85.7 m). These results are consistent with vegetation response to a warming montane climate.

Talk

The Colombian Orinoquia vegetation: an overview of its biodiversity, threats and conservation status

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In the Colombian Orinoquia, the major threats to flora and vegetation are due to selective logging and land use changes. An ordinal classification of actual threats in the study area was made according to the conservation urgency of their vegetation communities and associated flora. A multicriteria model was created from an Analytical Hierarchy Process (AHP) which involved source information from IUCN Threatened Species lists, recorded local plant species uses from field surveys, species geographical distribution and habitat quality observations. The grassland vegetation characterization was performed using 281 field surveys, from which, 258 species, 158 genera and 62 families of flowering plants, were registered. Among them, 13 species were ranked as very highly threatened. From 178 forest vegetation surveys, there a total of 546 species, 272 genera and 79 families of flowering plants were registered, and hundred twentyone species, were under highest threat category. The grassland vegetation type dominated by Paspalum carinatum Humb. & Bonpl. ex. Flüggé y P. pectinatum Nees ex. Trin., has been ranked on the highest threat category. The mixed palm forest dominated by Attalea maripa (Aubl.) Mart. and Iryanthera laevis Markgr., the forest dominated by Guatteria hirsuta Ruiz & Pav. and Inga cylindrica (Vell.) Mart. and the forest dominated by Protium guianense (Aubl.) Marchand. and Caraipa llanorum Cuatrec. have been ranked at the very high threat category. In conclusion, the proposed multicriterial model is an appropriate method for evaluating and for defining species and vegetation community's conservation status in the Colombian Orinoquia.

Talk

Are broad-scale vegetation patterns moulded by wind?

Dr. Mia Momberg[1], Prof. David William Hedding[1], Prof. Peter Christiaan le Roux[1]

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The relationships between climate variables and the distribution of vegetation are essential factors to consider to more accurately predict patterns of vegetation occurrence under future climatic conditions. Some climatic drivers of vegetation patterns, like temperature and precipitation, have been studied extensively, but to gain a more comprehensive understanding of these relationships, other components of climate also need to be accounted for. The impact of wind on vegetation patterns has received little attention, despite having clear physiological impacts on individual plants. Here, we investigate the relationship between both wind velocity and wind turbulence and vegetation at a broad- (i.e. island-) scale on the chronically windy sub-Antarctic Marion Island. The impact of wind was determined after accounting for other potentially important predictors, namely elevation, terrain ruggedness, curvature, geology, and potential direct incident radiation. Wind velocity was an important predictor of vegetation cover. While elevation had the biggest effect on the presence of individual vegetation types in the overall landscape, wind velocity was the second most important predictor, significantly contributing to explaining the occurrence of five out of the six vegetation types. Therefore, wind conditions could be important in explaining differences in the distribution of vegetation types in environments with heterogenous wind conditions, and this work exposes this understudied climatic variable as an influential factor in vegetation's response to future climatic change.

Talk

Bioclimatic modelling of Lantana camara invasion in the Shivalik landscape of Eastern Himalaya

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Spatial modelling has been an essential tool for predicting and mapping the suitable areas of a species' habitat. Ecological modelling was performed using 744 sampling locations to predict the potential habitat for the invasive plant Lantana camara in the lower Shivalik region of the Eastern Himalaya, India. The modelling engaged nine bioclimatic, four topographic, one land-cover, and two soil parameters that are known to be ecologically important for the species. Precipitation of the warmest quarter, mean temperature of the wettest quarter, precipitation of the driest quarter, and river flow accumulation contributed to the model. The predicted area for the invasion was classified into high, medium, and low potential areas. We identified nine potential hot spots based on species occurrence over a 2300 km^2 area to determine where immediate intervention is necessary to prevent the spread of Lantana camara. The study's findings can assist policymakers and stakeholders in developing an effective and strategic weed management approach at the landscape level.

Talk

Optimizing the DiffVal index for vegetation classification

Dr. Tiago Monteiro-Henriques[1,2], Professor Jorge Orestes Cerdeira[3]

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A problem that has been studied for a long time in vegetation science consists in finding distinct groups among a collection of vegetation samples (relevés). Recently, a criterion (DiffVal) has been proposed for this purpose, adequately grouping the relevés, by capturing patterns of differential species among the formed groups. The criterion optimization is quite complex as it implies searching optimal solutions among a huge set of possible combinations of relevé groupings. In this work we give an integer linear programming formulation to maximize the criterion for k = 2 (i.e., for 2 groups), that can be used to solve moderately-sized data problems; we also describe a Greedy Randomized Adaptive Search Procedure (GRASP) and a simulated annealing algorithm, both for arbitrary k groups. We combined these different approaches and prepared a collection of software functions, which are freely available as an open-source R package (diffval) in GitLab repository: https://gitlab.com/point-veg. Ultimately, we illustrate with examples using real data.

Talk

Structure and conservation of halophytic vegetation environments in the central andes

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Halophytes hold effective salt-tolerance mechanisms and can thorough their life cycles in naturally saline soils with NaCl contents greater than 200 mM. Although a noteworthy advancement has been made in contemporary times expounding underlying salt-tolerance mechanisms, these studies have been mostly confined to the vegetative growth stage.

Research into the structure of plant communities adapted to salinity has barely been studied. It remains unclear whether the reproductive biology of halophytes differs from that of non-halophytes, and whether their reproductive processes benefit, like their vegetative growth, from the presence of salt in the rhizosphere.

This study reflects the current knowledge of the structure of plant communities in saline environments found in the Central Andes, specifically in S Peru. The vegetation reflects a low richness in diversity of species but at the same time these environment host taxa not found elsewhere. Changes in structure, flowering time of the species, type of lifeforms and level of salinity depending on the pH was evaluated in three different ecosystems, at coastal and high mountain geographical zones.

Salt has advantageous effects on halophyte generative growth and it depends on the amount of rain received per year in Andean regions while in coastal ecosystems occurs the opposite because the plants indicate a high adaptation to sea breeze. These halophytic vegetation environments are important for conservation for the occurrence of natives and endemics plus pollinators. Long-term conservation purposes should be adhered to these environments.

Talk

Plants affect root-associated fungi through edge and corridor effects

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Most plants are associated with microorganisms, and especially symbiotic fungi. Plant-associated fungi provide many ecological functions for plants, determining their productivity and resistance to environmental stresses. However, plants are not associated to a random assemblage but rather show a certain level of host-preference effect. Based on this process, the passenger hypothesis assumes that plants shape fungi distribution by conditioning the spatial distribution of their niche.

Fungi are mostly transferred from one plant to another through hyphae or root contacts, therefore propagating over short-distances. Spatial arrangement of plants conditions the probability of contacts among different neighbor species and is likely to influence fungi dispersal. Two main mechanisms – edge effect and corridor effect – might condition fungi dispersal among plants and influence fungi distribution in space.

We report here two experiments set up in controlled growth conditions. In the first experiment we tested the effect of neighbor plant identity on root-microbiota of a focal plant using a plant-matrix design. We demonstrated that neighboring plants transferred part of their mycobiota to the focal plant, and determined the focal plant mycobiota richness and composition. In the second experiment, we tested the effect of linearly aggregated plants connecting two patches of a focal plants. We demonstrated that plant corridors were more or less permeable to fungal dispersal and affected the mycobiota of the connected plants.

This work deepened our understanding of the underlying mechanisms relating plant configuration and fungi distribution and offers dispersal-based processes in support of the passenger hypothesis. Overall, this study suggests that plant communities can constitute biotic landscapes for microorganisms, which composition and configuration can be manipulated to preserve fungi biodiversity.

Talk

Monitoring and Analysis of Tree Diversity Using i-Tree Eco to Strengthen Urban Forest Management

Ms. Amarizni Mosyaftiani[1], Ade Wahyu[2], Dr Regan Leonardus Kaswanto[2], Harityas Wiyoga[3], Nada Syasita[2], Indria Zhafirah Akbar[2], Chairunnisa Afrianti[2], Ghina Akbarinaldi[2], Ahmad Alfu Ihsan[2], Rahmat Akhirul Amin[2], Katarina Winny Aprilia Dhevy[2], Muhammad Faig Hanif[2]

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Insufficient data on vegetation growth poses challenges for managers to determine the measures to be taken for further effective urban forest management. This problem also arises in urban forests management in Jakarta, Indonesia. Collaborative research involving various stakeholders was conducted in five urban forests in Jakarta to assess the diversity and vegetation structure as a basis for long-term monitoring and management. We undertook a field inventory using 49 plots to collect data of tree species, number, DBH, tree height, and crown size. The collected data and information were analyzed using i-Tree Eco software. i-Tree Eco is recognized in many countries, was introduced to promote feasible evidence-based assessment and assist stakeholders in processing data. The results showed that the diversity of the five urban forests was in the medium category, with the index range between 2.1 to 3.0. Five exotic tree species dominate the urban forests with important values index above ten percent, namely Swietenia macrophylla, Ceiba pentandra, Delonix regia, Leucaena leucocephala, and Terminalia sp., while native species have significantly lower index values. Enriching native species and increasing vegetation diversity should be a priority in Jakarta's urban forest management. This research also implies that regular vegetation monitoring and analysis using advanced and user-friendly tools is beneficial for facilitating stakeholders to achieve better urban forests management.

Talk

Trade-off between analysis grain and positional error in modelling species-environment relationships

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Species distribution models use species occurrence data and environmental explanatory variables to infer species-environment relationships and predict species distribution ranges. Despite their routine use and relatively well-established practices and standards, some methodological considerations still require further investigation. With the increasing availability of heterogeneous data from a multitude of sources of varying quality, careful assessment of uncertainties and purpose-built methodologies are becoming more important. The performance of species distribution models is known to be affected by the analysis grain and the positional error of species occurrences. Coarsening of the spatial analysis grain has been suggested to compensate for positional errors. Nevertheless, this way of dealing with positional errors has never been thoroughly tested. Here, we examine the trade-offs between positional error and analysis grain and provide recommendations for best practice. We show that coarsening the analysis grain to compensate for positional error do not improve model performance. Our results reject coarsening of the analysis grain as a solution to address the negative effects of positional error on model performance. We recommend fitting models with the finest possible analysis grain (i.e., depending on data availablity and the response grain on which species are expected to respond to the environment) even when available species occurrences suffer from positional errors. If there are significant positional errors in species occurrence data, users are unlikely to benefit from making additional efforts to obtain higher resolution environmental data unless they also minimize the positional errors of species occurrences.

Talk

Effects of changing scales on remote sensing assessment of vegetation heterogeneity - an example from alpine tundra

Dr. Jana Mullerova[1], Dr. Premysl Bobek[1], Tereza Klinerova[1]

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High spatial and temporal heterogeneity is symptomatic to all natural ecosystems. Drones, providing high spatial resolution and covering inter-annual phenological changes, represent a perfect mean for mapping and monitoring of vegetation. The question remains about the optimal spatial/temporal resolution of the survey, and the differences in heterogeneity covered at different scales. We hypothesize that at different resolutions, different parts of ecosystem variability are covered, and that the amount of “meaningful information” about vegetation composition is not necessarily increasing with resolution 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 particular study.

To test this hypothesis, we choose heterogeneous mountain habitat above the treeline in Krkonoše Mts. It is composed of a variety of species and life forms, forming a fine grain mosaic of short herbs, grasses, mosses, chamaephyts and shrubs as well as bare soil, scree and lichens. Whereas such ecosystem can be considered rather homogeneous from the temporal point of view, changing slowly in extreme mountain conditions, it is very heterogeneous spatially. We assess the effect of changing scales on the variability covered by the data. Multispectral data were acquired by drone regularly four times over the season at four sites representative for main vegetation types, i.e. sub-alpine grassland, peatland, cirque and exposed slope. Spatial resolution of 5 cm was resampled to 10, 20 and 50 cm. On simulated data, vegetation was classified using both pixel and object based methods, and results compared to the detailed ground survey and expert onscreen interpretation of vegetation from the same orthophotos to compare vegetation heterogeneity covered by different resolution, and assess the power of remote sensing to map, classify and monitor high mountain ecosystems.

Talk

South American terrestrial biomes: a geobotanical and phytosociological landscape approach

Dr. Gonzalo Navarro Sánchez[1], Dr. Federico Luebert[1], **Dr. José Antonio Molina Abril**[1]

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The classic and current conception of the biome, in its various meanings, is fundamentally based on vegetation types that are considered as discrete or independent and fragmented entities in the landscape. Vegetation units are characterized by their structure or physiognomy, which is based on the dominant life forms, and mainly determined by climatic conditions. However, vegetation units are associated and mutually interactive at a landscape level. They are determined by local or regional gradients imposed by the clime, topography and soils within a given territory or geographic area. In this work, we propose a new conceptual and methodological approach that aims to have a better understanding of the biome concept in a landscape framework, developing ideas already partially advanced in Navarro & Molina (Vegetation Classification and Survey 2: 159–175.2021). In this sense, we consider the biome as a geocatenal set (geocatenal biome), made up by the following geomorphological-linked vegetation series: i) the potential natural climatophilic vegetation (zonal vegetation) and the seral vegetation with which it is repeatedly associated in the landscape; ii) edapho-xerophyllous vegetation (azonal vegetation as rocky outcrops or sandy soils); and iii) edapho-hygrophilic vegetation (intrazonal vegetation such as flooded vegetation in river banks). Based on the surveys and field data obtained by the authors in most South American countries from 1990 to the present, the 30+ geocatenal biomes and biome-geocomplexes identified on the continent are proposed and synoptically characterized, through graphic models (phyto-topographic type-profiles) extrapolated from numerous observations along representative bioclimatically and biogeographically stratified transects. Field data and plots are currently being processed to include into the GIVD database".

Talk

Poor protection of alpine hotspots in a global biodiversity hotspot

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The Irano-Anatolian global biodiversity hotspot in SW Asia harbours a high number of endemic species, many of which are restricted in alpine zone. However, hotspots of alpine species and their conservation status of the region are not investigated so far. Distribution data of all (sub)alpine vascular plant species of the region was compiled, resulting in 19,680 localities from 1672 alpine species, 76% of them endemic to the region. High proportion of the endemic species of this region are range restricted (65%, presence in maximally 5 cells), which shows high conservation value of these habitats. Six quantitative measures of species diversity, i.e. species richness (SR), endemic richness (ER), range-restricted endemic richness (RER), range-rarity richness (RRR), species phylogenetic diversity (SPD) and endemic phylogenetic diversity (EPD) were calculated on the basis of 0.5°×0.5° grid cells. The results of all six indices are highly correlated but the strongest correlation is for RER and RRR (R=0.98). Using the top 5%, 10% and 20% richest cells supported by any index, 32, 53 and 98 cells, respectively, were identified as Hotspots. Of those, 59%, 60%, and 58% were categorized as unprotected (i.e., constitute Conservation Gaps), as less than 10% of its surface area in the alpine zone (i.e., above 2300 m a.s.l.) were covered by nature reserves. Generally, only 22%, 18% and 16%, respectively, of the alpine surface area of these hotspots were covered by nature reserves for the top 5%, 10% and 20% richest cells, respectively. Although the rate of protection for alpine Hotspots (16%) exceeded that of the entire region (9%), alpine hotspots are much richer in endemic species and at the same time under high pressure of overgrazing and climate change; therefore, establishment of new nature reserves with high efficiency in these hotspots is strongly recommended.

Talk

Patterns of plant vascular species richness, endemism and vulnerability in the Brazilian Pampa biome

Dr. Bianca Ott Andrade[1], Dr. Rodrigo Bergamin[1,2], Dr. Gerhard Overbeck[1]

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The Brazilian Pampa biome, which is dominated by grassland ecosystems, covers 2.3% of the country's total area and holds 10% of the total number of vascular species currently known in the country. Despite its enormous biological and ecological importance, it remains neglected in terms of protection, and it is the Brazilian biome that has proportionally lost the most area of natural vegetation, totaling 2.5 mi ha, in the last 36 years. In this study we aimed to identify areas within the Pampa biome that have the highest species richness, as well as highest number of threatened and endemic species. To this end, we used the most current list of vascular plant species for the biome, a fraction of the result of a national collaboration that aimed to quantify the entire biodiversity of the biome and involved more than 120 researchers from 25 research institutions. Based on this list of species, we built three datasets containing species name and geographical coordinates retrieved from GBIF and SpeciesLink online databases. By mapping the three group of species mentioned above, we were able to identify areas of high biological importance (i.e., areas with high species richness, high number of endemism and endangered plants) and quantify how much of these areas are within conservation units, how much was already lost and how much is currently threatened by the expansion of the agricultural and silviculture frontier. We identified more than a dozen areas of high endemism, which had some overlap with areas of high species richness. Most of these areas are threatened by the advancing agricultural frontier. We hope that this study can foster future public policies that promote the management, conservation, and restoration of natural ecosystems in the Pampa biome, as well as serve as a basis for further research.

Talk

Citizen Science and determining biodiversity in 11 Tiny Forests in the Netherlands

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The Tiny Forest concept of the Indian engineer Shubhendu Sharma was brought tot the Netherlands by IVN (Institute for Education on nature and environment) in 2015. A Tiny Forest are small forests of approximately 200 square meters and are also called mini urban forests. More than 150 Tiny Forests have already been planted in the Netherlands and Wageningen UR is asked two answer two main questions: 1) Does a Tiny Forest provide biodiversity? and 2) Can an overview of the biodiversity be developed using Citizen Science? To answer these questions, a year-round research was conducted from 2017 until 2021, in which volunteers and professionals from Wageningen UR developed an overview of the biodiversity of 11 Tiny Forest that were been selected for the monitoring. More than 300.000 observations of species were made during the study. They are displayed divided over the time in the year per Tiny Forest. In addition to the question of which species groups and species were found, the carbon storage of a Tiny Forest was also examined. The study shows that an average CO2 sequestration of 127.5 kg CO2 eq is found for Tiny Forests aged 1 to 5 years. It was also investigated how much precipitation the 11 Tiny Forests absorb during the study period and whether they can contribute to the prevention of heat stress in the city. This showed that more than 8 million liters of water were collected and a Tiny Forest compared to the street can be more than 20 degrees cooler in the summer period. More results in detail of this research will be presented in this oral presentation.

Talk

Past and present influence of macroclimate on the phylogenetic structure of European alpine floras

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Alpine habitats host a high proportion of endemic species that evolved under harsh climatic conditions. We explored spatial patterns in the phylogenetic structure (i.e., the degree of species relatedness) of European alpine floras and address how historical stability and past climate since the late Pleistocene contributed to shaping these patterns. We compiled species-pool data for 22 alpine regions in central and southern Europe and calculated the phylogenetic structure within and between regions using two metrics sensitive to terminal branching in the phylogeny. We evaluated the effect of macroclimatic variables representing extreme climatic conditions that we obtained between the Last Glacial Maximum (LGM; 21,000 years BP) and the present in 1,000-year intervals on within- and between-region phylogenetic relatedness. We found the highest phylogenetic relatedness in the Carpathians and the central Alps and the lowest in the north-eastern and southern Iberian Peninsula. Increased temperature seasonality and lower winter temperature increased phylogenetic relatedness, confirming the role of environmental filtering in shaping alpine floras. The effect of temperature seasonality on the phylogenetic structure of alpine floras was relatively constant over time, but the effect of winter temperature increased towards the LGM. We also found that alpine floras were more closely related in areas that experienced higher historical climatic instability. Climatic distance explained better the variance in between-region phylogenetic relatedness than geographic distance, indicating that patterns of phylogenetic relatedness between regions were primarily driven by species sorting along climatic gradients rather than by dispersal limitations. Differences in the phylogenetic relatedness between alpine regions were better explained by post-glacial rather than glacial differences in winter temperature. Our findings point to the contrasting biogeographical histories of temperate and Mediterranean alpine regions in shaping large-scale patterns in the phylogenetic structure of European alpine floras.

Talk

Seed harvesting performance in a native grassland of South America

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Current global trends in agricultural intensification often result in degraded grassland communities. Restoration through the reintroduction of native species is needed. This can be achieved through the harvest of seeds from natural grasslands. Various methods are available, but little is known about their performance in the Río de la Plata Grasslands. We evaluated the efficiency of mechanical seed harvesting in a grassland of Northern Uruguay. The experiment assessed the seed-mixtures obtained in both spring and summer from two harvesting methods: seed stripper with pull-type equipment and the collection of dry hay. Hand collection was done to assess the standing seed yield. Harvested material was prepared for germination in a greenhouse. We analyzed for seed and seedling abundance and species richness, and germination proportion. Transfer efficiency for abundance and richness of seeds and seedlings was calculated in reference to the standing seed yield. Seed-stripper in spring had high germination (64%), while efficiency in abundance and richness of seeds was 2% and 68%, and for seedlings 5% and 48%, respectively. In summer, germination was low (20%), but efficiency for seeds was 58% and 97%, and for seedlings 44% and 88% respectively for abundance and richness. Dry hay in spring had similar germination (15%), while abundance and richness efficiency for seeds was 42% and 64%, and for seedlings 26% and 74%. Germination was low in summer (9%), but efficiency for seeds was 100% and 77%, and for seedlings 50% and 100% respectively. In spring, the method has a strong influence on the seed-mixture obtained, while in summer both yield similar results. Seed-stripper performance is dependent on the ripeness of seeds present, which entails the potential of harvesting seed-mixtures with high germination, while being non-destructive. Dry hay is effective and similar to standing seed yield in both seasons, but does not guarantee high germination.

Talk

Interspecific interactions shift the response to temperature in ten Mediterranean grassland species

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Mediterranean grassland ecosystems are experiencing changes in temperatures caused by climate change. These changes can shift species composition and the associated between-species interactions. Previous studies have shown the importance of temperature for germination and interspecific interactions between seedlings in community dynamics. However, our ability to investigate those changes is hampered by the lack of precise information about the species responses to temperature changes and how these can actually be modified by interspecific interactions. The aim of this research is to evaluate the germination and early development of annual Mediterranean species in response to temperature with and without interspecific interactions.

To do so we selected ten annual Mediterranean grassland species that were identified as characteristic of cold, warm, and intermediate conditions based on previous experimental data and field observations. To characterize the response to temperature, the target species were grown in monocultures in temperature gradient incubators in eight temperature steps from 6ºC, to 38 ºC for five weeks. To measure the effect of interspecific interactions the target species were sown in high density mixed cultures with 20 seeds of four species that were frequent and usually abundant in the natural communities were the targets grow. We followed germination success of the target species for five weeks and at the end of the experiment we measured the above ground and belowground biomass of the target species and the rest of the species in the mixed cultures.

Temperature optima, niche width and other descriptors of the shape of the response were affected by interspecific interactions. These results highlight the importance of studying the alterations of the interspecific interactions among the grassland species and give an idea of how profound these effects will be in the future as the temperatures keep shifting.

Talk

DarkDivNet: a global research collaboration successfully estimates the dark diversity of plants

Prof. Meelis Pärtel[1], Dr. Riin Tamme[1], Dr. Carlos P. Carmona[1], DarkDivNet Consortium

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Biodiversity is an important characteristic of ecosystems, but mostly just a fraction of the site-specific species pool is present locally. By knowing the absent set of suitable species in a site – dark diversity – we can better understand how and why biodiversity varies. However, dark diversity can only be estimated, and we need to test how well such methods work.

DarkDivNet consortium has done standardized vegetation sampling globally in >100 study regions (each includes 30-90 10x10 m plots in a 10 km radius). We applied a probabilistic method based on species co-occurrences described within study regions. The method will calculate for each absent species their suitabilities for a study plot (probability for dark diversity). Calculated suitabilities were compared to other local indications of dark diversity. (1) Species absent in a plot but found in the close surroundings (likely part of dark diversity). (2) Description of site-specific species pools provided by local experts (assigning suitability scores to all species in a region). (3) We also examine how species co-occurrences in the sPlot database can be used instead of local data.

We found that dark diversity methods worked well. The probabilistic method discriminated suitabilities of species found in the close surrounding of the plot compared to those found further away in the region. The method mimicked the local expert opinion and gave similar dark diversity sizes. Co-occurrences in sPlot produced slightly larger but otherwise similar dark diversities compared to these calculated from local data. The sPlot data also correlated with expert opinions but with slightly lower strength than the local data.

In conclusion, current methods provide very good dark diversity estimations for exploring biodiversity patterns. Large vegetation databases are a promising source of co-occurrences, but more work is needed to filter the noise by selecting optimal subsets of data.

Talk

The role of salinity and salt composition for species of salt-affected environments: a case study from the Pannonian Basin

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Salt-affected grasslands of Europe are well known e.g., from the Mediterranean, Atlantic, or Baltic Sea coasts. However, they also occur inland with a hotspot in the Pannonian Basin. Soil salinity is one of the main factors driving plant-compositional patterns in salt-affected vegetation, and relative amounts of salts might fundamentally affect plant growth and occurrence. However, while salinity indicator values characterizing species' optimal ecological niches are available for many Central European and some Eastern European species, species responses to salinity and salt composition based on actual measurements are largely missing. Our study aims to show the relation of characteristic species to salinity and salt composition in sub- to hypersaline vegetation types in the Pannonian Basin. In 2021, we sampled 216 relevés with soil samples, and added data from Danihelka et al. (2022) and Prokešová (2013), resulting in 263 relevés. We measured pH, electric conductivity (salinity), and content of calcium, inorganic carbon (carbonate), chloride, magnesium, nitrogen (nitrate), potassium, sodium, and sulfate and quantified their ratios. We calculated species response curves as a function of ions, chemical compounds, and element ratios for characteristic and differential species of salt-affected vegetation types using Huisman–Olff–Fresco models (HOFs). Results show substantial variations between species responses characteristic for sub-saline to hypersaline vegetation types and related to different salt compositions.

This study will facilitate our understanding of plant-compositional patterns and interpretation of vegetation classification studies in inland salt-affected vegetation. They might be further helpful in developing or adjusting salinity indicator values in the Pannonian Basin.

Talk

Relation between gamma- (regional) and alpha (local) diversity in forests

Ms. Jolina Paulssen[1], Martin Diekmann[1]

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Landscape modifications and habitat loss represent major threats for plant species richness. Increasing agricultural intensity is associated with reduced connectivity of potential habitats of forest plant species. Therefore, it is essential to evaluate the importance of landscape elements such as connecting hedgerows and historical stand age for the local diversity of forest species. The study is based on a large data set of deciduous forest plots (3538 plots in 699 forest patches) sampled along a European gradient from southwest to northeast comprising eight regions in five countries (France, Belgium, Germany, Sweden, Estonia) as part of activities of the FLEUR network (https://fleur.ugent.be/). We examined the effect of several environmental factors on plot alpha diversity: regional scale gamma diversity (total number of plant species per forest patch), historical forest age (ancient / recent) and landscape type (open / bocage). Site conditions were used as covariables and assessed by means of Ellenberg Indicator Values for soil moisture, soil nitrogen, soil pH and light availability. The analysis was performed with the traditional alpha-gamma model as well as with the log-ratio based regression model.

The results revealed a generally higher alpha diversity in forests that were embedded in the bocage landscape, while saturated alpha-gamma relationships were mainly identified in the open landscape, indicating a higher degree of community saturation. An increase in local light availability contributed to a decrease in alpha diversity of forest specialist species and to an increase in alpha diversity of generalist species. These findings suggest that hedgerows and tree lines serve as ecological corridors (likely by enhancing connectivity and plant species dispersal) and induce an increase in alpha diversity of forest plant species. The latter emphasized the importance of preserving landscapes with forest elements to promote alpha diversity in forests.

Talk

Possibilities of speciation in the sandy area of the Carpathian Basin through the example of *Festuca* taxa

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We examined the vegetation appearing in forest-steppes in the Pannon region. In the present survey taxonomical relations of the dominant Festuca species were examined. After deforestation and shrubcutting bare soil patches exposed to anthropogenous effects provided an opportunity for new vegetation to form. Inflorescence parameters and micromorphological characters of the leaves were examined in a new taxon and compared with two, presumably closely related, species of the genus Festuca L. F. tomanii Korneck, with silvery leaf surface, F. vaginata and F. pseudovaginata were compared based on 24 traits of the inflorescence and their leaf anatomy studied on leaf cross-sections. Spectroscopy measurements and phytolith analysis method were used to establish the taxonomic applications of the micromorphological characters of the epidermis.

The awns of the lemma of F. tomanii were shown to be longer than those of the two other species. F. vaginata and F. pseudovaginata specimen showed low variability in inflorescence parameters but inflorescence characters were not uniform because the panicle of F. tomanii individuals was found to be bigger in the northern part than the panicles originating from the southern part of the sampled area. The phytolith assemblages of the F. pseudovaginata and Festuca tomanii differ from the F. vaginata in the abundance of 'elongate sinuate' phytolith morphotype. We confirmed the appearance of F. vaginata in natural grasslands and discovered new occurrences of F. pseudovaginata and F. tomanii. F. pseudovaginata inhabits only the Pannon region, we found endemic and natural stands of it, but in its secondary habitats it was confirmed as a completely new species. Furthermore, taxa of disturbed vegetations are currently being examined. These habitats are potential hotspots of speciation.

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Talk

Brahea *dulcis* palms -stands in central-southern Mexico: a case of Landscape Domestication

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In traditional rural societies, subsistence strategies depend importantly on wild species, which are extensively managed in situ. While management is usually oriented to individuals or populations of a species, management practices are performed on large territories and have the faculty of gradually modifying the environment to favor the availability of useful species. As the outcomes of these practices are subtle, and often resemble the result of natural processes, the human imprint can remain unnoticed. Among the adaptations performed by traditional societies to nature are maintenance of hunting areas by burning, the manipulation of forest composition and species abundance, and the promotion of patches of vegetation dominated by one or few useful wild species. Here we assess the human influence on plant community distribution, using as a case study the palm-stands of Brahea dulcis in central-southern Mexico. By means of Species Distribution Modelling, we explore social and environmental variables as triggers of observed palm-stand distribution. Model performance predicted surface and variable importance were statistically evaluated. The model was further assessed by visual inspection and ground-truth validation to contrasts predicted versus observed palm-stand distribution. Social factors contributed the most to the model fit, proving to be strongly associated with palm-stand presence, while ground-truth assessment reached certainty of circa 80% between predicted and observed areas with palm-stands. Cultural identity, distance to roads, and land tenure were the strongest explanatory variables, revealing the considerable importance of social factors regarding the palm-stand presence, supporting the assertion that Brahea dulcis palm-stands in the region are the result of long-standing human actions. We further inquire in the underlying Landscape Domestication processes.

Talk

Linking spectral and plant diversity at the landscape scale: disentangling lights and shadows of different metrics

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Biodiversity monitoring is crucial for ecosystem conservation, yet field data collection has limitations related to costs, time, and extent. Furthermore, temporal and spatial variations in biodiversity make its assessment challenging, and standardisation is difficult. Remote sensing (RS) represents a convenient approach providing frequent, near-real-time information over wide areas. According to the Spectral Variation Hypothesis (SVH), spectral diversity (SD) constitutes an effective proxy of environmental heterogeneity, which ultimately relates to plant diversity. So far, the empirical studies testing the SVH have reported contradictory findings, calling for a thorough investigation of the key factors (e.g., applied metrics, ecosystem type) and the conditions under which the link between SD and biodiversity holds true. Therefore, this study aims at investigating the applicability of the SVH for plant diversity monitoring at the landscape scale by comparing the performance of various SD metrics. We relied on ground-based data from the Pladias database of the Czech Flora and Vegetation. Species richness (SR) and functional diversity (FD) were calculated for more than 2000 cells forming a grid covering the whole Czech Republic. Within each cell, we quantified SD from a Landsat-8 “greenest pixel” composite by applying three of the most well-known types of metrics: i) the standard deviation of NDVI, ii) Rao’s Q entropy index, and iii) metrics based on the concept of “spectral communities”. Furthermore, the ecosystem type (i.e., land cover) was accounted for in the models describing the relationship between SD and ground biodiversity. Both SR and FD show positive and significant relationships with each SD metric tested. The statistical significance of the models confirms the validity of the SVH, although the strength of the relationship depends on the ecosystem type. The lack of a noticeable difference among the SD metrics investigated suggests the suitability of less computationally demanding metrics at this scale.

Talk

Spatial patterns of plant assemblages in the alpine biome

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Despite covering a mere 3% of the globe's land surface, the alpine biome is invaluable. Alpine biodiversity if known for its richness, endemism and ability to sustain drastic environmental changes. As humans, we are highly dependent on the ecosystem services provided by alpine biodiversity worldwide, but we are also responsible for the many environmental threats it faces today. Our goal was to shed light on some of the main biogeographical patterns of alpine plants worldwide and understand the drivers of alpine plant assemblages across different spatial scales. Specifically, we estimated species turnover among vascular plants in 18 alpine areas distributed globally, then compared regional alpine areas across continents and finally correlated species turnover with environmental factors. To do so, we relied on a large dataset of almost 16.000 vegetation plots for alpine areas issued from sPlot – the global repository for plant community data. First, we turned the vegetation data into a Bray-Curtis distance matrix to emulate composition similarities at the regional, continental and global scales. Second, we performed Generalized Dissimilarity Models to evaluate correlations between species turnover, geographic and environmental factors (soil, climate), and compare factor importance between regions and continents. Last we predicted species turnover over the complete alpine range worldwide using regionally-calibrated models. Our results identified important dissimilarities in plant composition between regions and continents, highlighting the importance of distance and isolation in driving species turnover. In addition, East-West and South-North oriented mountain ranges presented different rates of species turnover. Finally, climatic factors were primordial in driving species turnover overall, and their importance diversified and increased with latitude. Our study is pioneer in assessing the turnover in plant assemblages across the alpine belt worldwide, and it gives new insight on global phytogeographical patterns.

Talk

Plant invasions in the northern Andes: a socio-ecological perspective

Prof. Gwendolyn Peyre[1], MSc Daniela Giraldo[1]

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Tropical mountains harbour unique ecosystems that are highly vulnerable to environmental threats, yet remain understudied. Invasive species for example are often underestimated, even though they can cause severe ecological impacts on the structure and functions of tropical mountain ecosystems. In that context, providing monitored data on the expansion of invasive plant species and assessing their role within native vegetation is key to promote better management strategies. Here, we explored the taxonomic and functional diversities of invaded plant communities following roads along the forest-páramo elevation gradient in the Chingaza mountain range (Colombia). We followed the Mountain Invasion Research Network (MIREN) protocol to establish the first monitoring site for invasives species in Colombian mountains. We sampled three roads, sixty vegetation plots in total, recording for every invasive species, its relative cover and 10 functional traits. Then, we calculated the total invasive richness and cover as metrics of taxonomic diversity, as well as the total functional richness, evenness, divergence and dispersion as metrics of functional diversity. Each metric was correlated with elevation, environmental and disturbance factors using Generalized Linear Models. We observed a significant increase in the functional diversity of invaded communities with elevation but no clear gradient in taxonomic diversity. Moreover, vegetation structure and soil factors were identified as predominant drivers for both taxonomic and functional diversity metrics. Therefore, we shed new light on the behaviour of invasive species in forest and páramo vegetation, as our results inform that taxonomic and functional diversities of invaded plant communities are highest in fertile grasslands under intermediate levels of human disturbance. To conclude, this exploratory study helps understanding the ecological impact of invasive species in tropical mountain environments. We hope it can further contribute to establishing efficient management initiatives of invasive species in the Andes.

Talk

Pattern of diversity of *Castanea*-dominated formations along environmental gradients in the Tuscan-Emilian Apennines

Dr. Giovanna Pezzi[1], Daniela Gigante[2], Fabrizio Buldrini[1], Michele Adorni[4], Antonio Gabellini[5], Matilde Gennai[3], Bruno Foggi[3], Daniele Viciani[3]

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Chestnut-dominated formations (traditional orchards and coppices) are a key element of southern Europe mountain landscape and a habitat of conservation interest (9260 Castanea sativa woods), according to the Habitat Directive (92/43/EEC) of the European Union. As human-dependent ecosystems, they require an in-depth knowledge of the pattern of species diversity in relation to management and environmental gradients in view of preservation plans or to guide their dynamics. A dataset for the Tuscan-Emilian Apennines of existing phytosociological relevés with a C. sativa cover/abundance ≥50% was built. This dataset consists of more than 800 relevés, with a temporal extent between 1970s and 2010s. Each relevé was coupled to a pair of coordinates together with a radius indicating the uncertainty of position. After updating nomenclature, the Ellenberg indicator values, chorotype and life form were attributed to each species. Data were analysed by ordination methods such as Canonical Correspondence Analysis. Diversity pattern of species composition in chestnut-dominated formations is due to hierarchically ordered environmental factors. Heliophilous vs sciaphilous species and acidophilous species are rough indicators of management gradients

Talk

Functional traits and diversity as determinants of plant decomposition in temporary ponds: insights from a field experiment

Ms. Verónica Pinelli[1,2], Mariana Illarze[2], Lucía Rodríguez-Tricott[2], Lucía Sosa[2], Cinthia Novo[2], Esteban Ortiz-Grandal[2], Felipe Maresca[2], Andrés de la Rosa[2], Ana Inés Borthagaray[2], Matías Arim[2]

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Vegetal decomposition depends on climatic and soil conditions, decomposers' diversity and the legacy of plant functional traits as litter quality. Functional diversity drives decomposition, regulating nutrient cycles. Litter decomposition field experiments have focused in one or few native species or in exogenous material, so there is a lack of understanding in the process at whole community level. Temporary ponds undergo a dramatic state change when dry out changing from aquatic to terrestrial conditions, are under-represented in decomposition analysis. We analyzed the effect of plant functional diversity in litter decomposition at community scale in temporary ponds, in active and dry phases.

We performed a field experiment in a set of 54 temporary ponds closely distributed, covering a wide range of local conditions. Litter bags of local native species (totalizing 68 species) and green and rooibos teas were buried together both in active and dry phases (totalizing 448 sample units). We measured decomposition rates as the fraction of vegetal material mass loss. Leaf and plant functional traits were measured at species level. Species abundances were estimated for each community. We calculated community weighted traits means and functional diversity as Rao's quadratic entropy indices of diversity (RaoQ).

Weight loss of teas and native litter were weakly correlated (r = 0.06 to 0.35), with the stronger correlation corresponds to green tea and native material in active pond phase. Decomposition was significantly more variable in dry than in active phases. Correlation among decomposition and RaoQ was significative and variable among phases. Main decomposition predictors were dry leaf matter content, area and P content. Our results suggest that climate, soil conditions and functional composition, that determine litter quality and diversity, were important drivers of litter decomposition, in concordance with plant economic strategies.

This connection is crucial for understanding vegetation–soil and climate dynamics in wetlands.

Talk

Changes in species composition and diversity of loess hill prairies in southwest Illinois

Mr. Andrew Pyszka[1], Dr. Peter Minchin[1]

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Loess hill prairies are grassland ecosystems on shallow loess-derived soils on the bluffs of the Mississippi and Illinois rivers. They have escaped transformation for agriculture but are surrounded by deciduous forest and at risk of woody encroachment. My objective was to investigate changes in loess hill prairies since the Illinois Natural Areas Inventory (INAI) surveys in the 1970s. I tested the hypothesis that reduction in native species diversity is positively correlated with woody encroachment. Ten sites were selected and the prairie at each site was resampled using the same methods as the original surveys. Transect coordinates were obtained from digitized INAI maps. Cover of herbaceous species was estimated using a modified Braun-Blanquet scale in 0.25 m^2 quadrats at 5 m intervals along the transect. Stem counts of shrub species were obtained in five 10 m^2 circular quadrats centered at five positions along the transect and DBH data for trees was collected in concentric 250 m^2 quadrats. Richness and Shannon diversity of the herbaceous community were calculated from frequency data. NMDS ordination was used to visualize trajectories of change over time. Paired t-tests were performed to test for changes in richness and diversity. Fisher exact tests were used to test for changes in the frequency of species over time. Linear regressions were used to test whether changes in richness and diversity were predicted by woody species abundance. Ordination showed that composition of the ten prairies has changed in a consistent way and Fisher tests identified species that contributed to these changes. Native diversity declined over time. Regression found a positive relationship between tree dominance and decline in diversity. Woody encroachment is a major contributor to the degradation of loess hill prairies. Management practices such as periodic prescribed burning, and mechanical removal of woody species are essential to maintain this rare ecosystem.

Talk

Do we yet know what a plant community is?

Dr. Jill Rapson[1]

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Scientists have theorised and written about the nature of plant communities for years, but a progressive definition still eludes us, complicated by a community's internal variability at a range of scales. Yet communities must exist in nature, as we can detect ecotones between them. I consider some past definitions in the context of recent work which suggests an alternate answer.

We have examined productivity and decomposition rates of tussocks in a grassland community over a 700m altitudinal gradient, in a space-for-temperature experiment on carbon sequestration rates. We measured productivity by tracking leaf elongation rates, and converting these to biomass equivalents. Decomposition of leaf litter was measured over 4 years in a full reciprocal transplant design.

Results show greater productivity as biomass increment at lower altitudes, as expected. But decomposition rates were indistinguishably different based on both sites of litter origin, and of destination, and there was no significant origin X destination interaction. And productivity expressed as relative growth rate also showed no significant differences along the altitudinal gradient, even if we refined censusing of defoliation losses.

Other work looking at variation within alpine communities at their range extremes, has shown high variability compared with range centres, but there seem no adequate statistical methods to really test this.

So, while the composition of tussock grassland may vary within limits along the gradient, carbon flows do not. The implication is that, within a community, constancy of rates of resource flows might be the defining feature. The questions are whether these results are similar for other resource flows and communities, whether we should add more rates to our trait library, and how to improve examination of within-community variation to aid our understanding of the nature of the plant community.

Talk

Ancient forests become more like recent ones. Marginal role of forest habitat continuity in shaping understory vegetation of mountain, temperate forests

Dr. Kamila Reczyńska[1], Prof. Krzysztof Świerkosz[1]

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Most studies confirm that ancient (AF) and recent (RF) forests differ in species composition, diversity and functional structure. However, the less isolated AF and RF patches, the weaker dissimilarities between them. This may be explained by the gradual colonization of RF by forest specialists from adjacent plots of AF. Rarely, consequences of such connectivity for AF are discussed. Thus, we verify the influence of forest habitat continuity on compositional and functional patterns of herbaceous vegetation of weakly isolated AF and RF under different edaphic and topographic conditions.

We surveyed AF (persisting since 1750) and RF located in the Eastern Sudetes (Poland) and managed under different site conditions (acidic vs basic forests). Understory vegetation within 617 plots was recorded together with topographic factors and forest structure. Specific leaf area, plant height and seed mass were used to calculate community-weighted mean values and functional diversity (FDQ). The overall pattern in vegetation including environmental variables was analyzed using hierarchical clustering and ordination techniques. Generalized Linear Models were used to assess the relationship between traits and environmental variables.

AF were richer in forest specialists than RF. However, both types of forests shared a large group of constant species including nutrient-demanding and invasive taxa. This caused the lack of differences between AF and RF in species richness and FDQ. Habitat continuity was responsible for less than 2% of variation in species composition which was mainly shaped by altitude, stand age and dominant tree species. Land-use history was only important in explaining plant height (H) variation regardless of the site conditions.

Our results suggest that herbaceous vegetation of AF and RF weakly depends on the habitat continuity. We assume that high patch connectivity and regular management enable two-way species exchange in which AF are not only donors of forest specialists but also recipients of nutrient-demanding species.

Talk

Plot sizes affect patterns of plant diversity

Dr. Lorenzo Ricci[1], Prof. Michele Di Musciano[1,2], Prof. Anna Rita Frattaroli[1], Dr. Piero Zannini[2], Dr. Marco Cervellini[2], Prof. Alessandro Chiarucci[2], Dr. Valter Di Cecco[3], Prof. Marco Cutini[4], Prof. Marco Iocchi[4], Prof. Jean Paul Theurillat[5,6]

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Observed plant diversity patterns are affected not only by environmental conditions but also by plot sizes and sampling design. At different plot sizes, species diversity is shaped by the heterogeneity of different environmental variables that varies at different spatial scales. Based on presence-absence data from 84 randomly selected nested plots ranging from 0.0156 m x 0.0156 m to 16 m x16 m, we investigated the association of different plot sizes with plant diversity patterns along an elevational transect two kilometers wide in the Central Italian Apennines (Velino massif, Abruzzo). The gradient ranged from 1100 to 2486 m a.s.l. and was divided into 13 elevational belts of 100 m each. Alpha diversity (species richness) was calculated in each nested sampling unit while gamma was measured in all the plots belonging to 13 elevational belts of 100 m. Beta diversity was calculated among all plots and inside elevational belts. We used Generalized Linear Models (GLMs) to investigate the elevational patterns of alpha, beta, and gamma diversity. For all the models we carried out linear quadratic and cubic regression and the most parsimonious model, based on Akaike Information Criterion (AIC), was chosen. Alpha and gamma diversity showed a decrease along the elevational gradient. GLMs results confirmed that the influence of elevation on species richness increases when increasing the plot size. The multisite beta diversity (within elevational belts) didn't show any significant pattern due to the great environmental heterogeneity within elevational belts. Beta diversity among plots, instead, showed a clear pattern driven by the elevational distance among plots, in the plot sizes bigger than 4 m^2. To conclude, this study has demonstrated that sampling sizes strongly affect elevational patterns of alpha, beta, and gamma diversity of plant communities.

Talk

Diversity of vascular plants, bryophytes, lichens, soil fungi, and ground beetles of temperate forests depends on habitat availability in space and time

Dr. Kersti Riibak[1], Prof. Meelis Pärtel[1]

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The loss of old-growth forests exposes a threat to many forest-dwelling species. Thus, a better understanding of which factors determine forest biodiversity at different temporal and spatial scales is needed. Using different biodiversity metrics, we will explore how the diversity of different functional groups relate to forest availability estimates at different spatio-temporal scales in old-growth boreo-nemoral forest sites in South-Estonia (NE Europe).

We recorded all vascular plants, bryophytes, lichens, and ground beetles in 100 forest sites (10 x 10 m). Soil fungi were described with eDNA-based analyses. Forest availability was estimated at the 0.5–5 km scale around the sites using historical (past 100 years) and contemporary topographic maps. For each functional group, we quantified the observed diversity (Shannon diversity index) and dark diversity (species that were absent from potentially suitable sites but present in the region; the absent part of the site-specific species pool). Dark diversity was estimated using species co-occurrence data. We related the diversity metrics to forest availability and spatio-temporal scales that had the strongest relationships.

Our results showed that the dark diversity models were often more strongly related to forest availability estimates than observed diversity models. The diversity of forest specialists (ground layer and epiphytic species, ectomycorrhizal fungi) depended mostly on historical forest availability and was highest in the sites surrounded by large forest areas (up to 5 km radius). Contemporary forests at 0.5–2 km radius scale affected negatively light-demanding forest ecotone taxa (arbuscular-mycorrhizal fungi, ground beetles).

Our results suggest that consideration of the absent part of the site-specific species pool provides complementary information to observed diversity patterns. Additionally, early successional (young) forests cannot provide suitable habitats for many forest-dwelling species. Consequently, to enhance biodiversity and ecosystem functions in historically mosaic landscapes, both long-term (stable) forest and open (semi-)natural habitats are essential to preserve.

Talk

Cartograms for mapping sampling effort bias: 'croce e delizia del cor'*

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Cartograms - here in the meaning of density-equalizing maps - are a powerful analytical tool that distorts the geometry of spatial features to visually emphasize the heterogeneity in the distribution of target variables. For example, they have been used in ecological cartography to map the sampling effort bias associated with species or, more generally, biodiversity distribution models fitted across different spatial scales. In this study, we disentangle advantages and disadvantages of cartograms for mapping biodiversity patterns - considering species richness and turnover, as well as species distributions - and their variation across space. Showing uncertainty through cartograms may provide a straightforward solution to communicate the actual degree of knowledge of species distributions and diversity. This said, we do envision an iterative process of model testing and cartograms visualization, so that the representation of uncertainty patterns can be used to guide data collection and optimization of model specification.

** This italian expression comes out from the Traviata (1853) opera by Giuseppe Verdi. In English it would sound like "torment and delight of the heart"*

Talk

Experimental tests of fire energy effects on resprouting shrub and grass persistence in a semi-arid savanna ecosystem

Dr. William Rogers[1], Ms. Lela Culpepper[1], Mx. Quinn Hiers[1], Ms. Virginia Preiss[1], Dr Matthew Dickinson[2], Dr. Kathleen Kavanagh[3], Dr. Alexandra Lodge[4], Dr. Peyton Smith[1], Dr. Heath Starns[1], Dr. Douglas Tolleson[1], Dr. Morgan Treadwell[1], Dr. Dirac Twidwell[5], Dr. Carissa Wonkka[6]

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Woody-shrub encroachment is decreasing graminoid abundance and threatening biodiversity in savanna ecosystems worldwide. Conventional management has struggled to reduce woody-plant densities; however, previous research showed that high-energy prescribed fires during drought could cause resprouting shrub mortality. The impact of these fires on herbaceous vegetation and soils is unknown. We manipulated fire-energy (J/m2) via supplemental fuel loads in 72 completely randomized 100m2 plots centered on a mature Prosopis glandulosa in a semiarid Texas savanna ecosystem and measured survival and growth for 2-years. We also assessed fire treatment effects on tiller density, bud bank dynamics, and resprouting potential of two dominant grass species, Nassella leucotricha (C3-caespitose) and Hilaria belangeri (C4-stoloniferous). Additionally, we established replicated wildlife herbivory exclosures and examined soil properties in response to fire treatments. Only 25% of Prosopis shrubs resprouted when exposed to high-energy prescribed fire, whereas all shrubs in low-energy fire treatments resprouted. Shrubs exposed to low-energy fires had 30x more resprouts compared to shrubs exposed to high-energy fires. Graminoids were differentially affected by fire likely due to varied phenology and morphology. Dead buds significantly increased and bud-activity significantly decreased within 24hr post-fire treatments in both species. Only 25% of Hilaria buds exposed to high-energy fire resprouted, whereas all Nassella eventually did despite early bud deaths. Nassella bud numbers and activity in high-energy treatments were equal to unburned controls after 8-months, whereas Hilaria buds did not recover. Significant effects of wildlife herbivory were observed, but these did not manifest in response to fire treatments. Physical properties of soil were not significantly affected by fire treatments, but high-energy fires altered chemical and biological properties, notably a decrease in extracellular enzyme activity. Our experiments demonstrate herbaceous vegetation and soil resilience to extreme disturbance events in this ecosystem and the potential for high-energy prescribed burning to manage woody-shrub encroachment in semi-arid savannas.

Talk

Dynamics and phenology of the urban spontaneous vegetation in the city of Toledo (central Spain)

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The EU Biodiversity Strategy 2030 points out the value of greening urban and peri-urban areas based on the ecosystem services provided to the population. For that reason, European cities with over 20,000 inhabitants are encouraged to develop Urban Greening Plans to bring nature back to cities. This work includes a comprehensive study of the nitrophilous flora and vegetation types from the spontaneous vegetation of the peri-urban areas and vacant lots in the city of Toledo (~ 85,000 inhabitants). The characterization of the vegetation was based on the phytosociological approach. The phenological patterns of the plant species were registered during the realization of 150 vegetation relevés during the spring of 2021. Parallelly, weekly images from near-ground digital cameras allowed to study the phenological development of the main ruderal plant communities from a spectral point of view.

The plant communities of nitrophilous vegetation identified belong to six syntaxonomical classes. Megaforbic perennial and thistle communities belonging to Artemisietea vulgaris or Galio-Urticetea classes are associated to nitrogen-rich soils of very perturbed areas and anthropogenic communities of riverine soils on the riverbanks of the Tagus river. But the most common vegetation covering extensive mesic or xeric ruderal areas and vacant lots belongs to the annual communities of the Stellarietea mediae class. The continental (Rivas-Martínez index of 19.8) and profoundly seasonal Mediterranean climate in central Iberian Peninsula conducts to a drastic phenological change in mid-May and early June between greenup, maturation and senescence for these plant communities, which may be accelerated by the mowing of vegetation. Early mowing of spontaneous vegetation also may increase the allergenic risk due to the development without competition of late-flowering allergenic grasses such as Dactylis hispanica or Trisetum paniceum. Knowledge about the diversity and dynamics of spontaneous vegetation may conduct to a more efficient management of peri-urban spaces of the cities.

Talk

Inferring community assembly processes from functional seed trait variation along temperature gradient

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Trait-based assembly of plant communities has long been

analysed using mainly vegetative traits ignoring how ecological processes may affect plants at their early stages of their life cycle.

Here, we analyzed an extensive data set of 16 traits for 167 species measured in-situ in 36 grasslands located along a steep climatic gradient and compared the impact of abiotic filtering, biotic interactions and dispersal on traits reflecting different trait categories: plant vegetative growth, germination, dispersal, and seed morphology.

The seed traits were weakly correlated to vegetative traits and thus constituted independent axes of plant phenotypical variation that were affected differently by the ecological processes.

Abiotic filtering impacted mostly the vegetative traits and to a lesser extent on germination and morphological traits. Increasing low-temperature stress towards colder sites selected for short-stature, slow-growing and frost-tolerant species that produce small quantity of smaller and dormant seeds, high temperature requirements for germination and comparatively low germination speed.

Biotic interactions, competition in the lowlands and facilitation in uplands, also filtered certain functional traits. The benign climate in lowlands promoted plant with competitive strategies including fast growth and resource acquisition and early and fast germination, whereas the effects of facilitation on the vegetative and germination traits were cancelled out by the strong abiotic filtering.

The changes in the main dispersal vector from zoochory to anemochory along the gradient strongly affected the dispersal and the seed morphological trait community structure. Specifically, stronger vertical turbulence and moderate warm-upwinds combined with low grazing intensity selected for light and non-round shaped seeds with lower terminal velocity and endozoochorous potential.

We clearly demonstrate that, in addition to vegetation traits, seed traits can substantially contribute to functional structuring of plant communities along environmental gradients. Thus, the ‚hard' seed traits related to germination and dispersal are critical to detect multiple, complex community assembly rules.

Talk

An empirical test of the longitudinal tree species diversity gradient in eastern North America

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Moving from the east coast to mid-continent in the continental USA should show a decrease in species (taxon) diversity for most plant life. This is due to the vectors of climate which leads to less precipitation towards mid-continent. I used data from the USDA Forest Service, Forest Inventory and Analysis (FIA) program to empirically test for differences in tree species diversity across longitudes in the eastern USA. Four east-west transects, approximately 900 km long and 300 km apart, were established in GIS software. The northern-most transect was at 41.50 latitude, the southern-most transect was at 32.50 latitude. Along each transect three equally spaced sample unit (SU) collection points were established to lasso all the FIA SUs (~250) inside a 40-km radius circle. The species diversity metric applied was tree species richness (S) and the alpha diversity (point diversity) approach was defined by the number of tree species ≥2.54 cm dbh on each SU. The size of each SU was approximately 0.067 ha. The hypothesis of diversity decline from east to west is not fully supported in this study because of mixed results. The two middle transects showed substantial decreases in average (S) SU^{-1} ; however, the northern- and southern-most transects showed slight increases in average (S) SU^{-1}, east to west, respectively. The highest number of species recorded on any SU was 14. Possible reasons for mixed results are: 1) the alpha (S) measure in a SU does not capture the full complement of species (SU size too small), 2) the change in and number of habitats, 3) the amount/degree of disturbance, 4) various stages of succession may be present, and 5) real random data is messy. The study demonstrates one way to assess tree species (S) over a large geographic area. Future studies will incorporate beta and gamma diversity measures.

Talk

Setting restoration priorities for burned nothofagus forests in Tierra del Fuego, Argentina: impact of distance from fire boundary and remnant live trees on seedling and sapling regeneration

Mr. Matthew Ruggirello[1], Dr. Rosina Matilde Soler[1], Dr. María Vanessa Lencinas[1]

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Wildfires in Tierra del Fuego (southern Argentina) have had devastating impacts on native Nothofagus forests: tree regeneration post-fire has been sparse and restoration plantings have lacked scientific support. A deeper understanding of the impacts of wildfire is essential to restoring the region's forests. During the summer of 2021-2022, we established 192 plots in burned and unburned areas to determine the impacts of biophysical variables on post-fire Nothofagus tree regeneration. Explanatory variables measured at each plot included distance to fire boundary and remnant live trees, remnant tree height (site quality) and total basal area; response variables were seedling (<30cm) and sapling (30-130cm) density of lenga (Nothofagus pumilio) and ñire (N. antarctica) trees. Data were correlated using Pearson's correlation coefficient. Distance to fire boundary was negatively correlated with seedling and sapling density for lenga ($r=-0.43$, $p=0.0001$; $r=-0.41$, $p=0.0002$), but not for ñire ($r<0.2$, $p>0.05$). Distance to remnant live trees was negatively associated with seedling and sapling regeneration of both lenga ($r=-0.28$, $p=0.01$; $r=-0.29$, $p=0.01$) and ñire ($r=-0.22$, $p=0.02$; $r=-0.27$, $p=0.004$). Total basal area was positively correlated with lenga seedling and sapling regeneration ($r=0.58$, $p<0.0001$; $r=0.34$, $p=0.008$), but not with ñire regeneration. Average tree height was only associated with lenga seedlings ($r=0.54$, $p=0.0009$). Our results suggest that lenga will struggle to reestablish in the interior of fires, particularly on low-quality sites. Burned areas where few trees survived the fire will struggle to regenerate any forest cover at all. When deciding how to allocate limited resources toward forest restoration, land managers should prioritize planting lenga in the interior of burned areas where few live trees remain.

Talk

Re-creation of grassland by sowing low-diversity grass seed mixture: short-term impacts on soil, vegetation and farming

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Grassland re-creation by seeding is an important tool in restoration. A fundamental aspect for applied projects is how to incorporate grassland restoration in farm's economy. If a considerable proportion of farm's grasslands undergo restoration, it demands substantial changes in the routine of grassland and livestock management over several years. In addition, restoration leads to considerable decrease of grassland productivity in a long-term. One solution could be to use seed mixtures that are well perceived by farmers so that they could gradually adapt to the decline in grassland yields. The aim of this study was to explore short-term impacts of grassland re-creation by sowing "farmer-friendly" grass species on soil, vegetation and farming. We re-created grasslands in a large-scale restoration project, GrassLIFE, in Latvia in 2019. Lolium multiflorum was sown on four fields, 30 ha in total. Two were old fallow-lands mowed and grazed extensively for last 25 years. Other two were post-arable land overgrown by secondary woodland. Woodland was cut, roots were shredded followed by disc harrowing and sowing of Lolium multiflorum. Two more fields (15 ha) of post-arable grasslands were ploughed and seeded with Lolium perenne, Poa pratensis, Festuca pratensis and F. rubra. In 2020, green hay sourced from nearby semi-natural grasslands was applied. Vegetation sampling was done annually before and after restoration and in reference sites. Soil samples were collected before and two-three years after restoration. We analysed changes in species diversity, community completeness index, vegetation composition, yield, plant available phosphorus, total nitrogen and carbon, and the farming practice of restored grasslands. We conclude that the tested approach was well perceived by farmers and the farming of restored grasslands changed only slightly due to restoration activities. Vegetation and soil developed in a positive direction towards reference sites.

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Talk

Impacts of land use change on plant species composition across ecoregions

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Land-use change and intensification are among the most important drivers of the biodiversity crisis. Most studies testing for the effect of land-use intensity on plant biodiversity, however, either focused on gamma diversity only, therefore neglecting the role of compositional turnover, or were limited to small spatial extents.

Here, we aim at disentangling the regional effect of land-use change on plant species composition across ecoregions. Specifically, we: 1) modelled how changes in land-use and land-use intensity affect the spatial distribution of plant species composition over a 25-year period, 2) calculated the proportion of plant species committed to extinction as an effect of changes in land use, and 3) identified hotspots where an increase in land-use intensity is likely to induce a higher than average number of species to go extinct.

For a selection of 120 well-sampled ecoregions, we used sPlotOpen, a fine-resolution, large-extent open-access database of plant vegetation plots, to calibrate ecoregion-specific Generalized Dissimilarity Models (GDMs) linking between-plot compositional dissimilarity to geographical distances, ecological dissimilarities, and differences in land use. Fitted GDMs were then used to predict the compositional dissimilarity within each ecoregion and create wall-to-wall maps of species composition in year 1990 and 2015. By comparing these two times, we highlighted areas where change in land use and land-use intensity induced changes in species composition, and quantified the proportion of species committed to extinction with an approach based on species area curves.

Land use significantly impacted the composition of plant communities, with wide variation across ecoregions. The proportion of plant biodiversity committed to extinction was greatest in developing countries, especially in frontier areas of the tropics and subtropics, i.e., areas with high rates of agricultural expansion and intensification. In developed countries, instead, increasing land-use intensity was, at least partially, counteracted by a positive effect of land-use abandonment.

Talk

Characteristics of poisonous plant patches in the semi-arid and arid rangelands of Namaqualand, South Africa

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The Namaqualand region in South Africa is part of the richest arid biodiversity hotspot in the world. Plant distribution and diversity here are impacted by various biophysical and anthropogenic factors. In these landscapes, poisonous plant patches, which pose serious threats to livestock, are widespread but their contribution to the rangeland's ecology and biodiversity are not fully understood. The aims of this study were to assess the plant species composition, associations and diversity on poisonous plant patches and compared it to the matrix in the semi-arid to arid Steinkopf pastoral area South Africa.

Twenty-five 15x15 paired sites were selected based on the dominance of poisonous plants within the genera Tylecodon, Euphorbia and Adromischus. Within these sites, the number and abundance of different plant species were recorded and categorised into different plant functional types. Results showed that plant association were found to be affected by aspect. The highest number of positive associations were found on north facing slopes. Cheiridopsis denticulata were found to be an indicator for the presence of all of the poisonous plants evaluated in this study on north facing slopes. Furthermore, a significant difference in Shannon Wiener plant diversity where poisonous plant patches displayed a greater diversity compared to sites sampled in the matrix.

We interpret these findings as a consequence of herding in the region, where herders do not allow their animals to graze on or near poisonous plant patches. As such, palatable plants, which are absent or low in abundance in the surrounding landscape have a refuge where they can survive and set seed. This study provides evidence that the ethnobotanical knowledge of herders and palette of livestock are also major contributors to the spatial distribution, composition and diversity of plant species in this arid biodiversity hotspot

Talk

Challenges and insights for the understanding and classification of halophytic vegetation in Europe and North Africa

Prof. Daniel Sánchez-Mata[1], MSc Esteban Ramírez[2], Prof. Lourdes Rufo[3], MSc Irene Sánchez-Gavilán[2], Prof. Vicenta de la Fuente[2]

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For more than fifteen years, we have studied some taxonomical and geobotanical aspects concerning the halophytic flora and vegetation throughout the European Western Mediterranean, and North Africa territories.

Several contributions to elucidate the taxonomic diversity of different genera involved in this highly specialized kind of vegetation, and some syntaxonomical approaches have been duly published.

The threats of the peculiar European saline landscapes structured on saline soils, appointed as prioritized EU habitats, has led us to support all the scientific efforts for a better understanding and knowledge of these vegetation types.

A syntaxonomical compilation of the higher phytosociological units involved are also included.

Talk

Ultramafic vegetation in California

Prof. Daniel Sánchez-Mata[1]

[1]*Complutense University, Madrid, Spain*

Over more than two decades of research the main vegetation types growing on ultramafics soils throughout the California state landscapes are compiled.

Most important features related with the biogeographical distribution, structure, dynamics, and floristic composition of the main vegetation types are considered.

A complete syntaxonomic scheme with the formally published phytosociological units is also included.

Talk

Drivers of the spatial stabilization of metacommunities: from theory to data analysis

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Despite great progress in our understanding of the mechanisms governing ecosystem stability in local communities, we still lack knowledge on a larger spatial scale. Previous attempts to disentangle the processes simultaneously affecting metacommunity stability encountered conceptual and methodological barriers. We propose a framework aiming at disentangling the relative effects of population stability and different types of synchronies on metacommunity stability. Our framework relies on closer links between mathematical indices and ecological mechanisms than previous work. In a grassland metacommunity, we found higher stability at a larger spatial scale, mainly due to statistical averaging (portfolio effect). We also found that positive synchrony between populations (within and between species) prevailed at the metacommunity level, while anti-synchrony emerged at the local scale. Finally, we demonstrated that due to methodological bias, previous work has not correctly connected patterns of synchrony at the metacommunities level with the underlying ecological processes.

Talk

Is a treeless savanna a grassland? The answer lies in the forb layer

Prof. Frances Siebert[1], Prof Stefan Siebert[1]

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Tropical savannas and grasslands are ancient ecosystems, which are widely misunderstood and undervalued since they are commonly perceived as degraded ecosystems created by human-induced fires and deforestation. In recent years, substantial scientific evidence has been provided to challenge these perceptions, although a clear differentiation between ancient, tropical savannas and equally ancient grasslands have not yet been considered. Treeless ancient tropical savannas, mostly associated with vertic clays derived from basalts and gabbros, are often described as grasslands through the use of physiognomic, rather than functional and floristic characteristics.

Making use of floristic and functional data across ancient grassy ecosystems in South Africa, we tested whether treeless savannas and treeless grasslands, both ancient, non-degraded ecosystems, are related in terms of species- and functional composition. Our results revealed that, apart from having equally low abundances in fire- and herbivory tolerant trees and shrubs, overall species and functional composition differed significantly, particularly in the herbaceous layer. Although differences in grass composition were observed, the strongest dissimilarity between these systems was evident in the forb layer. Forbs in ancient, treeless grasslands are dominated by members of the Asteraceae, they represent more monocotyledonous species, and contribute substantially to belowground carbon pools via significantly more species with large underground storage organs. Savanna grassland forbs are dominated by Malvaceae, Fabaceae and Acanthaceae, they represent both perennial and annual life history strategies, although annual forbs are more strongly associated with savanna grasslands. Forbs from both ecosystems were functionally defined by both fire- and herbivore-adapted traits, although herbivore resistor and –avoidance traits were better represented among savanna grassland forbs.

Failure to distinguish between floristically and functionally different ancient grasslands and savannas may lead to a further underestimation of ancient grassland biodiversity and the important ecosystem functions provided by the high diversity of forbs.

Talk

Native vegetation recovery after herbivore exclusion in antarctic beech *(Nothofagus antarctica)* forests

Dr. Rosina Soler[1], Eng. Gimena Bustamante[1], Dr. Verónica Cruz-Alonso[2], Dr. Bernd Lenzner[3], Assoc.-Prof. Dr. Franz Essl[3]

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Livestock grazing generates negative impacts on forest understorey vegetation in regions without a long eco-evolutionary history of grazing/browsing by large herbivores. Excluding livestock has been proposed as a restoration strategy to recover some original attributes (e.g., forest specialist species) in many temperate forests. However, a robust understanding of the effects of livestock grazing on plant community composition -including native and alien species introduced for livestock raising- is essential for effective conservation management. This study evaluates the effect of herbivore exclusion on on restoring native vegetation assemblages in Nothofagus antarctica forests and the potential implications for biodiversity conservation. The dynamic of understory native and alien plant species was monitored from 2015 to 2020 by using exclusion treatments (overall herbivores excluded, livestock excluded, and grazed area) in four sites of Tierra del Fuego, Argentina. We determined the effect of exclusions and time since the onset of exclusion on species richness and abundance of main vascular plant groups (monocots, dicots, and ferns), and the rate of change (ROC) between 2015 and post-years exclusion using generalized linear mixed models. After herbivore exclusion, we found that the abundance of native species increased, although species richness (natives and aliens) did not change. We also found a negative native-alien relationship after herbivore exclusion (i.e. aliens decreased as natives increased), suggesting that herbivores exert some control in the balance of native-alien abundances (e.g., through biomass consumption, trampling). All groups changed in abundance over time, but the exclusion treatments only affected the ROC for native grasses, which increased significantly inside exclusions compared to grazed areas; finally, alien dicots, which increased significantly in the livestock exclusion compared to the others. Plant community assembly of N. antarctica forests responds favorably during the first years after exclusion of herbivores, although long-term monitoring is necessary to better understand native-alien dynamics in slow-growing forests.

Talk

Novel vegetation of the former Iron Curtain: a valuable relic of a Cold War era

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Novel vegetation of the former Iron Curtain: a valuable relic of a Cold War era

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The landscape of the former Iron Curtain between Bavaria and former Czechoslovakia contains many endangered, rare and/or relic plant species and habitats. This narrow strip of land is a small part of the longest linear artificial structures in Europe and often serves as a source of biodiversity and migration corridor between northern and southern Europe. In our project, we explore nature conservation targets in two transborder regions at the Czech – Bavarian border. This task is rather complex: most of the border landscape is covered by a mosaic of later successional stages of the former cultural landscape. Moreover, it contains many cultural relics, abandoned military installations and villages at the Czech side, as well as intensively and continuously inhabited landscape in Bavaria.

We performed a detailed vegetation mapping of six 4×4km square areas in two adjacent regions of the Czech-Bavarian border. Consequently, the data analysis showed concentration of floristic and vegetation diversity along the former Iron Curtain and in certain successional phases of former cultural grasslands, which are mostly linked to relic man-made structures including the former military structures. These “isles of diversity” are rather local, fine-grained and densely scattered across the region, making it very difficult for traditional approaches of nature conservation. In contrast to general landuse change eliminating extensive ways of landscape management, we suggest frequent, low-intensity and spatially widely distributed interventions composed of a mixture of traditional and innovative conservation management. The aim is to preserve the positive legacies of the former Iron Curtain - high biodiversity and unique landscape structure.

Talk

Global patterns of observed and dark diversity brought to light by the DarkDivNet research network

Dr. Riin Tamme[1], Prof. Meelis Pärtel[1], Dr. Carlos P. Carmona[1], DarkDivNet Consortium

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To protect or restore biodiversity, it is essential to understand which factors influence species diversity in different parts of the world. In addition to observed species diversity, it is also important to consider dark diversity (i.e. absent part of the species pool) that can give further insights into why some suitable species are missing from local communities, limiting biodiversity. Considering both observed and dark diversity allows us to analyse the processes shaping local diversity across different regions and habitat types.

Global research collaboration network DarkDivNet has collected standardized vegetation data from >100 study areas. In each 10 km radius study area, collaborators have sampled 30-90 10x10 m plots. For each plot (>4000), we used the observed vascular plant species richness and estimated dark diversity using species co-occurrences in the neighboring plots. We then explored how environmental (climate, soil) and anthropogenic factors influence observed and dark plant species diversity at a global scale.

Both observed and dark diversity in plant communities were influenced by climatic factors. This highlights the importance of large-scale climatic conditions shaping species pool size in different ecosystems. However, soil conditions were better linked to observed diversity while anthropogenic factors had a stronger influence on dark diversity.

Coordinated global sampling allows comparisons of local species richness patterns in different habitats and regions across the world. We found that environmental factors shape local plant communities globally, but anthropogenic factors determine which species remain in the dark diversity. The information about factors influencing dark diversity helps us to evaluate the conservation value and restoration potential of plant communities in different parts of the world.

Talk

Overview of the Salicornietea fruticosae class in the central Mediterranean area

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Mediterranean coastal salt marshes are areas temporarily and periodically flooded by brackish waters covered by halophilous plants. Despite their continuous decline due to human pressure, these habitats host many ecologically specialized plant species. From the phytosociological viewpoint, the coastal salt marshes are predominantly colonized by plant communities belonging to the Salicornietea fruticosae class (=Sarcocornietea fruticosae). These halophytic perennial communities include succulent suffruticose and fruticose species, growing in the wetlands of the Mediterranean and Saharo-Sindhic regions. They are mainly found in the infra- and meso-Mediterranean thermoclimatic belts. This vegetation type usually includes floristically poor phytocoenoses, chiefly represented by succulent species belonging to the Amaranthaceae family with a chamaephytic to nanophanerophytic habit, such as Arthrocaulon meridionale, A. macrostachyum, Halimione portulacoides, Halocnemum cruciatum, H. strobilaceum, Salicornia fruticosa, S. perennis s.l., Suaeda vera, etc.

As regards the central Mediterranean area, literature data on the Salicornietea fruticosae are rather uneven. Actually, some territories are sufficiently surveyed, while others seem to be poorly investigated. Given this gap, we carried out an accurate research on the already published data, as well as several field investigations, still ongoing, in order to have a big dataset, partly retrieved from EVA (European Vegetation Archive), that includes ca. 2,600 vegetation plots.

Aim of this study is to provide an updated syntaxonomical classification of the Salicornietea fruticosae class in the coastal central Mediterranean area, as well as to elucidate the nomenclature of some critical syntaxa. Finally, we define the geographic distribution of the alliances and orders and we perform an interpolation between bioclimatic variables and plant communities.

Talk

Effects of controlling an invasive native plant on ecosystem multifunctionality of wet grasslands

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Grasslands were historically managed to provide multiple services and goods to human societies, such as animal husbandry and production of raw materials (fodder and bedding for livestock) as well as security from environmental hazards, groundwater protection and carbon storage. Despite its negative effects on human wellbeing, grassland degradation has been neglected for a long time resulting in biodiversity losses and functioning impairment. The intensification of cultivated grasslands and the abandonment of marginal sites pose substantial threats to the services and goods provided at local and landscape scales. Moreover, invasion by unwanted plants (e.g. poisonous species) can cause direct and indirect losses of ecosystem services. This is the case of Jacobaea aquatica, a native invader in pre-alpine grasslands of C Europe. Invasion by this poisonous plant directly reduces the economic value of sites through forming dominant stands, resulting in the abandonment of grassland usage. Here, we tested different management regimes to reduce J. aquatica abundance in wet grasslands in S Germany, and assessed how its regulation affected grassland functioning via different indicators of ecosystem functions. We monitored indicators associated with grassland productivity and conservation, such as the abundance of poisonous plants, forage quality and yield as well as the abundance of specialist and pollinator-relevant species. More intense grassland management promoted grassland productivity. Despite positive effects of management intensity on the abundance of poisonous plants, nutritional value of forage was not affected. Also, most of the indicators positively correlated to increased management intensity, thus resulting in higher grassland multifunctionality. However, such effects were only observed at intermediate levels of grassland multifunctionality in comparison to the five percent optimum level of functioning. Therefore, intermediate management could be an effective way to combine the control of poisonous plants such as J. aquatica and the support of grassland multifunctionality.

Talk

Identifying plant diversity hotspots in small Mediterranean islands

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Small Mediterranean islands are centres of plant diversity within one of the most diverse regions of the Earth. These areas are also particularly exposed to the adverse effects of anthropogenic disturbance, species invasions and changing climatic patterns. In this context, local hotspots (i.e., islands with higher species richness than expected simply by their area) could be prioritized when planning conservation actions. Such local hotspots can be detected at multiple spatial scales, from local communities to whole islands. Here, we collated a large dataset of about 5000 vegetation plots located in more than 50 central Mediterranean small islands of different degree of isolation, morphology, geological origin, and climate. First, we estimated total island species richness from the plot data using an asymptotic estimator. Then, we used the species-area relationship to identify alpha (plot-level) and gamma (island-level) hotspots of plant species richness in a multi-model framework also considering the uniqueness in species composition. To assess the drivers underlying the observed patterns, we modelled alpha and gamma diversity as a function of a set of environmental and biogeographical predictors. Both alpha and gamma hotspots are mainly located in southern Italian archipelagos, although with some discrepancies between the two spatial scales. Moreover, diversity hotspots do not necessarily exhibit the greatest uniqueness in species composition. After accounting for area, gamma diversity is mainly explained by island morphology, while alpha diversity relates to island origin and local contingencies, with a marginal effect of climate at both scales. Our work explores the conservation implications of classical biogeographic theory across scales.

Talk

Helical graphs to track ecological trends

Dr. Elisa Thouverai[1], Dr Matteo Marcantonio[2], Dr Emanuela Cosma[1], Prof. Duccio Rocchini[1]

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Global change caused by human activity has several effects on the biomes of Earth, such as land fragmentation, deforestation, pollution, anthropization of natural landscapes and alterations in the functioning of ecological systems. In this context, remote sensing represents an important tool to assess ecosystem changes, as it allows to collect a huge amount of data at different time and spatial resolutions concerning different components of Earth system (land, ocean, atmosphere, and cryosphere), from which different measurements such as precipitation patterns, global temperatures, snow cover and aerosol can be determined. The aim of this work is to exploit this wide availability of data to display the ecosystem changes using a new visualisation method: the helical graphs. The helical graphs represent the change of a variable over time, reporting on the y-axis its moving averages and on the x-axis its rates of change. These new charts were tested on vegetation indexes and climate data retrieved from Google Earth Engine (https://earthengine.google.com) to visualise trends on selected biomes of Earth. The results show that the helical graphs are a useful tool to highlight trends that might not be easy detected in a time series. In conclusion, the helical graphs can have a lot of application in ecology, especially exploiting the wide amount of data available thanks to the remote sensing.

Talk

A synthetic evaluation of global plant diversity facets highlights the relative roles of historical, environmental and anthropogenic factors

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Recent evidence suggests that humans have caused ecologically transformative changes across the terrestrial biosphere since the early Holocene. Nevertheless, most of the research is based on recent human impacts and focusing mostly on the taxonomic patterns. However, biodiversity is a multidimensional metric encompassing multiple diversity facets (taxonomic, phylogenetic and functional diversity), which are less considered compared to species richness. By taking advantage of a new metric (μ-Diversity) synthesizing taxonomic, functional and phylogenetic information across more than 300,000 species of vascular plants, we show the global geography of plant μ-Diversity disentangling also the relative roles of climate variability since the Last Glacial Maximum, environmental features (e.g., AET, topographic roughness), geological activity and anthropogenic factors (past and current) in explaining broad-scale patterns of plant distribution. We collate a database encompassing the most comprehensive and up-to-date information on traits and evolutionary history that, coupled with the use of machine learning methods (e.g., random forest), aid us to disentangle the main drivers of plant μ-Diversity. Higher μ-Diversity is mainly observed in Papua New Guinea, India, Central and South America and Australia, whereas the lowest values are located in Africa and the Northern Hemisphere. AET is the most important variable showing a positive relationship with μ-Diversity, followed by climate variability with a negative one. Among human factors, the date of onset of pastoralism is more important than current human impacts, suggesting a role of old civilizations that date back at least to mid-Holocene which may have shaped plant diversity in the long run. Synthesizing plant broad-scale patterns through a synthetic multifaceted index can help to prioritize areas of global importance along with the main factors underlying it, especially under a global change scenario. Our results might also contribute to revise the idea that strong human impacts occurred only since the Industrial Revolution.

Talk

Livestock-type does matter: Intensity-dependent effects of cattle- and sheep grazing in sand grasslands

Prof. Péter Török[1,2], Andrea McIntosh-Buday[1,2], Francis David Espinoza Ami[1], Istvánné Törő[2], Dr. Judit Sonkoly[1,2], László Demeter[3], Dr. Katalin Tóth[1], Luis Roberto Guallichico Suntaxi[2], Dr. Nóra Balogh[1,2], Patricia Díaz Cando[1], Dr. Gábor Matus[4], Béla Tóthmérész[1,5], Gergely Kovacsics-Vári[1]

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Conservation of grassland biodiversity in agriculture-driven landscapes has a top priority. Grasslands provide essential ecosystems services and contribute to the landscape-scale biodiversity. In maintaining grassland biodiversity, grazing by domestic livestock has a crucial importance. We compared the effects of cattle and sheep grazing on sand grassland vegetation under various grazing intensities, we selected sites with low to medium, and high grazing intensity, and selected ungrazed sites and exclosures for absolute control. The composition of the vegetation was surveyed in 2 by 2 m plots, and biomass was harvested in from an area of 20 by 20 cm. The biomass was further sorted to litter, forb and graminoid biomass, the latter two fractions were separated and identified to species. We found that both the identity of livestock and grazing intensity significantly affected the vegetation composition and most of the biomass fractions. With increasing levels of grazing intensity, the amount of litter and graminoids decreased, having typically lower values in sheep-grazed sites. The amount of lichen and moss biomass were decreased with increasing grazing intensity and the highest values were detected in grazing exclosures. The total biomass was the lowest in sites grazed by sheep in high intensity. With increasing grazing intensity, the cover and biomass of short-lived species has been increased. Our results suggest that in conservation and sustainable management of sand grasslands both grazing intensity and the identity of livestock should be carefully selected and adjusted.

Talk

Assessment of flower and bee diversity by UAV images. A case study within the H2020 SHOWCASE project

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The role of pollinators and the related flower diversity is considered a key ecosystem service in agricultural crops supporting the overall habitat biodiversity and the agricultural production.

The habitat loss and fragmentation, the intensive agricultural practices and the climate change are just some of the causes of pollinator and vegetation diversity decline in some areas of the world.

The monitoring of diversity of these important wild insects is therefore a primary first step for their safety and protection but it can be methodologically difficult, time consuming and expensive when based on field data. Remote sensing can cover large areas and provides spatially continuous, consistent quality and standardized data, which can be used to estimate different aspects of diversity.

The aim of the study was to assess bee abundance and diversity in 30 agricultural plots situated in the Netherlands by using true color (RGB) Unmanned Aerial Vehicle (UAV) images at various spatial resolution making use of different machine learning approaches. In the areas an intensive field campaign was carried out in 2021 in order to collect information of flower and bee diversity/ abundance.

Bee diversity/abundance was estimated indirectly by assessing the relationship with flower cover estimated from UAV orthophotos.

The results showed that the coupling of UAV RGB images and machine learning algorithms leads to a reliable estimation of bee and flower diversity/abundance in the considered areas. Further analysis regarding the use of ultra-violet and multispectral images will be done in order to understand which sensor is the most appropriate for our purpose.

In addition, within the H2020 SHOWCASE project, analysis related to the Spectral Variation Hypothesis (with UAV and satellite images) and Height Variation Hypothesis (with UAV photogrammetry and local LiDAR data) will be tested in order to assess the possible correlation between spectral/structural heterogeneity and bee/flower diversity.

Talk

Drivers of species richness are sensitive to grain size on a sub-Antarctic island

Mr. Joshua Tsamba[1,2], Professor Peter le Roux[1], Dr. Luis Petierra[1], Ms. Bongekile Kuhlase[1], Professor Michelle Greve[1]

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Patterns of species richness are one of the most fundamental descriptors of biodiversity. Various environmental factors drive species richness, but the nature of this relationship can change with sampling grain. Here, we investigated the environmental drivers of plant species richness at two sampling grains on a sub-Antarctic island. The presence of a keystone cushion plant increased richness at both grains, but this effect was stronger at large than small grains, suggesting that the keystone plant limited species richness at small but not larger grains. At small but not large grain wetness resulted in more richness; therefore, under wet conditions, many species coexist at smaller grains, but local beta diversity in the landscape is low. Increasing elevation resulted in lower richness at both grains, indicating temperature limitations on richness. At larger grains, declines in species richness with elevation were steeper in plots without the keystone plant than those with the plant. This difference suggests that the keystone plant facilitates species at higher elevations. At large but not small grain size, richness was higher at north than south-facing plots. This suggests that warmer north-facing areas support more species. We, therefore, conclude that drivers of species richness are sensitive to grain size. Also, based on these results, climate change effects on species richness are likely to vary with grain size. In conclusion, assessing how richness differs with grain size provides insight into local patterns of species assemblage.

Talk

Slope exposure and species identity modulate positive effects of admixture on drought impact in Mediterranean mountain forests

Ms. Carmen Ureña[1], Asier Herrero[1], María Esther Pérez-Corona[1], Enrique Andivia[1]

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In the last decades, promoting mixed stands is an ongoing trend in management for the adaptation of forest ecosystems to climate change. However, whether tree diversity might ameliorate extreme drought impacts is still an open question. Positive effects of admixture seem to depend on species identity, environmental conditions and drought severity. Thus, increasing our knowledge on the response of different species to admixture along environmental gradients could be very helpful in the design of adaptation strategies. In this study, we evaluated drought impact and growth recovery in mixed and monospecific stands of two functionally different species (Pinus sylvestris L. and Quercus pyrenaica Willd.) at northern and southern exposures in Sierra de Guadarrama National Park (center of the Iberian peninsula). For this, we quantified radial growth patterns in 180 individuals along twelve different sites (six on each exposure) and evaluated growth responses to extreme droughts in the last 30 years. Our results show lower drought impact in pines growing in mixed than in monospecific stands. Admixture positive effects on pine trees response to drought were greater in sites with northern than southern exposure. On the other hand, oak trees showed better growth recovery after drought in mixed stands, being recovery higher at northern than at southern exposures. Our results confirm that admixture effects on growth response to drought are species-specific and shift with environmental conditions. Admixture may contribute to increase resilience of drought-sensitive pines, but positive effects would be increased with water availability conditions associated to exposure. On the other hand, oak showed greater growth recovery in mixed than in monospecific stands. Overall, admixture can increase the stability of forest productivity in a context of more frequent extreme droughts through species-specific responses, which can be modulated by local environmental conditions.

Talk

Current woodland plant assemblages result from landscape connectivity dynamics over the past decades

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In ever-changing agricultural landscapes, there is increasing evidence that current plant assemblages are shaped by the temporal dynamics of landscape connectivity. Attempts to take the temporal dynamics of connectivity into account have only focused on the degree of connectivity at one or several moments in time, but neglected the cumulative effects of temporal changes in connectivity.

We investigated the effects of the temporal dynamics of landscape connectivity (i.e., the degree of connectivity, the magnitude and the variability of its temporal changes) over seven decades on current plant herbaceous assemblages surveyed in 50 woodlands. Assemblages were described using a taxonomic and a functional approach based on four traits linked to the colonisation capacity of plant species.

The taxonomic diversity of current woodland assemblages did not respond to the degree of connectivity nor to the magnitude and the variability of temporal changes, but the mean and/or the diversity of trait values did. Responses were modulated by the type of connectivity trend experienced by woodlands. In woodlands experiencing an upward connectivity trend, high magnitude of temporal changes in connectivity increased the abundance of species that invest in sexual reproduction at the expense of vegetative multiplication whereas the degree of connectivity and the variability of its temporal changes had no effect. In woodlands experiencing a downward connectivity trend, the diversity of seed mass values was independent on the magnitude but decreased with the variability of temporal changes, and increased with the degree of connectivity.

Overall, we show that, besides the degree of connectivity, the cumulative effects of decades of changes in connectivity exert a strong influence in shaping woodland plant community assembly by selecting for particular trait values. This study opens new perspectives for integrating the temporal dynamics of connectivity in plant community assembly rules and in the development of strategies to manage connectivity.

Talk

Effects of grazing and water availability on the functional structure and ecosystem functions of a semi-arid gypsum community

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Grazing is a disturbance that acts as an environmental filter, regulating the presence and abundance of plant species and affects ecosystem functions; however, its effect on semi-arid gypsum habitats is poorly studied. In addition, in this type of habitat, spatial variations in water availability, such as slopes or orientation, can alter the relationships between grazing, the plant community and the ecosystem functions. Therefore, this study evaluated the effect of grazing on the plant community and the ecosystem functions in plots located on northern or southern slopes, or crests. The results showed a combined effect of grazing and the slope type on functional diversity, as well as the effect of dominant species (CWM), for example on the leaf width or SLA, especially on northern slopes or at crests. In addition, these two types of slopes under grazing also showed higher C/N ratio and available phosphorus extracted. These slopes have greater availability of water and thus greater plant abundance and biomass, so the goat herd prefers these slopes; this, in turn, has greater effects on the structure of the vegetation and the ecosystem functions. Nevertheless, most of the ecosystem functions change with the type of slope regardless of whether there is grazing or not, with the southern slope plots being poorer in nutrients. Overall, our results help to understand how grazing affects these stress-systems and how they could respond to aridity increases, such as those forecasted with climate change in semiarid areas.

Talk

Syntaxonomical delimitation of calcareous perennial dry grasslands and scrub of Southern Europe

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Syntaxonomy of dry grasslands and scrub in Southern Europe is quite complex and still has numerous issues to unravel. There are many blurry boundaries between the vegetation units, especially in submediterranean areas, which is further complicated by the regional focus of most studies. We aim to delimit geographically, ecologically and floristically the calcareous perennial dry grasslands and scrub of Southern Europe on the level of vegetation classes. This delimitation will help clarify the position of some syntaxonomical units and allow conducting classification studies at lower syntaxonomic levels. Moreover, as many of these vegetation types are vulnerable and endangered, our results might be a basis of proper conservation and management measures.

The geographical scope of the project is Southern Europe including Portugal, Spain, France, Italy, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Kosovo, North Macedonia, Albania, Greece, Bulgaria and Turkey. We used the vegetation plots of calcareous perennial dry grasslands and scrub from the EVA database based on the vegetation class assignment (Astragalo-Brometea, Carici-Genistetea lobelii, Daphno-Festucetea, Elyno-Seslerietea, Festuco hystricis-Ononidetea striatae, Festuco-Brometea, Lygeo sparti-Stipetea tenacissimae, Ononido-Rosmarinetea, Poetea bulbosae, Trifolio anatolici-Polygonetea arenastri) and corresponding units of the EUNIS habitat classification. Altogether we collected 69,758 relevés from 15 countries.

We used only relevés with plot area ranging from 9 m2 to 100 m2 and applied a geographically stratified heterogeneity-constrained resampling. After taxonomic homogenization, we used different classification techniques (such as TWINSPAN and fuzzy C-means) and based on the results, prepared clear floristic definitions with diagnostic species of phytosociological classes and developed an electronic expert system.

Talk

Long-term effects of selective herbicides in a grassland community

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Selective herbicides are a common tool to remove invasive non-native forbs from natural lands. However, the efficacy of this practice, non-target effects on native plants, and secondary invasions, are often assessed only in the first 1-2 years after treatment, which limits understanding of long-term effects. Furthermore, we know little about the extent to which herbicide drift may affect plant communities. We carried out a six-year experiment in foothills grasslands of western Montana, USA, to investigate changes in the abundance of the target plant, knapweed (Centaurea stoebe subsp. micranthos) and plant community attributes in response to the forb selective herbicides Tordon® (picloram) and Milestone® (aminopyralid), applied at a recommended rate and a diluted rate to simulate drift. As expected, knapweed cover and the richness of native and non-native forb species declined in the first three years in response to recommended rates but not drift rates. Secondary invasion by non-native graminoids was significant but weak. The cover of native forbs and the cover and richness of native graminoids did not differ among treatments but changed significantly with year, likely explained by annual precipitation differences. Surprisingly, six years after treatments, we did not find any differences among treatments in the cover of the target species, nor the richness or cover of native and non-native graminoids and forbs. These results question both the long-term efficacy of herbicides in controlling a target invasive species and their non-target effects on plant community structure. Our study supports previous calls for long-term monitoring of invasive species control measures in land management.

Talk

Reinvasion of Native Invasive Trees After a Tree-Thinning Experiment in an African Savanna

Dr. David Ward[1], Tiffany Pillay[2], Siphesihle Mbongwa[3], Kevin Kirkman[4], Erik Hansen[4], Matthew Van Achterbergh[4]

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Woody plant encroachment has serious negative consequences for ranchers because of the reduction in herbaceous fodder for domestic livestock. Long-term monitoring of a tree-thinning experiment was established near Magudu (northern KwaZulu-Natal, South Africa) in 1990. The objective of this experiment was to determine the optimal tree density that would maximize grass production while benefiting grasses from nitrogen fixation, hydraulic lift and/or shade from the leguminous trees. The initial dominant species was the nitrogen-fixing tree, Dichrostachys cinerea. There were 12 plots (six pairs) with trees removed to approximate 0, 179, 277, 428 and 625 trees ha-1, with one pair left as a control (unmanipulated). One plot of each replicate (except the controls) was treated with short-acting herbicide (picloram) once in 1990. We collected data on herbaceous cover and species composition, tree species composition, sizes, and mortality. We also used remote sensing to examine the patterns of herbaceous cover. Herbaceous biomass decreased as tree density increased. After 30 years, the same dominant tree species (D. cinerea) had re-invaded all the removal plots despite the fact that several encroaching species (Vachellia karroo, V. tortilis, V. nilotica) occurred in these plots. These D. cinerea trees were mostly less dense, and contained many more juvenile individuals, in the cleared and partially cleared plots than those in the control plots after 30 years. Should maximizing herbaceous cover be the goal, repeated management would be necessary to maintain adequate control of woody plants in these savannas.

Talk

The influence of environmental factors and biotic interactions on the early-stage establishment of *Chamaecyparis obtusa* var. *formosana* seedlings in Taiwan

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Early-stage establishment and survival are of crucial periods of woody species' regeneration process. The survival rate is relatively low due to limited root/leaf system, and lack of nutrient storage. Here we focus on Chamaecyparis obtusa var. formosana, an endemic coniferous tree species found in the montane cloud forest in Taiwan. We aim to uncover how different environmental factors influence the seedlings' establishment, namely large-scale climatic variables, small-scale micro-habitat conditions, biotic interactions, and their interaction.

We conducted a nested sampling design across 11 localities of varied fog frequency in northern Taiwan, each sampled by eight plots with detailed measurement of habitat conditions (e.g., substrate type, moss/ litter coverage, light conditions, coverage of other species). A total of 87 plots were established. We apply generalized linear mixed models at different scales for answering how environmental variables affect the establishment of the seedlings.

Firstly, on the regional scale, summer fog frequency is significantly related to seedlings' abundance. Second, at the local scale, coarse wood debris (CWD) can facilitate seedling establishment, with more decayed ones having a superior effect. This may be due to higher moss cover with appropriate thickness, a lower cover of thick litter, and less extensive competition with other herb species. Plus, limited light conditions have a negative effect on the seedling establishment. Thirdly, there is a negative interaction between summer fog frequency and CWD coverage, increasing the importance of CWD in less foggy areas.

We verified the common belief of foresters in Taiwan that the species can regenerate on downed logs in the forests, and pointed out that these results might be due to different environmental conditions and different competition pressure between CWD and other substrates. Resurvey of the seedlings' survival will be finished this year, enabling a more detailed analysis based on the survival rates of the seedlings.

Talk

Historical biogeography of the steppe grasslands in eastern Central Europe

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The steppe grasslands of eastern Central Europe are located at the western margin of the Eurasian steppe belt. There is growing evidence for a local persistence of steppe-like vegetation in this region throughout the Holocene. This evidence is mainly based on pollen and macrofossils. To further investigate the historical biogeography of steppe grasslands in eastern Central Europe, we use the regional diversity of habitat specialists and chloroplast DNA data. We identified habitat specialists of meadow steppes, grass steppes and rocky steppes, and compiled their regional presence-absence in grid cells of 75 km × 75 km. We analysed the dependency of habitat specialist diversity to climate, topographic heterogeneity and geographical distance to potential refugia (especially the lower mountain ranges surrounding the Pannonian Basin). For genetic analysis, we sampled 3–4 habitat specialists of each steppe type and used cpDNA markers to investigate intraspecific diversity and geographical distribution of haplotypes.

Climate and topography explained between 40% and 63% of the variance in habitat specialist diversity. Adding geographical distance to potential refugia increased the explained variance in the models for all steppe types. This suggests that species distributions are still influenced by migration lags, i.e. limited migration from mid-Holocene (and/or LGM) refugia. Chloroplast haplotypes featured a complex pattern across the study area. Several species showed a strong geographical differentiation, suggesting migration waves from multiple refugia with only limited subsequent genetic intermixture.

We can clearly reject the scenario of a late-Holocene immigration of steppe species from areas outside the Pannonian Basin. Most species must have been present in the region since at least the early Holocene, highlighting the importance of the lower mountain ranges surrounding the Pannonian Basin as long-term refugia for European steppe species.

Talk

Plant diversity in archaeological sites as bioindicator of the present and the past uses, and its importance for conservative issues: the case of Etruscan tombs of Tarquinia (Italy)

Mr. Giulio Zangari[1], Prof. Fernando Lucchese[1], Prof. Giulia Caneva[1]

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In archaeological sites, as in any human-managed area, plant diversity and vegetation features are highly influenced by the effects of human activities, which changes the natural conditions. They can be analysed as bioindicators of the present and past conditions. Furthermore, in these sites, a refugium for the biodiversity occurs, since the management gives a certain protection with respect to other highly disturbed human ecosystems. Understanding the ecological dynamics that led to these changes is essential to manage an ecosystem sustainability. For this purpose, we selected the UNESCO WHS of "Monterozzi" of Tarquinia, an Etruscan necropolis that also holds a Special Protection Area for nature. In this site, we have previously evaluated the floristic features, such as the benefits of plants for stabilising the microclimate of wall paintings in underground tombs, along with studies on the risk of root penetration. For a management plan, able to combine both cultural and naturalistic values, we carried out an assessment of the plant's bioindication value arising from their ecological features. At this aim, phytosociological field surveys on tumuli, trampled areas, and surrounding areas, less exposed to visitor's influence, such as a mapping the vegetation characteristics and its ecological values were also performed. The results revealed the structure and distribution of plant communities at the Monterozzi site, understanding the role of the current and past ecological conditions. The detected vegetation mainly belongs to the following phytosociological classes: Artemisietea vulgaris, Festuco valesiaceae-Brometea erecti, Stellarietea mediae, Quercetea ilicis, with various associations. The analysis of their distribution provided indications about naturality, artificiality, and relictuality of the vegetation growing in the area, which is relevant for conservation activities. These findings indicate that plant diversity at archaeological sites has an important value, and it can be used in planning sustainable vegetation management activities.

Talk

Measuring the effectiveness of Natura 2000 network in conserving plant diversity

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The ongoing biodiversity crisis is one of the greatest threats humanity has ever faced. To halt and reverse current trajectories of biodiversity loss, the European Union (EU) recognized the need of

ambitious conservation measures and committed to enlarge the Natura 2000 network to effectively protect at least 30% of its land and sea area within 2030. One precondition for an effective expansion, however, is a large scale quantification of Natura 2000 current effectiveness in conserving biodiversity, which is still lacking. Here we address this issue by leveraging plant diversity data from the European Vegetation Archive. In particular, we aimed to measure Natura 2000 effectiveness by comparing vascular plant diversity, in terms of alpha-, beta- and gamma-diversity, within and outside Natura 2000. Hence, we retrieved 1,223,017 vegetation plots across the EU 27 countries and overlapped them with Natura 2000 sites. After standardizing nomenclature at species level according to Euro+Med and removing non-native occurrences, we calculated and compared alpha-, beta- and gamma-diversity within and outside Natura 2000 as well as across countries, biogeographical regions and habitat types. Natura 2000 sites hosted a significant portion of plant diversity, although this quantity varied largely across different countries, biogeographical regions and habitat types. Our results benchmark the present effectiveness of the Natura 2000 network in protecting plant diversity. Moreover, we pinpoint areas where plant diversity is underrepresented within Natura 2000, offering insights towards its possible expansion in the current decade.

Talk

"Sun leaves" not always so sunny: light as confounding factor in intra-specific trait studies focused on woody species

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When measuring leaf traits of woody species, the recommended procedure is to collect sun-exposed leaves and, if not available, leaves from the least shaded parts of the canopy. While studies focused on inter-specific trait differences may prioritize mature individuals with sun-exposed canopy, intra-specific trait variation studies with a limited number of individuals within sampled area or habitat may need to include also leaves from more shaded individuals. For some leaf traits (such as SLA), there are known differences in values of sun and shade leaves within the same individual, and light exposure of a given individual may confound the measured trait value. Here we illustrate how ignoring the confounding effect of light leads to misleading conclusions about the actual environmental cause of intra-specific trait variation.

Within the 1-ha Lalashan Forest Dynamics Plot (Taiwan), we inventoried all woody species individuals (DBH > 1 cm) in 25 systematically distributed subplots (10 × 10 m). From up to three randomly selected individuals of each species in each subplot, we collected the least shaded leaves and measured leaf traits (e.g. SLA, LDMC, and leaf thickness, for 694 individuals of 52 woody species). For each tree individual, we also estimated its canopy exposure. When using site-level intra-specific trait-environment analysis (CWM approach), wind exposure played a crucial role in the trait-environment relationship. However, detailed individual-level analysis (linear mixed models, including canopy exposure) revealed that what appeared as a wind effect is likely a confounding effect of light availability (the wind-exposed forest is shorter and canopies have sun-exposed leaves).

We show that ignoring the confounding effect of light in intra-specific trait studies focused on woody species may mislead interpretations of observed trait-environment relationships. This can be avoided by sampling canopy exposure for each tree individual and including it as an additional factor in the individual-based trait-environment analysis

Poster

Transition in species composition after livestock reintroduction and grazing exclusion of natural grasslands

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Grazing by large herbivores is the main driver of the structure and functioning of grasslands. The presence or absence of grezers generates changes in the plant community through several mechanisms. Successional trajectory of the vegetal community after grazing removal is widely documented. However, there is insufficient evidence of the changes induced after the reintroduction of grazing in excloure areas. Our objective was to analyze the successional trajectory of plant species in natural grasslands with long-term exclusion and continuous grazing in the presence and absence of livestock, and to understand if the species changes associated with grazing are directional and reversible. The experiment was carried out in a reserve with 30 years of grazing exclusion, surrounded by grazing areas, located in the Río de la Plata Grasslands. It consisted of a factorial design with four treatments: Fences were removed to reintroduce cattle into the reserve (EG=Exclosure-Grazed), grazed areas were closed (GE=Grazed-Exclosure), grazed sites were kept with cattle (GG=Grazed-Grazed) and reserve areas were sampled (EE=Exclosure-Exclosure). To assess species turnover, we performed nonmetric multidimensional scaling(NMDS) and tested the effects of treatments with permutational multivariate analysis of variance (PERMANOVA), considering each year separately. NMDS suggests a clear differentiation between EE and GG, and a considerable overlap between GE and EG five years after starting the experiment. PERMANOVA indicates that during the first two years of succession there were no significant trends in species composition. However, in the third year GE changed the dominant species with respect to GG. The fourth year EG differed from EE, and last year a convergence between the species composition of GE and EG was observed. Our results show that livestock reintroduction and exclusion produce a fast species turnover in the first years, with directional and opposite effects. This has implications for the conservation of natural grasslands in the region.

Poster

Ploid analysis and morphotaxonomic study of Festuca taxa

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The purpose of our research was to identify and clarify the taxonomic position of the dominant Festuca species in different sand steppes ecotypes along the Danube River. For species identification, we used measurements of the morphological traits of the inflorescence, and cytoflex flow cytometer for ploid level examination. We have collected short or longer awn from the tip of the lemma, which has short fibers under the tip of the lemma. One of the key features when differentiating the taxa is the length of the awn on the lemma. Other important key traits were the length of the generative stem, the inflorescence, the lower branch, the first internode of the inflorescence and the length of the spikelets. Our research proved that Festuca vaginata can be easily distinguished from the other Festuca taxa and it is one of the most dominant Festuca species along the Danube. We also proved that the Festuca population which was identified as potentially Festuca javorkae in our previous researches, it actually belongs to the Festuca rupicola species. Because of this, the occurence of Festuca javorkae in the Hungarian flora is still dubious. Ploidy studies also confirmed that the Festuca taxon found in the planted grasslands and acidic sandy areas is Festuca brevipila, because its hexaploidic level is distinct from morphologically similar taxa. In addition, F. tomanii can be described as a new species in the native flora.

Our research was supported by OTKA K-125423.

Poster

Vegetation and biomass of natural and sown sandy grasslands in the Little Hungarian Plain

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In the present survey we compared the vegetation of two different types of open sandy grasslands on two military areas in the Little Hungarian Plain (at Gönyű and Győrszentiván). The dominant species was Festuca vaginata in the surveyed natural open grasslands, while Festuca rupicola dominated the closed ones; in the latter, Festuca javorkae was found too. We made 6 coenological records and 50×50 cm biomass samples on every vegetation type in both areas. Differences between areas were analysed using variation coefficient (CV%) and one-way ANOVA; diversity values were also calculated. Data structure of the coenological records was analysed with non-metrical multidimensional scaling (NMDS) ordination using Bray-Curtis Distance Indices. Among the Festucetum vaginatae types of open sandy grasslands, natural ones were the most diverse, to which planted and spontaneously growing vegetation became similar during the 5 years of the survey. Species pool of the burnt vegetations was poorer in species and their diversity values were lower. Grasslands dominated by Festuca rupicola were more diverse during the survey. The biomass values were higher in the case of closing Festuca rupicola vegetation, and the relation of agriculturally important species was significant. On the surveyed areas restauration can be noted as successful, from the viewpoint of nature conservation and grassland farming too.

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Poster

Past vegetation dynamics and human peopling of Sicily during the Holocene

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The Holocene landscape of Sicily is the result of a long history of paleogeographic and paleoecological events that, together with human actions, have shaped the distribution of flora and phytocoenoses. The evolution of vegetation throughout the Holocene in Sicily since 11,750 years BP has been reconstructed using different paleoenvironmental records (pollens, charcoals, and isotope analysis) of lacustrine deposits that are crucial in both the understanding of paleobiogeography and the identification of human ecological prints, and intensity.

The cultural and demographic dimension of the island have been delineated reviewing archaeogenetic studies and human settlement dynamics have been mapped using archaeological site locations. Landscape classification was based on Potential Natural Vegetation of Sicily, at the level of phytosociological alliances, and related to past vegetation records.

Analysis have shown that different climatic fluctuations caused no significant changes in the ecological setting of Sicily, demonstrating the high adaptability of natural ecosystems and human societies. The Neolithization of Sicily led to the development of the first agroecosystems, which evolved in tandem with the introduction of new species that accompanied human migrations.

Sicily proved to be the ideal context to analyze the deep relationships between biodiversity and history because it has always represented, since its first colonization, a crossroads of several human groups who visited and settled on the island.

The cross-disciplinary approach of historical ecology that includes human populations as a component of ecosystems may allow us to understand the deep relationships between biodiversity and history. Indeed, despite its long human history, the Island is still one of the Mediterranean's biodiversity hotspots.

Poster

Impact of *Asclepias syriaca* on the vegetation composition of primary and secondary sand grasslands

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There is an increasing need to understand the ecological impact of invasive plant species for more effective management. However, the impact of invasive species may be different in areas with different land-use histories, e.g. never-ploughed land and abandoned agricultural fields. Common milkweed (Asclepias syriaca L.), a perennial clonal herb, is one of the most important invasive species in Hungary, but knowledge of its effects on native plant communities is still incomplete. This species is mainly present on secondary grasslands (i.e. abandoned agricultural fields); however, it also spreads and threatens primary grasslands. We aimed to study the impact of common milkweed on the vegetation composition of primary and secondary grasslands. We compared invaded and non-invaded pairs in both grassland types and hypothesized that the presence of milkweed resulted in different vegetation composition.

Our study was carried out in the Kiskunság National Park, Hungary. We surveyed the cover of vascular plants in 20 pairs of invaded and non-invaded plots at primary grasslands and 30 pairs at secondary grasslands (both 1m x 1m). We used tbRDA to compare the vegetation composition of the plots.

Invaded and non-invaded plots are clearly separated from each other along the first axis in the ordination space and the plots are scattered along the second axis, which is related to the gradient of dominance of annual and perennial species. Primary and secondary grasslands are also separated along the first axis if non-invaded, but if invaded, this separation is obscured.

Our results indicate that sand grasslands can recover on abandoned agricultural land, but the invasion of milkweed has a large effect on the vegetation composition, homogenizing the sites. We conclude that in order to conserve sand grasslands, it is important to prevent further spread of milkweed in both primary and secondary grasslands.

Poster

"How Tiny (urban) Forests Boost the Well-being of Inner-city Children"

Mr. Daan Bleichrodt[1]

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In December 2015, IVN planted the first Tiny Forest of Europe was in the municipality of Zaanstad. So far, 220 Tiny Forests have been created in 50 different municipalities in the Netherlands. Local residents and a local school adopt every forest. The goal of the project is to reconnect children with nature and teach them how to restore and enjoy nature.

The past six years 160 Tiny Forests have been created in the Netherlands, using the Miyawaki method. Every forest is adopted by a nearby school and used for outdoor education. So far 12000 children have followed the Tiny Forest rangers education and a thousand teachers were trained on how and why to use the forest as a learning environment. We analysed numerous scientific studies on the health and wellbeing effects of nature on the development of children.

Immersion of nature throughout early childhood offers numerous health benefits. The sheer presence of nature helps children to develop superior social and emotional skills, can assist in preventing child hood obesity and helps them to develop better motor skills. Children who grow up in a green neighbourhood are happier, healthier and more creative than children that do not have access to green space. Children that play on a forest floor have a better mix of beneficial gut bacteria. Just a little bit of nature can make a big difference in a child's life. Children that have a view on a tree, from their window are able to cope with negative experiences (like the death of a grandparent) better than children who have a view of a wall.

Tiny Forests can help urban children to connect to nature and by playing and learning in the miniature forests, they boost their health and wellbeing.

Poster

The historical range of fire and vegetation variability informs current nature conservation strategies

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The Central European landscape's current nature heritage and biodiversity have been formed by a complex interplay of natural and anthropogenic processes over the past millennia. However, agricultural abandonment and rural depopulation now represent a significant trend in many regions in Europe, raising the question of how to manage these areas in the future without losing their biodiversity. A long-term perspective on vegetation development and disturbance history as provided by paleoecology may improve landscape decision-making in these areas. In a Czech-Bavarian boundary region, a strip of the land along the former Iron Curtain underwent two contrasting scenarios of landscape development. On the German side, settlement continued undisturbed, while there was extensive abandonment of the landscape on the Czech side. This dichotomy has strongly impacted the current vegetation and biodiversity patterns and formed novel vegetation types that may resemble plant communities from the deeper past. In our study, we reconstructed the joint evolution of the natural environment of both areas using paleoecological methods such as pollen and charcoal analysis. Specifically, we focused on changes in landcover and diversity during the Holocene and their relationship to disturbance agents such as fire. We conclude that prescribed burning may be a viable management tool for conserving semi-open habitats that developed after landscape abandonment.

Poster

Selecting native plant species for Annex I Habitat in-situ and ex-situ conservation: the perspective of LIFE IMAGINE Project in Umbria Region (Central Italy)

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The LIFE Integrated "IMAGINE" Project (LIFE19/IPE/IT/000015), which has the overall goal to develop an integrated unified, coordinated, and participatory management strategy for the Natura 2000 network in Umbria (Central Italy), includes a particular preparatory Action (A11) focused on the selection of local spontaneous plant species with a key role for the conservation of those Annex I Habitats more subjected to pressures, with special attention to the natural dynamics resulting from the abandonment of traditional practices.

Starting from the collection of a set of 633 both published and unpublished phytosociological relevés related to the target Annex I Habitats (H3130, H3170*, H6110*, H6210(*), H6220*, H6230*, H6510) occurring in Umbria region, we identified for each habitat different subtypes based on phytocoenoses and ecological characteristics, and submitted these subtypes to Indicator Species Analysis, getting a first list of plant species that best fit with each Habitat. Subsequently, a prioritization protocol based on 9 criteria was developed, taking into account the suitability of each taxon to represent the reference Habitat, the conservation importance of the species itself, the feasibility of field collection (e.g. identification, abundance, site accessibility), and the possibility of ex-situ conservation. An expert-based score has been attributed to each species on the previous list.

Based on this procedure, we obtained for each target Habitat a selected list of native plant species, called "H-key" species, significant in physiognomical, phytocoenotical, biogeographical, and ecological terms, and addressed by the concrete possibility of germplasm conservation and propagation, suitable for use in both future concrete in-situ Habitat reinforcement interventions and ex-situ conservation activities.

Poster

Correlation between specific leaf area (SLA) and leaf dry matter content (LDMC) across scales

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Leaf economy spectrum is a well-known pattern of leaf traits among species on global scale: leaf traits are changes in a correlated way. However, at final spatial scales (e.g. within communities) or within species these correlations often become weaker or even non-significant. However, if there is a physical relationship in the background of correlation, we expect that correlation remains relatively stable across scales.

Specific leaf area (SLA) and leaf dry matter content (LDMC) are two often measured leaf traits. Their negative correlation is a part of correlations forming the leaf economy spectrum. The background of this correlation is that both traits are related to cell wall:protoplasm ratio. Due to this physical connection, we expected that this correlation is stable across scales.

We have measured SLA and LDMC of almost all species (covering at least 80% of total abundance) in each of 93 plots situated along a water-availability gradient from dry open sand grasslands to wet meadows. 199 species were recorded in the survey, resulting in 2050 SLA and LDMC measurement pairs (species-plot combinations). Correlation and type II regression between log-transformed traits are calculated over several scales: for raw measurement in all species-plot combinations, within plots and within species, and for aggregated values (species means, and community weighted means).

The slope of the relationship only slightly changed when the relationship was calculated within plots instead of the whole gradient or for aggregated instead of raw values. The only exception is the within-species relationship: for the majority of species, the slope within species did not considerably differ from slope for all data. However, for several species, mainly for grasses and sedges, but also for some herbs, the within-species correlation between SLA and LDMC became non-significant.

This exception calls attention to the limits of extrapolating trait correlations across scales.

Poster

Syntaxonomical checklist of Sierra de Guadarrama National Park (Spain)

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Some years ago, we decided to improve the field work researches on vegetation dynamic and global geobotany in Sierra de Guadarrama National Park.

Our main goal was to review and update the plant communities and the syntaxonomical checklist.

During the last 8 years we have gone on periodic excursions to the territory to study in situ the plant communities. The review and update was made with the last syntaxonomical checklist of Spain and Portugal.

As a result, we recognize 134 associations belonging to 40 phytosociological classes, distributed in the following groups:

- Floating or rooted submerged aquatic vegetation
- Amphibious vegetation of fresh waters, springs and fens
- Chasmophytic, epiphytic and scree vegetation
- Anthropogenic, fringe and megaphorbic vegetation
- Supratimberline climatical zonal vegetation on cryophilous geliturbated soils
- Grassland and meadow vegetation
- Heathland, dwarf scrub and scrub vegetation
- Forest and woodland potential natural vegetation

We also present the list of vegetation series of the Sierra de Guadarrama National Park.

Poster

TraitDivNet: a global network to explore aboveground and belowground functional diversity

Dr. Carlos P. Carmona[1], Dr. Enrico Tordoni[1], Dr. Kadri Koorem[1]

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Plant traits (features like their height, the size of their seeds and leaves, or the thickness of their roots) characterize how they respond to environmental conditions, disturbances and interactions with other organisms, and how they affect ecosystem processes such as nutrient cycling or food production. Thereby the information about plant traits enable to get an overview about how plants respond and influence ecosystem processes. However, the practical use of plant traits is hampered by the use of disparate traits between different studies, which are often measured inconsistently, and that mostly characterize aboveground plant parts. Recent research, however, has revealed that belowground traits provide additional information about the functioning of the plant that is not captured by aboveground traits. However, only ca. 0.1% of the species in the global flora have complete information for the most commonly used aboveground and fine root traits, and this lack of information hampers the application of trait-based ecology at large scales.

Here, we present TraitDivNet, a network of researchers interested in functional diversity implementing trait surveys replicated on a global scale in a wide range of environmental conditions. The information collected in the network will allow to 1) determine what is the dimensionality of functional traits and how it changes across ecosystems; 2) boost the number of plant species where both above- and belowground traits are characterized, opening new opportunities for macroecological studies of functional diversity; 3) produce new insights into how the patterns of functional variation differ between and within ecosystems.

TraitDivNet is open to incorporate participants from all over the world. In the poster we will explain the structure and rationale of TraitDivNet, the guidelines for participation, the structure of the sampling protocol, and the publication plan. Contact can be made at traitdivnet@ut.ee.

Poster

A sampling strategy for assessing terrestrial habitats at eu scale

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Assessment of habitats conservation status is a major task for EU Member States in compliance with the Habitat Directive. Under such framework, it is essential to achieve quantitative and affordable measures of ecosystems quality indicators. Here we present a two-phase sound statistical sampling scheme to estimate the coverage of EU terrestrial habitat types. We used 6 habitats distributed among different EU countries using the whole Italy as case study. For each habitat type, its presence or absence inside a quadrat is known (M). Each quadrat is composed by 10.000 (N) cells of 1 ha to be surveyed for detecting the presence of the investigated habitat, therefore the product of M x N is the population to be sampled. In the first stage of the first phase, the set of the M quadrats was partitioned into clusters of neighbouring quadrats in order to achieve a spatially balanced sample, subsequently a quadrat was selected in each cluster with probabilities proportional to a score indexing the suitability of the cell to contain habitat. Then, in the second stage, a sample of cells is selected within each quadrat selected in the first stage. In the second phase, a final sample of cells out of those selected in the first phase within each quadrat is selected. The presence and absence of habitat in the sample was assigned by experts and coverage estimate computed. Results show that adopting a small sampling fraction of the survey area the relative standard error values ranged from 7 to 15% for commons habitat having strong correlation between habitat suitability scores and presence previously known. The possibility to apply the strategy at European scale could be an applicative and standardized achievement in building a shareable approach for maintaining a favourable conservation status of the Nature 2000 terrestrial habitat network.

Poster

Interspecific interactions independent of soil legacy by invasions, reduce the performance of a native species in Cerrado

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Invasive plants directly impact native species through competitive interactions and indirectly by modifying soil properties and associated organisms, leading to a reduction in the performance of native plant species. We evaluated the role of competitive interactions (intra- and inter-) and the soil legacy of the Pinus invasion (spatial gradient of Pinus invasion) on the performance of an invasive (Melinis minutiflora) and native grass (Aristida megapotamica). We assembled mesocosms with seedlings of the two species (interspecific) and with seedlings of the same species (intraspecific) filled with a mixture of sand and soil from each Pinus invasion area. Specifically, we collected soils from areas with different invasion histories, including areas: (1) where Pinus was never present, (2) under natural regeneration (native species) for 20 years after Pinus removal, (3) under natural regeneration (native species) for 8 years after Pinus removal, and (4) with a Pinus monoculture. The performance of the native species was reduced by interspecific interactions with the invasive species but was not affected by the soil legacy from the previous Pinus invasion. However, the invasive species benefited from the combined effects of interspecific competition with the native species and soil from the recent Pinus invasion legacy. Collectively, the results show that synergetic effects of soil legacy and interspecific interactions may further promote the performance of invasive species relative to native species.

Poster

Sample coverage estimation based on sample-based abundance data

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To fairly compare the species diversities among communities, Jost and Chao (2012) previously showed that when samples are standardized by their coverage instead of by their size (or area), the estimated diversities approximately meet the replication principle, that make the ratio between coverage-based standardized diversities of any two samples more representative of the true relationship between the communities' diversities. Therefore, the standardized diversity through the use of sample coverage can be used to fairly compare the diversity among different communities or can be used as an analytical object for related ecological studies.

For biodiversity studies and assessments, especially in vegetation science, the sampling unit is usually not an individual, but a plot, quadrat, net, trap, or transect. Here, the sampling unit is randomly sampled from the target region, and the number of individuals for each species appearing in the sampled plot is recorded. In this case, the individual in the sample is no longer randomly and independently sampled, so the traditionally and widely used estimators of sample coverage will not be available to exploit this kind of data. In this poster, we derived a new estimator of sample coverage based on the concept of Good-Turing frequency formula and its variance estimator through the asymptotic approach. We evaluated the new estimator by using three forest data sets. The simulation results showed that the new proposed estimator is nearly unbiased and its coverage rate with a 95% confidence interval tends to be significantly more accurate compared to the traditional estimator. The new proposed estimator makes it possible to fairly compare diversity between individual-sampled abundance data and plot-sampled abundance data.

Poster

Vegetation dynamics of Pannonian inland sandy habitats analyzed using vegetation mapping by digital orthophotography

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Pannonian sands are critically endangered habitats, directly and/or indirectly threatened by human activities. The dynamics of these vegetation types imply a rapid transformation in successive stages: from pioneer sandy communities with low total diversity and species cover to species rich grassland communities with high biomass production and closed canopy. For the last 200 years, these habitats have been intensively forested and the selection of species used in the afforestation process influenced the natural dynamics. Robinia pseudoacacia (black locust) was frequently used in afforestation. Due to its invasive population dynamics, afforestation with black locust accelerated the spontaneous closure of the vegetation set of sandy phytocenoses.

Application of digital orthophotography enables the analysis of qualitative and quantitative changes in vegetation, even when only cartographic data are available. Classical phytocoenological studies usually lack the clear information on the total presence of specific vegetation types.

In this paper, the analysis of orthophotos of the Deliblato Sands, as the one of largest continental sandy areas in Europe, was done. In this survey are used military maps from XIX century, orthophotos from 1954 as well as recent satellite images of Deliblato sands. Digitalised maps and photos are compared using ArcGIS 10.5 as a tool for comparing the representation of polygons defined as different types of vegetation (open sand, grasslands, shrubs, forest vegetation).

This survey confirmed accelerated dynamics of sandy habitat, especially in the period from 1954 until today. Changes in climatic parameters amplify the impact on the accelerated change in the dynamics of vegetation of sandy habitats as the choice of species for afforestation.

Digital orthophotography completes the analysis of such fragile vegetation types and represents an important aspect of the analysis of habitats that are on the verge of collapse, to better understand the changes that occur in them and the pressures they face.

Poster

How does fire history affect the resilience of open ecosystems of the Cerrado?

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Cerrado is a fire-prone ecosystem that has evolved in the presence of fire. Thus, fire affects its structure, composition and diversity. Fire exclusion results in changes not only in plant community composition and dynamics, but also in ecosystem services and possibly in the Cerrado resilience. Post-fire regeneration strategies are influenced by resources, productivity and fire regime. Plant communities in low-intensity and high-frequent fires ecosystems regenerate mostly from belowground organs (e.g.tropical savannas). Further, high-intensity fires with low frequency, species recruiting from seeds have more advantages. We investigated regeneration strategies after prescribed fires in two fire-excluded areas with different fire histories and frequencies: FE1985 – 30 years fire-excluded, one fire event in 1985, and FE2009 – 12 years fire-excluded, three fire events since 1985, being the last one in 2009. We established randomly 30 plots of 0.5x0.5m in both areas five months (during the rainy season) after mid-dry season fires and counted the number of seedlings and ramets. We found lower seedlings and ramets in FE1985 when compared to FE2009 ($P<0.001$), showing that fire reintroduction hampered and decreased plant community regeneration. Recruitment from seedlings showed to be less important than resprouter (FE1985=1.82±0.57 seedlings.m^2 and FE2009=3.64±1.06 seedlings.m^2) and fire history did not influence seedlings recruitment at FE2009. FE2009 however, regenerated mostly from bud bank (88.13±14.90 ramets.m^2), with rapid recovery of aboveground vegetation showing thus, its high resilience to fire. FE1985 presented lower capacity to resprout from the bud bank (43.87±5.41 ramets.m^2), confirming that fire exclusion led to the decrease of the bud bank, as consequently, the resilience to fire. The feedback process between fire and vegetation community is responsible for ensuring maintenance and conservation of grasslands and savannas. Therefore, the long-term fire exclusion can affect how plants will persist and regenerate after a fire event, leading to loss of resilience of the Cerrado.

Poster

An Assessment of Floristic Assemblage of Chandra Tal: A Cold Desert Ramsar Wetland (Lahaul-Spiti) of Himachal Pradesh, India

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Introduction: Chandra Tal, a high altitude Ramsar wetland lies in Chandertal Wildlife Sanctuary (WLS), a Trans Himalayan cold desert region of Lahaul-Spiti, geographically the largest district in the State of Himachal Pradesh, India. Being a Ramsar site, situated 32°28.552′N latitude and 77°37.054′E longitude with altitude 4300 m a.s.l. falling in the 1B Tibetan Plateau Biogeographic zone, the wetland harbors a unique floral diversity in the riparian areas.

Material and methods: The vegetation sampling was done through quadrat method along with three elevational gradients during June-August from 2016–2019.

Results: We found a total of 126 taxa distributed in 75 genera under 28 families with only one Gymnosperm species Ephedra intermedia. Among the recorded 28 families, Asteraceae was the most dominant (18 taxa) family followed by Gentianaceae (12 taxa) and Polygonaceae (9 taxa). Life form classification (Raunkiaer) of total taxa revealed that Chamaephyte (62.70%) was dominant form followed by Helophyte (19.84%) and Hemicryptophyte (11.11%). Shannon diversity index showed that higher plant diversity was in middle area (3.69) followed by upper area (3.61) and lower area (3.52) whereas, the evenness (e^H/S) was highest in upper area (0.72) followed by in middle area (0.53) and lower area (0.46). The cumulative dissimilarity in the species assemblage between the three elevational gradients was 97.41 owing to the species like Potentilla, Carex, Halerpestes etc.

Conclusions: Long term monitoring of the species composition surrounding the lake is needed for effective biodiversity conservation and maintenance of ecosystem services of the Chandra Tal in future.

Poster

Fire promotes compositional changes in plant communities only at fine spatial scales

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Disturbances can modify community assembly by affecting mortality, birth and dispersal rates, which in turn can lead to the turnover of some species and the loss of others. In the Cerrado, fire is a recurrent disturbance that shapes vegetation over time. However, natural fire regimes have been changing in the last centuries. Here, we investigated how different fire frequencies affect the temporal and spatial variation in the composition of the herbaceous layer of open savannas of the Cerrado. We compared metacommunities and communities submitted to annual fire (AF), biennial fire (BF) and fire exclusion (FE, total of 11 plots of 30x30 m). In each experimental plot, a random 1 x 1 m grid was established for vegetation sampling. Ten subplots were sorted and species cover was sampled in the dry season from 2017-2019. Linear models based on a Sørensen dissimilarity matrix indicated that different fire frequencies caused changes in species composition over time. Variation in species composition occurred only at the finest spatial scale (subplots, 1 x 1 m), while at the largest spatial scale (30 x 30 m plots) species composition remained similar among treatments. At the subplot scale, differences in species composition were higher between communities under biennial fires and communities under fire suppression. Our results suggest that fire promotes variation at fine spatial scales and that frequent fires maintain the stability of the composition of plant communities.

Poster

An overview of wildfire events across Europe in the last 15 years: impacts on the major vegetation types

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Climate and land-use changes are globally driving the frequency and severity of wildfires. Albeit fires are stochastic in nature, the speed, intensity, and extension of new extreme fires that have occurred during the last years are unprecedented. This is particularly evident in Europe, where ongoing changes in land use have strongly modified fire patterns over the last decades. Although satellite data by the European Forest Fire Information System (EFFIS) provide large-scale wildland fire statistics across European countries, there is still a crucial need to collect and summarize data related to the effects of the increasing fires on vegetation types across Europe. Thus, we aim to provide a general overview of the impact of recent wildfire events (2007–2021) across Europe.

The spatial and temporal data of wildfire events within the 27 EU member states were collected from the free accessible database of the European Forest Fire Information System (EFFIS). The major vegetation types were retrieved using the Land Cover Map of Europe 2017 resulting from the Sentinel 2 – Global Land Cover project.

To provide an overview of wildfire events across Europe, both the number of fire events and total burned areas were calculated for each vegetation type across countries and biogeographical regions. Extreme wildfire events increased in all the European countries, especially in the Mediterranean region. Indeed, in the last 15 years a strong increase of megafire was observed in Portugal, Spain and Italy (e.g. in Portugal more than 42 thousand hectares were burned in one week of June 2017). Broadleaf forest was the vegetation type most affected by wildfire events. To conclude, wildfires are one of the major threats to biodiversity conservation and their impact in the last years underlines the need for a more accurate overview of wildfire impact on vegetation and the post-fire recovery dynamics.

Poster

Responses of grassland plant species' phenology to climate change: Environmental cues and the importance of plant strategies

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Climate change not only causes global warming, but also leads to altered precipitation regimes. It is well-known that plant phenology is linked to environmental cues that influence the timing of their developmental stages. While some of these cues, like photoperiod, are independent of climate change, temperature and water availability are directly altered by it. Unfortunately, we know little about the relative importance of these cues for altered phenology of herbaceous plants. One of the main reasons of this knowledge gap is that most studies focus on only one cue, and that experiments are mostly conducted under greenhouse conditions, thus missing realistic climate change scenarios, and plant responses under field conditions. It is also well established that plants' life-history strategies play an important role in determining the direction and magnitude of phenological shifts in herbaceous species. To disentangle these effects, we took advantage of the Global Change Experimental Facility, a unique large-scale and long-term outdoor climate change experiment in Eastern Germany that simulates a realistic future-climate scenario of rising temperatures, increased precipitation in spring and fall, and decreased precipitation in summer. We recorded the phenological stages of plant individuals of selected target species dominating in an extensively managed grassland, both under ambient and experimentally applied future climate conditions. Additionally, we sampled species' functional traits to evaluate their life-history strategies.

Here we present preliminary results of how a warmer and wetter spring impacts phenological shifts, and how the direction and magnitude of phenological responses can be related to plants' life-history strategies. Our results will help to improve our understanding of how climate change affects phenology in central European grassland species, and how these shifts might impact plant – pollinator interactions or necessitate adjusted management regimes to avoid disturbing plants at a critical time in their life-history.

Poster

Mountain grassland restoration using hay and brush material transfer combined with temporary wheat cover

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Mountain grassland restoration success may be hampered by limited seed dispersal and poor soil seed banks of many grassland species. These constraints can be overcome by actively introducing propagules from nearby nondegraded communities. We tested different restoration techniques in order to understand the mechanisms favouring target species seedling recruitment and establishment. In five degraded mountain grasslands, we analysed (i) the effect of two techniques increasingly used in ecological restoration to overcome low seed dispersal: transfer of brush-harvested seed material and hay transfer, and (ii) the potentially facilitative effect of a temporary plant cover (common wheat) on the recruitment of transferred brush-harvested propagules. We found that both propagule transfer techniques were successful in establishing plant species of the donor community with an increase of plant species richness, cover and abundance of transferred species. Hay transfer was more efficient in transferring species of the donor grassland than brush-harvested material transfer. Brushharvested material transfer only increased abundance and cover of donor grassland species when sown together with wheat. The results indicated that hay mulch favoured seedling recruitment of target species, and that propagule transfer without hay mulch needs to be compensated by additional temporary plant cover in order to create favourable conditions for seedling recruitment. A comparison with best reference communities for each restoration grassland confirmed that hay transfer and brush material transfer with wheat sowing were successful in driving plant community composition towards the desired reference state. In conclusion, restoration of mountain grasslands with shallow and stony soils clearly benefits from a facilitative effect of dead (hay) or living (wheat) vegetation cover.

Poster

Patterns and drivers of functional diversity on an oceanic island

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Functional diversity is an increasingly applied measure of biodiversity that characterizes plant communities based on the breadth of their functional traits. Trait-based ecology has fostered the understanding of assemblage processes induced by environmental filtering, biotic interactions, and anthropogenic disturbances. Although functional diversity patterns of continental ecosystems received much attention in the past, the underrepresentation of islands questions whether their community's functional diversity composition underlies the same mechanisms. This study aims to comprehensively describe the distribution of functional diversity on the oceanic island of Tenerife and to identify the major environmental drivers.

I linked trait information for Tenerifes native flora with species occurrence data derived from a large-scale raster dataset. I then computed the 3-D trait space of each species assemblage within the 2039 grid cells using the 'hypervolume' package in R. To analyze the richness, evenness and divergence dimension of each hypervolume, I used functions of the 'BAT' package. Subsequently, I investigated the relationship between the functional metrics with four environmental drivers - temperature, precipitation, topographic complexity, and land use - by generalized linear models.

Functional diversity on Tenerife varies on two continua: the north – south and the elevational gradient. Northern communities exhibit higher leaf area and lower leaf thickness than those in the south, while communities at high elevation comprise smaller species with lower leaf area and thickness, but higher leaf nitrogen content. Areas with the highest functional richness and divergence lay at medium elevation on the north-facing windward slopes, while communities on the southern or leeward slopes exert considerably lower richness and divergence. Among the considered predictor variables, precipitation was found to impact the functional structure most evidently, followed by temperature.

The results of this study suggest that assembly processes recognized to shape functional diversity in continental landscapes act similarly on functional assemblages of oceanic islands.

Poster

Seed longevity patterns in alpine fellfield and snowbed communities

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In alpine landscapes, topographic roughness determines local environmental conditions along microhabitats such as fellfields vs snowbeds, which are supposed to act as local refugia under climate change. A functional ecological approach is still needed for understanding how these small-scale drivers modify the regeneration niche in alpine communities. Here we focused on seed longevity, a plant trait generally used to assess long-term ex-situ conservation of seeds, but with implications in seed persistence in the soil of natural habitats. We hypothesized that seed longevity of co-occurring species differs as a response of species preferential microniches, meaning that we can identify species groups which are consistently more short-lived than others. We analysed seed longevity of 25 species occurring in alpine communities from the Cantabrian Mountains (southern Europe) in two study systems (calcareous and siliceous) above 1900 m a.s.l. Seeds were exposed to laboratory-controlled accelerated ageing and then regularly sampled for germination tests. Initial viability (Ki), deterioration rate (r-1) and time taken for viability to fall to 50 % (p50) were estimated using probit analysis and microniche effects tested by GLMM in R. Our results show that seed longevity responses vary greatly across species, with p50 ranging from 3 up to 42 days. Seed longevity were ecologically and phylogenetically constrained, with some plant families adapted to cold and wet microhabitats (i.e., snowbeds) consistently showing short-lived seeds. Such results highlight that survival and persistence of alpine species facing climate change may depend on species microhabitat. While low average temperatures of alpine climates contribute to protect seeds from deterioration, some species might be particularly threatened with climate warming, especially those from cool-wet environments. The large variation of seed longevity, here observed within the alpine zone, may also have important implications for ex situ conservation.

Poster

Living together along an invasion gradient. The example of the plant communities at the Iles Kerguelen

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Incorporating functional traits in community ecology led to many advances in understanding community assembly rules. The individual being the fundamental unit of ecological interactions, recent literature demonstrated the importance of intraspecific trait variability in enabling species to resist biotic and abiotic filters. In a context of biological invasions, species with different evolutionary and interactive histories meet within the same habitat, which raises questions about their ability to coexist. In isolated islands, like the Iles Kerguelen, native species that have evolved for a long time in isolation under constraining and stable environmental conditions are expected to be more stress-tolerant, less plastic and then less competitive than invasive alien species. We therefore expect mechanisms of species coexistence to be modified along invasion gradient from niche stabilization under low invasive species abundances to competitive hierarchy at the opposite end of the gradient. Their possibility of coexistence would therefore depend on their intraspecific trait variability.

We studied responses of native and invasive species along an invasion gradient at the Iles Kerguelen. We sampled plant individuals along ten gradients located on five islands, and in two sites with only native or invasive species and we measured traits related to competition and to resource acquisition (i.e. height, SLA,and LDMC).

Preliminary results emphasized that, in allopatry, native species have lower size and SLA than invasive species, and that the two groups occupy distinct multidimensionnal trait spaces. Along the invasion gradient, both native and invasive species show the same strategy with an increase in their trait values for height and SLA and a decrease in LDMC, while no difference in trait range and variance is observed. Further analyses, including hypervolumes and null models at community scale are in progress, to understand the mechanisms of coexistence involved between the two groups (competitive hierarchy or niche stabilization).

Poster

Ecological niches of nitrogen-fixers and parasitic plants in Europe

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Nitrogen-fixers and parasitic plants are examples of plant functional groups displaying specialised ecological strategies. Thanks to those, they may escape ecological constraints associated with deficiency of some resources. Both specialised groups also exert multiple effects on the communities and the ecosystems they inhabit. The community ecology of these functional groups and their ecosystem effects have been studied rather intensely. However, their ecological niches and habitat preferences have not yet been synthesised on the continental scale.

In this study we firstly identified the ecological niches of both nitrogen-fixers and parasitic plants in relation to climatic gradients. To define the niches (habitat suitability models) we used climatic variables deriving from high-resolution climate models (CHELSA Bioclim) based on the plot geographical coordinates and Ellenberg-like indicator values deriving from plot vegetation composition. Secondly, we explored the geographical ranges of the particular species and the habitat types, where they occur. We classified all vegetation plots into EUNIS habitat types using the Expert System-approach and compared habitat specialisation of the investigated plant groups. For our analysis we used data of 1,100,421 vegetation-plots from the most comprehensive database recently available, the European Vegetation Archive (EVA).

Nitrogen-fixers, mainly represented by the taxa of legumes, show generally broad ecological niches, while some parasitic plants tend to be rather specific. The distribution center of nitrogen-fixers is located in the Mediterranean region of Europe. Parasitic plants do not show such a clear geographical pattern, with the exception of holoparasites which are considerably less frequent in cold climates. We believe our overview of ecological niches and habitat preferences of nitrogen-fixers and parasitic plants is an important contribution not only to the knowledge of their individual ecology, but also in the context of their community ecology and evolution.

Poster

Disentangling community selection from drift in fine-scale forest dynamics

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A central issue in vegetation ecology is the relative importance of deterministic differences in plant fitness (selection) vs. stochastic processes (drift). The importance of selection and drift is a function of the community, and the spatiotemporal scale. Fulton & Harcombe (2002, Ecology 83(5)) showed that forest stand dynamics were predictable at a spatial scale of 0.04 ha and a temporal scale of a decade, implying that selection was detectable even at that relatively fine spatiotemporal grain.

This poster reports an attempt to operationally distinguish selection from drift by the comparison of simulations with data from a 4 ha forest plot in SE Texas, USA. Over 9000 trees were tagged, mapped, and remeasured every 3-5 years from 1982 to 2004. Empirical models of diameter growth and tree mortality were fitted for a 6 year time window (1998 to 2004). Diameter growth was modeled from diameter and relative size (within a 20x20 m = 0.04 ha plot), plus or minus species. Mortality was modeled from diameter and recent growth (1992 to 1998), plus or minus species. Simulations were either selection-based (species included in the fitted models), or drift-based (species not included the fitted models). Both simulations incorporate stochasticity from the fitted models, so 1000 replicates of each simulation were produced. Simulated changes in basal area abundance were compared with measured changes from 1998 to 2004 at the site and plot level by calculation of city-block distances.

Both drift-based and selection-based models accounted for some dynamics, but at both the site and plot levels, the selection-based simulations were much closer to the data (lower city-block dissimilarities) than the drift-based simulations. Moreover, the dissimilarities between selection-based simulations and data were of the same order as the dissimilarities between pairs of simulations. The approach shows promise for rigorously distinguishing selection from drift in vegetation dynamics.

Poster

Comparative microtaxonomical and vegetation analyses in the central region of the Carpathian Basin

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In this work, we focused on sandy grasslands in steppe-forest-steppe vegetation along the Danube in the central part of the Carpathian Basin. The goal of the study was to find out whether Festuca wagneri was a species of open grassland or steppe. Based on our hypothesis, we could reveal the original or secondary woody, shrubby patches through the clarification of dominant taxa.

Grasslands were surveyed coenologically focusing on the dominant Festuca taxa. According to our previous surveys and the literature, three vegetation types could be distinguished due to the occurrence of a dominant Festuca taxon in all of them. Surveys were carried out at four different areas of the Carpathian Basin. Dominant grass species cover was used as an indicator value. The pedological context was also investigated.

F. vaginata grassland was considered as an open vegetation type based on its coenosystematic composition and ecological values. It was growing on a very weakly developed calcareous soil with a sandy texture, with the lowest and highest organic carbon content between 0.2% and 11.3% (0.2%) and the highest carbonate content (11.3%). F. pseudovaginata and F. tomanii appeared where the grasslands were disturbed. These taxa were also found in the forest patches. The subsoil was more developed under F. pseudovaginata, with a higher organic carbon content (1.1%) and lower carbonate content (6.9%) in the surface soil horizon. The subsoil structure of F. wagneri was the most developed, because of the deep soil content, which showed the significant humus-rich soil material from deflation and degradation.

Therefore, the dominant Festuca taxa of these vegetation types are good indicators of changes in their vegetation and ecological background.

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Poster

Mapping of habitat of Caspian whip snake (Dolichophis caspius) by remote sensing in Hungary

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Habitat of the specially protected Caspian whip snake (Dolichophis caspius) is little known in Hungary. There were few accessible data about its occurrence, but a new population were discovered by a German herpetologist in Vörös-kővár in 2012. The aim of the research was to map the vegetation of the Vörös-kővár area with remote sensing and GIS tools based on The High-Resolution Aerial Monitoring Network (HRAMN) methodology of Interspect Ltd.

The high-spatial-resolution aerial remote sensing service was combined with field studies. It was be able to map the upper canopy of vegetation species by analyzing orthophotos taken with a range of 0.5–5 cm spatial resolution and 3D surface models of aerial surveys. We determined the individual vegetation patches of grassland and we recorded woody vegetation at the individual and homogeneous group level.

Based on the composition of the vegetation, there were three groups, peripheral area, scrubland and wooded area. There were natural habitat patches and traces of anthropogenic activity, such as fruit trees, bomb craters and traces of mining activities. Despite the apparently low species count, it was diverse and species-rich, and species indicating acidity were there as well. In addition, the forest-shrub central area, interspersed with bared sandstone cliffs, was surrounded by a band of sloping steppe and shrub mosaic habitat, providing an extraordinary diversity of vegetation. Plant associations were determined such as dry and semi-dry pioneer scrub (P2b), siliceous open rocky grasslands (G3), open acidofrequent oak forests (L4b) and closed steppes on loess (H5a).

The available results could be used in the future for landscape reconstruction to the benefit of the Caspian whip snake (Dolichophis caspius), expanding the habitat of the species and thus helping to sustain the population.

Poster

The Peruvian routes of the botanical expedition to the Viceroyalty of Peru and its correlation with the current vegetation

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The Royal Botanical Expedition to the Viceroyalty of Peru (1777-1815), headed by Hipólito Ruiz and José Pavón, was one of the most important scientific explorations of the Enlightenment period. The main result was the collection and description of the flora of part of the current territories of Peru, Chile, and Ecuador. Their findings were published, among other works, in Florae Peruvianae et Chilensis Prodromus (1794), Systema Vegetabilium Florae Peruvianae et Chilensis (1798) and in the first four volumes of the main work Flora peruviana et chilensis (1798; 1799; 1802; 1957), which was left unfinished. Between 1788 and 1815, Juan José Tafalla and later Juan Agustín Manzanilla shipped materials from the mountains of Monzón (Huamalíes), Huánuco and Pozuzo, and from the regions of Ica and Atiquipa (Camaná) (Steele 1964).

After plotting the routes of the expedition based on the works, manuscripts and herbarium preserved in the Royal Botanical Garden of Madrid; and through the knowledge and update of the names of the collected plants, with the IPNI and The Plant List databases, we have detected that logically many of them are indicators and characteristic of both the bioclimatic belts and units of vegetation of Peru, previously studied in numerous trips to the region between 1987 and 2021 (Galán de Mera & Linares Perea 2012, Galán de Mera et al. 2021a, 2021b).

As a result, we present the types and even the current units of vegetation from which the expedition members obtained their study material, how the Peruvian settlers used them, and which species arrived in Spain for medicinal purposes.

Poster

Phytosociological classification of the vegetation of Peru: Andean meso-supratropical salt marshes

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The high Andean salt marshes of Peru and Bolivia, above 3800 m, are confined to the class Distichlio humilis-Anthobryetea triandri Navarro 1993 due to the presence of Distichlis humilis, Frankenia triandra, and Salicornia pulvinata. However, the littoral ones are included in the class Batido-Salicornietea ambiguae Borhidi 1996, where elements such as Cressa truxillensis, Salicornia neei, and Sporobolus virginicus are included. The recent description of Salicornia cuscoensis and the study of the meso-supratropical salt marshes where it grows have led us to analyse the classification of this type of communities in order to continue with the syntaxonomic scheme of Peru (Galán de Mera et al. 2021).

For analysing the distribution of the plots carried out throughout Peru (Gutte & Müller 1985, Galán de Mera et al. 2011), including the high Andean plots of Bolivia (Navarro 1993), we have used a Principal Component Analysis (PCA). The development of a biplot with vectors gives us the trend of species presence in the different groups.

Four groups are separated in the PCA: A- the orotropical associations of Bolivia; B- the associations of the coast of central and southern Peru; C1- the association with Salicornia cuscoensis in the salt marshes of Cusco, and C2- the plots of the association with Distichlis spicata in Huacarpay (Cusco) and in Yura (Arequipa). The Cusco and Arequipa plots are well separated from the rest, since Salicornia cuscoensis or Distichlis spicata are involved with other plants, such as Hymenoxys robusta, which allows us to assume different phytosociological units of the meso- and supratropical belts (2590-3385 m).

This leads us to consider the association Salicornietum cuscoensis Gutte & Müller 1985 and Hymenoxyo robustae-Distichlietum spicatae Gutte & Müller nom. nov. in inland salt marshes of Peru, and to create the class Hymenoxyo robustae-Distichlietea spicatae cl. nov.

Poster

Pastoral value, remote sensing, and vegetation analysis for Annex I grassland habitats conservation: first data from Maiella National Park (Central Italy)

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The Maiella National Park is one of the 24 Italian National Parks, and one of the most significant biodiversity-rich areas in Europe, hosting 201 endemic plants to Italy and 15 exclusive endemics. It includes the Apennines' second-highest mountain peak and hosts five Natura 2000 Sites. The study had the main objective of analyzing the areas currently covered by secondary herbaceous vegetation within the territory of the Park, used (to date or until recently) as extensive grazing for livestock. We took into consideration floristic composition and vegetation peculiarities of the grassland plant communities of the hilly and montane belts of the area, as well as their pastoral value and distribution related to the ecological-environmental characteristics. The analyses included the development of both statistical models for the spatialization of productivity indices, and a web interface (based on NDVI and running on Google Earth Engine) for near-real-time analysis of the vigor and phenological phases of vegetation, as a support for more rational and sustainable use of the pasture areas of the Maiella Park. The surveyed plant communities have been mainly framed in the class Festuco-Brometea Br.-Bl. et Tx. ex Soó 1947, and, to a lesser extent, Nardetea strictae Rivas Goday et Borja Carbonell in Rivas Goday et Mayor López 1966, Elyno-Seslerietea Br.-Bl. 1948, and Molinio-Arrhenatheretea Tx. 1937. The various aspects have been investigated from an integrated perspective, with the aim of outlining an overall scenario that brings out the peculiarities of the territory and the possible directions for sustainable development for the area's animal husbandry. The final aim is to enhance the production activities and, at the same time, ensure adequate management of herbaceous habitats and their maintenance in a satisfactory state of conservation, as required by the Directive 43/92/EEC, with particular reference to the types 6210(*), 6230*, and 6510 of Annex I.

Poster

Functional heterogeneity within biomes: the Cantabrian mixed forests ecoregion

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The Temperate Broadleaf and Mixed Forests Biome is mainly dominated by deciduous forests with species adapted to seasonal climates with cold winters. However, due to local climatic conditions and past biogeographical processes, coniferous or broadleaf evergreen forests can also be found within this biome. Understanding the extent of these functional divergences across biomes is important to assess vegetation diversity and conservation at the regional level. Here, we address the diversity of forest types in the Cantabrian mixed forest ecoregion, a transitional region of northwestern Iberian Peninsula included in the Temperate Broadleaf and Mixed Forest biome, at the border with the Mediterranean biome. We collected vegetation relevés from the Ibero-Macaronesian vegetation database (SIVIM) to create an updated classification of the different forests of this ecoregion based on European EUNIS typologies and functional types. The final classification reflects the high diversity of forests found in this ecoregion, including deciduous, marcescent, evergreen and coniferous forests, as a result of the high diversity of climatic conditions and bedrock types. To assess the drivers of such forest diversity, we studied the ecological profile of major forest types by using climatic, edaphic and topographic variables. Our results demonstrate how deciduous, marcescent and evergreen forests may overlap distribution ranges in the same biome, with their distributions being modulated by local climatic conditions and edaphic factors. In our study area, this effect is related to past biogeographical events and the refugia of ecologically different Quercus species in the Cantabrian coast during the last glacial period.

Poster

How invaded are Uruguayan grasslands by alien plant species?

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Biased field data has hindered to evaluate how invaded are ecosystems at country level for proposing adequate national management actions. In this study we determine the level of invasion of natural grasslands in Uruguay, considering the most problematic invasive alien species (Cynodon dactylon, Eragrostis plana, Senecio madagascariensis and Ulex europaeus) across different geomorphological regions. We propose a hierarchical randomized national-scale sample design in which four geomorphological regions with a larger proportion of natural grasslands were considered: Basaltic, South-center, North-eastern sedimentary basin and Eastern-hills (13, 3 Mha, 75% of Uruguay). Land use/cover maps were used to randomly localize 137 of 100 km2 quadrants in grazed natural grasslands, in which five 1 km2 cells were again randomly selected. In each cell, a 250 x 250 m random quadrant was localized, where we did the species surveys in three 25 m2 m plots. At each plot, the presence and cover of the four invasive alien plants were obtained. We elaborated maps where the level of invasion of each species was represented (invasion frequency and cover) and showed differences between and within regions. We found 53% of the surveyed cells were invaded at least by one species. The level of invasion was different between regions, being the North-eastern the most invaded one (75% of the cells), followed by Eastern-hills (68%), South-center (66%) and Basaltic region (11%). However, the cover was higher in Eastern-hills (11% of the plot). We found that C. dactylon was the most frequent and abundant species in Uruguayan grazed grasslands, and specifically in Eastern-hills and South-center regions. We suggest prevention of invasive plants should focus on lower invaded areas, mostly localized in Basaltic region. Control and containment plans must priorized the eastern and South-center of the country, where the invasion was higher, and mostly focused on C. dactylon management.

Poster

Forest resilience after extreme winds: effect of material legacies on tree regeneration capacity

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The frequency and intensity of extreme winds is increasing in southern Europe, but the impact they produce on forest structure and function and subsequent recovery is almost unknown. In July 2018 a tornado, with extreme winds higher than 180 km/h, caused a massive downfall of trees in 40 ha of a beech (Fagus sylvatica L.) forest in the north of the Iberian Peninsula. Tree mortality was approximately 80%. In autumn, the fallen trees were extracted by salvage logging, except in two 2 ha plots, where all the dead wood was retained. The present study analyzes the role of material legacies (e.g. dead wood, surviving trees) on the post-disturbance forest regeneration capacity. For this purpose, in 2019 and 2021, the availability of potential microhabitats for tree recruitment (e.g. branches, trunks, herbaceous cover, bare soil) and seedling and sapling densities were quantified in 40 transects of 40 m x 2 m located in four plots, two in each management type (harvested vs. wood retention). Availability of the different microhabitat types and sapling density were generally higher in wood retention plots than in harvested plots. Greater availability of some microhabitats (e.g. branches and trunks) may help to mitigate the water stress of summer drought and thus favor tree regeneration in wood retention plots. The results point to the importance of material legacies and post-disturbance management in forest resilience to extreme winds.

Poster

Vegetation composition along elevational and longitudinal gradients in North-western Patagonia

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We investigated tree and understory diversity and composition along elevational and longitudinal gradients in North-western Patagonia to identify climatic turning points between different forest types. For this, we established a first, ca. 70km long west-east transect of increasing aridity close to the community of El Manso province Río Negro. In four sectors along this transect that were 10 to 15 km apart, vegetation surveys of 100m² were systematically conducted in steps of 100 m from an elevational gradient of 400 up to 1600 m.a.s.l. of linearly decreasing mean temperature. Both north and south exposition were considered to additionally represent favourable and unfavourable mesoclimatic aspects.

In total, 70 relevés were sampled up to now. In high precipitation areas in the western part of the transect, we observed a transition from mixed forests of Austrocedrus chilensis, Nothofagus dombeyi and Lomatia hirsuta forests from ca. 500 up to ca. 1000 m.a.s.l. to dense N. antarctica shrublands up to 1400 m.a.s.l. and Nothofagus pumilio forests in highest elevations. In contrast, low precipitation areas in the eastern part of the transect were dominated by N. antarctica shrublands up to ca. 1300 m.a.s.l. Above this, the dominance of N. pumilio forests remained as in the western part of the transect. N. antarctica shrublands are presumably the result of succession after N. dombeyi and A. chilensis forest fires 100 to 60 years ago. Except for the low elevations, human impact in humid areas was low. However, the longitudinal vegetation change towards the driest areas in the east was significantly exacerbated by human activities, wildfires and soil degradation. With upcoming microclimatic measurements, soil analyses and comparisons with historic vegetation data we aim to identify the main environmental drivers of vegetation shifts now and in the past. Results can help to develop sustainable forest management concepts.

Poster

Differences between vegetation on the Czech and the Bavarian side of the Iron Curtain

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There was a violent overlap in cultural landscape in most border areas of Czech Republic- Sudetenland, in the middle of 20th. These parts has been depopulated and closed for 50 years for citizens. There was created a forbidden zone, guarded by soldiers- The Iron Curtain. After the revolution in 90s the remote land was still without management. A semi-natural habitats of appearance was created here. Available land has been consolidated into multi-hectare blocks with intensive farming. The German borderlands retained the character of remote agricultural landscape owned by small farmers. Local peasant farm on ancestral farms on about 1ha of land.

Our research focused on the development of vegetation of northwestern Sudetenland. We wondered whether human activity influenced by the ruling ideology could cause fundamental changes in the border landscape within a few decades. The landscape has got the same historical development and the natural condition on both sides of border. We investigated differences in the distribution of species and habitats in the landscape on both sides of the Iron Curtain by collecting vegetation data. Our data were collected by using by a modified collection methodology in three research squares.

On the German side of the Iron Curtain, a fine-grained mosaic of farmland has been preserved. The plant species diversity has decreased compared to the Czech side. On the Czech side, the spatial diversity of the landscape has undergone strong changes. It was enriched on the remote places with successional habitats.

Divisions into small plots seem to be a key to a species- rich landscape be a variability of management, including its absence, i. e. natural succession.

Poster

Influence of prolonged water shortage on herbaceous species of temperate forests

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Ongoing climate change raises the importance of understanding the effect of prolonged drought periods on biodiversity of temperate forests. While scientific interest concerning the water deficiency in recent years significantly grows, in comparison with trees and field crops, forest herbaceous community remains relatively overlooked. Herbaceous seedlings and juveniles are critical phases of community dynamics due to their sensitivity to temperature and precipitation variability. The regeneration phase presents a major bottleneck of survival of the community, thus understanding overall future species dynamics could be critical. The seedling and juvenile morphological, anatomical, and physiological functional traits are good indicators to the water stress and thanks to them we can get an idea of ecological consequences of the climate change (i.e., changed precipitation regime, prolonged droughts) on forest understory communities. These changes can have widespread implications for herb species distribution and some species may become locally extinct or replaced by non-native species resulting in changes in biodiversity.

The aim of this study is to determine the impact of prolonged drought periods on forest understory herb species. We carried out a manipulated soil moisture greenhouse experiment under controlled conditions with seedlings of nine forest understory herb species with different life forms and cycles commonly occurring in the lowland forests in Central Europe. Each species was cultivated under two environmental conditions – drought treatment and fully watered. By measuring various physiological (stomatal conductance, photosynthetic activity and minimum leaf conductance) and morphological (leaf size, leaf dry biomass, SLA, stomatal density) functional traits and by assessing growth rate and biomass allocation, we identified whether there are any significant differences in coping with drought and growth between those two groups of individuals.

Poster

Using trait data improves correlation between environment and community data only if abundances are considered

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A straightforward way to explore variation between communities is to calculate dissimilarity indices and relate them with environmental and spatial variables. Communities are most often represented by the (relative) abundances of taxa they comprise; however, more recently, the distribution of traits of organisms included in the communities has been shown more strongly related to ecosystem properties.

We test whether taxon- or trait-based dissimilarity is correlated more tightly with environmental and geographical distance and how the abundance scale influences this correlation. We sampled vegetation plots spanning a long productivity gradient in Hungary. We considered the traits canopy height, specific leaf area and seed mass for vascular plants. We obtained field estimates of normalized vegetation difference index (NDVI) as proxy of productivity for each plot. We calculated between-community dissimilarities using a taxon-based and a trait-based index, with raw and square-root transformed abundances and presence/absence data. Applying distance-based redundancy analysis and variation partitioning, we quantified the explained variation of NDVI difference and geographic distance on the dissimilarity matrices. Then, we calculated ordinations from all dissimilarity matrices and compared them using Procrustes analysis.

Taxonomical dissimilarity matched environmental and spatial variables better when presence/absence data was used instead of abundance. This pattern was mainly determined by the increasing variation explained by space at the presence/absence scale. In contrast to this trend, with trait-based dissimilarity, accounting for abundance increased explained variation significantly due to the higher explanatory power of NDVI. With abundance data, considering traits improved environmental matching to a great extent in comparison with taxonomical information. However, with presence/absence data, traits brought no advantage over taxon-based dissimilarity. Changing the abundance scale caused larger difference between ordinations in the case of trait-based dissimilarity than with taxonomical dissimilarity.

We conclude that considering relevant traits improves environmental matching only if abundances are also taken into account.

Poster

Area vs. Environmental Heterogeneity: Regional Diversity of European Alpine Grasslands

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Area and environmental variation are entwined in explanations of diversity. Their relative importance for the diversity alpine grasslands of 23 mountain ranges in southern and central Europe was investigated. We used the estimated species pools based on records of 16,000 relevés of the 23 ranges as their gamma diversity. The area of each range was derived from the Landsat pixels identified as grasslands using NDVI. For environmental heterogeneity, we used 8 climatic variables from CHELSA, 11 soils variables from ISRIC, and a metric of topography. The climate and soils variables were condensed using PCA, and we calculated their heterogeneity in 2D PCA space using the shoelace algorithm. We applied commonality analysis of regressions to partition the variance among the unique and shared contributions of the four independent variables. Most of the explanation was partitioned to shared explanation, and most of the this was in the combination of area, climate and soils. Topography had little effect. Gamma diversity had relatively large unique explanation by area, which contrasts with recent results in other systems. Area may be a more direct driver in the case of nonequilibrium islands.

Poster

Effects of aerosol smoke on the germination of Cerrado species

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Fire is both an evolutionary and environmental filter in many ecosystems. In the Cerrado, fire is one of the factors that most influence plant community dynamics. Fire directly alters abiotic conditions, which may affect flowering, fruiting, seed and germination traits. Thus, smoke produced during fire events may impact germination, such as increasing seed germination percentage, influencing synchrony and mean germination time. Therefore, we aimed to investigate if smoke influences the germination of Cerrado species. We evaluated the effect of aerosol smoke on the germination percentage, mean germination time and germination synchrony of 37 species from Cerrado, including species from different growth forms, vegetation types and families. We exposed seeds for 10 minutes to aerosol smoke (produced through the combustion of biomass collected in the study area). Moreover, we had a control group, where seeds were not exposed to aerosol smoke. The germination experiments were conducted for 30 days, with observations every two days to verify the number of germinated seeds. Viability tests were carried out with ungerminated seeds, using a 1% tetrazolium solution. Our results showed that 54% of the total of species studied were affected by smoke. When analyses were performed by species, 18.9% of the species had an increase in germination percentage when exposed to smoke. Moreover, 13.5% of total species germinated faster, and 2.7% of total species had their germination synchrony increased when seeds were exposed to smoke. When we analyzed the effect of smoke by growth forms and vegetation types, smoke had no effect on germination. However, when analyses were performed by families, Eriocaulaceae had an increase in germination percentage when exposed to smoke. Finally, we conclude that the responses to smoke are different between Cerrado species, and further investigation is needed to better understand the physiological response to smoke of Cerrado.

Poster

Regression to the mean in vegetation science

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We present a possible pitfall in the statistical evaluation of vegetation resurvey studies and longitudinal experimental studies caused by the stochastic phenomenon called “regression to the mean” (RTM). It manifests itself in a negative correlation of change scores (the difference between an initial and a follow-up measurement) with the initially measured values. If disregarded, analyses of the drivers of change may be misleading. While the issue is well known in the medicinal fields, we aim to raise awareness about RTM in vegetation science.

The relevance of RTM is shown using four exemplary resurvey datasets, two from grasslands and two from forests, with time gaps for the survey periods between 11 and 32 years, using in total 26 variables. The stochastic mechanism behind RTM is explained in detail and visualised with artificial data. This is done both for the setup of a resurvey study and for an experimental study. We suggest how to deal with this phenomenon when regressing change in a variable on a predictor variable by using one of the exemplary data sets.

We found the effect of RTM in 24 out of 26 examined variables. It also had a significant impact on the results of models that aimed to explain the change in an observed variable (e.g. change in species richness) with another variable (e.g. soil nitrogen content).

The effects of RTM are important to keep in mind when interpreting results of resurvey studies, but also when evaluating treatments in experimental studies. We propose to always include the initial values of a variable as a predictor when calculating models of its change scores or evaluating treatment effects. This is especially important when the initial values are already correlated with potential predictor variables.

Poster

Species climatic niches in a world without clear-cut climatic boundaries

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Exploring how climate varies throughout the world and how the ranges of the species interact with climatic variation is essential to understand diversity and how it emerged. Specifically, identifying whether the transitions between climatic regions correspond to sharp limits or to gradual climatic gradients and analyzing how species distributions intersect with these transitional areas can help elucidate how species have migrated from one climatic region to another. A good example to study these issues is the tropical-temperate dichotomy in the Asian Palmate group (AsPG) of Araliaceae. According to experts' criteria, the clade is mainly tropical, since 16 genera (70%) occur in the tropics or subtropics while only seven in temperate zones. In this study, we reevaluate the tropical nature of the AsPG considering the interplay between the distribution of the taxa and the transitions between climatic regions. We found large disagreement in the climatic characterization of genera among regionalizations and little support for the tropical-temperate dichotomy. Both results are attributed to the complexity of delimiting tropical, subtropical and temperate climates in the World and to the distribution of the study group in regions with transitional climatic conditions. These results show that to properly evaluate tropical-temperate dichotomies we cannot ignore the complexity of distribution ranges and their interactions with transitional areas.

Poster

The effects of stand density, standards and species composition on biomass production in traditional coppices

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Traditional coppices and coppice-with-standards were widely used throughout Europe and Asia for centuries but were largely abandoned in the second half of the 19th century, specially in central and northwestern Europe. In last decades, there has been a renewed interest in traditional coppicing for nature conservation and most often, for rapid woody biomass production. However, there is little information on biomass productivity of traditional coppices and what affects it. In this study, we focused on the effects of stand density, standards and tree species composition on sprout biomass production in newly restored coppices in the Czech Republic. We measured sprouts and calculated sprout biomass 7 years after the harvest from 2013 resprouting stumps in two 4 ha experimental plots. Each plot was divided into 64 subplots with different densities of standards and sprouting stumps. Total sprout biomass declined with increasing density of standards, but the effect of standards differed significantly among studied species. Whereas increasing density of standards decreased sprout biomass in Quercus petraea and Carpinus betulus, it did not affect sprout biomass productivity in Acer campestre and Tilia cordata. Sprout biomass on stand level increased linearly with increasing number of sprouting stumps and we observed no levelling of this relationship even in the highest densities of stumps. We also found significant shift in tree species composition with steeply declining relative abundance of Quercus in favor of other studied tree species.

Poster

The current situation of moss balls and the growth condition of the aquatic bryophytes, Warnstrorfia fluitans and others in the Lake Kussharo, northern Japan

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Moss balls basically consist of bryophyte species that grow near the surface of the water or in the water of lakes. Lake Kussharo's moss balls in eastern Hokkaido, Japan, are best known, but they are concerns endangered with water pollution, and the impact of pleasure boats on the lake bottom environment in recent years. Although the local government has designated the moss balls as Natural Monument of the town, detailed research has not been conducted in the last five decades. Therefore, the purpose of this study was to help conserve the habitat by investigating the distribution and environment of the moss balls and their constituent species. We also grasped the distribution of bryophyte species in the community at the bottom of the lake. As a result, the bryophyte community at the bottom of the lake was formed in places with many substrates, such as rocks and coarse woody debris, for plants growth. Species composition of the community is quite different from it of the past study conducted in five decades ago. Phosphorus is abundant depending on the season, and it would be a suitable place for bryophytes growth. The distribution locations of the moss balls have decreased from five decades ago, and changes in the constituent species were also observed compared to past moss balls. Since the decrease in the moss balls occurred due to changes in the surrounding environment, more detailed research is needed on the bryophyte composition and surrounding environment in the area where the moss balls are distributed.

Poster

A collection of R Tools for vegetation analyses

Dr. Tiago Monteiro-Henriques[1,2], Professor Jorge Orestes Cerdeira[3], Professor Mar Cabeza[2], Professor Paulo M. Fernandes[1]

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We present a collection of tools to support the analysis of vegetation data in the R environment. This collection contains several open-source R packages with several different functionalities:

i) diffval, with functions aiming at obtaining classifications based on differential taxa, using discrete/combinatoric approaches and mathematical optimization.

ii) florae, with functions to consult, from R, some well-known online plant lists (as Euro+Med and Flora iberica).

iii) maniphyt, with utility and auxiliary functions to manipulate phytosociological tables.

iv) rSIVIM, functions to import XML files produced by SIVIM (Sistema de Información de la Vegetación Ibérica y Macaronésica) to R data frames.

v) synphysiognomy, with functions to analyse the vegetation macrostructure of the relevés of a phytosociological table.

vi) vegaRangodb, with functions to manage vegetation data (flora lists, relevé lists, bibliography lists, georeferencing, correction lists, and ultimately taxonomic harmonization) using ArangoDB (database) as storage place.

All these packages in-development versions can be found in the GitLab repository (https://gitlab.com/point-veg). We welcome other developers to contribute to these packages.

Poster

Effect of landscape structure on potential and expressed plant biodiversity in grasslands: A combination of remote sensing tools and field surveys

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In agriculture-dominated landscapes, grasslands constitute one of the key remaining refuges for plant species. They have then an important role in biodiversity conservation. However, plant assemblages developing in grassland patches should depend on landscape characteristics such as habitat amount and mosaic heterogeneity. Indeed, these characteristics drive dispersal processes and condition species arrival and colonization in the habitat. This study aimed at analyzing the effect of landscape structure on plant biodiversity in permanent grasslands at different spatial scales – from the field to the landscape level.

This work was done using a large-scale sampling design of 30 landscape windows distributed in the Couesnon river catchment (Western France). They were selected along four uncorrelated gradients of compositional heterogeneity, configurational heterogeneity, grassland amount and hedgerow amount. In each landscape window, we measured plant biodiversity using two methods. Potential biodiversity was measured using the spectral variation hypothesis derived from multispectral 10 m Sentinel-2 images acquired between 2018 and 2019. Expressed biodiversity was measured using floristic surveys done in June 2019. Then, we analyzed the effect of landscape characteristics on the potential and realized alpha, beta and gamma diversity.

We demonstrated that landscape structure affected plant composition and some components of diversity, especially at the alpha-scale. In addition, Sentinel-2 images were able to reflect partially biodiversity measures and to provide analysis of potential biodiversity that were spatially exhaustive compared to field surveys(e.g. all fields analyzed in the landscape window instead of a sub-sample for floristic data).

This work offers a new understanding on how landscape drivers can influence plant species coexistence in grasslands and demonstrate the interest of remote-sensing tools for biodiversity assessment.

Poster

Seed banking strategies of alien and native herb species

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Seed persistence plays an important role in the successful establishment and spread of alien plant species. Seed burial experiments can provide valuable information on how temporal variability in this trait affects the invasion process. We run two seed burial experiments to assess the potential role of differences in seed bank dynamics in determining naturalization and invasiveness of alien plants. In a three-year experiment, we compared seed germinability and viability percentages for native and alien closely related herbaceous species, while we used data from a nine-year experiment to test for differences between 59 invasive and non-invasive alien herbs. Over time, we found a higher percentage of viable seeds in alien than native herbs, with differences being more obvious in the spring than autumn, while germinability was lower in alien herbs. In the second experiment, seed viability was higher in the first few years from burial in invasive herbs but declined more rapidly than in non-invasive species, while differences in germinability were minimal. These findings suggest that alien naturalized species do not differ from native species in seed bank persistence in the short term but do so in overall germination and viability dynamics. Also, a high number of dormant seed in soil seed bank could give alien species an advantage when environmental conditions are suitable for germination. On the other hand, native species could benefit from higher seed germination if it resulted in a competitive advantage. Our findings also suggest that invasive herbs take advantage of a higher percentage of viable seeds in the seasons following dispersal, while non-invasive species maintain naturalized populations through extended seed persistence and germinability over time. The findings from these burial experiments represent a critical starting point to assess how temporal variability in seed traits contribute to determining the naturalization and invasive potential of alien plants.

Poster

A comparative assessment of the levels of invasion across habitats in Central Alberta, Canada

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The Central Parkland subregion in Alberta, Canada, has been historically impacted by land use and urban development, factors known to facilitate establishment and invasion by many non-native plants. Despite the variety of habitats in the region, most local plant invasion research has focused only on prairie grasslands, and differences in the presence of non-native plants across habitats have not yet been quantified. We surveyed 204 plots across six common habitats in the Central Parkland subregion to (i) describe the relative frequency of non-native plants across habitats, (ii) identify the most and least invaded habitats, and (iii) identify the most common functional groups among non-native plants.

We have identified 362 species across prairie grasslands, snowberry shrublands, wolf-willow shrublands, aspen forests, saline marshes, and urban sites, of which 23% are introduced, with a relative frequency of 11% of non-native species per plot. All natural habitats appear to have comparable relative frequencies of non-native species, while urban sites contain significantly higher frequencies. Moreover, perennial forbs seem to be the most common functional group of non-native species across all habitats, closely followed by perennial graminoids. Notably, non-native annual forbs occur in similar or higher frequencies than native ones in prairie, aspen, and saline marshes, suggesting that these habitats might be vulnerable to short-lived opportunistic invasive species. When analyzing urban sites, non-native forbs of all lifespans occur in greater frequencies than native ones, which can be an indication of the high degree of disturbance that these sites are subjected to.

Overall, these results suggest that non-native species are widely present across all natural habitats in the Central Parkland subregion. This baseline study provides the first assessment of the magnitude of invasions across habitats in this region. Future analyses should consider species abundances, as well as identify potential problem species that have a broad habitat range.

Poster

Global analysis of source and destination areas for past and future plant invasions

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Non-native plants (NNP) are threatening biodiversity globally. Identifying areas that have been historically frequent NNP source and destination areas can provide valuable information to mitigate the NNP impact. Here we add a new dimension to NNP research and identify likely future invasion by using the dark diversity concept, the set of species that are currently absent albeit being suitable for an area. We compare NNP source and destination areas in the past and in the future across the World.

We used the new database Plants of the World Online which describes native and NNP at level 3 of WGSRPD. NNP dark diversity was estimated probabilistically by exploring which species co-occur in their native ranges with already established NNP species more often than expected randomly. For NNP dark diversity we only considered species that have been recorded as NNP somewhere. We estimated the frequency of potential source areas in the past and in the future by applying the Hanski connectivity index to distances from NNP occurrence to all native occurrence areas of respective species.

Frequent past source areas can still contribute many NNP in the future (Spearman rho = 0.96). In contrast, past and future destination areas differ considerably (rho = -0.28). In the past, frequent source and destination areas tend to overlap (rho = 0.43). In the future, there is a significant negative relationship between the likelihood of being sources and destinations (rho = -0.41).

While there is strong evidence of no depletion of NNP sources, the future destinations of NNP may likely change. That asymmetry can be the result of the transport revolution which enables more people to access far-off lands, bringing NNP to new suitable areas. Proactive conservation might prevent the realization of NNP dark diversity, if potential NNP, their likely source, and destination areas are known.

Poster

Effects of Long-term Mowing on Biomass Composition in Pannonian Dry Grasslands

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This study is focusing on the vegetation of seminatural dry grasslands. Those grasslands are valuable with large biodiversity; however their long-term preservation requires regular conservation management. The report demonstrates the results of a 13-year mowing experiment, designed to suppress the spread of unpalatable grass species, Calamagrostis epigejos. The study site is located in mid-successional grasslands, in the Western-Cserhát, near Rád, northern Hungary. The experimental design consisted of 8 permanent plots, where mowing was applied twice a year. The vegetation had been sampled annually (from 2001 to 2021) using 2×2 meter quadrats before. The impacts of mowing were tested using repeated–measure analyses of variance (ANOVA). In 2001, C. epigejos was the species with the highest coverage rate according to the both treatment types, with an average cover value of 63%. However, as a result of mowing, a significant difference was detected in the amount of litter and legumes as well. The number of species showed a slight increase under both types of treatment, from 15 to 37 in the mowed plots, but also from 18 to 27 in the control plots. We concluded that mowing twice a year was beneficial to modify botanical composition of a grassland. In a way it was suited well for agricultural usage, in particular grazing which can replace the expensive and time-consuming scythe. It is also a suitable management measure for controlling the native invader species as Calamagrostis epigejos, and can significantly increase the proportion of species with higher forage values. The work has been supported by OTKA K-125423.

Poster

Maintaining grassland-forest mosaics formed as a result of habitat reconstruction in the temperate deciduous zone of the Pannon Region

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The European temperate forest zone has great importance by maintaining habitats of not only forests, but of anthropogenous grasslands formed as a result of habitat reconstruction as well. These habitats have great importance from the viewpoint of nature conservation, landscape use and grassland economy too. The mosaic-like habitat complexes consisting of these grasslands and forest patches help increasing biodiversity and supplying habitats for forest game. In this survey, the changes of the vegetation in the temperate forests (Fagetum) of the Mátra Mountains of Hungary were followed after reconstruction. In 2012, shrub cutting was carried out in the studied area of Hungarian Middle Mountains Parádóhuta, and then 3 different management methods (abandoning, mowing and grazing) were utilized. Our goals were the following: to perform vegetation survey of the sample areas (i), surveying the natural regeneration of the grassland and analysing, valuing the effect of mowing and foraging on grasslands (ii), analysing the vegetation in terms of nature conservation and valuing its life forming spectrum (iii), according to our results, systematic mowing has significantly higher positive effect on biodiversity and on coverage of species marking the natural state of the studied grassland habitats, while game grazing can also be a significant help in maintaining them.

Poster

Studies on nature conservation- and grassland management value of a pannonian pasture near Bugac (1997-2020)

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The coenological quadrats were made in 1997, 2005, 2010 and 2020 in a sandy grassland which is used as cattle pasture.

The quadrats can be sorted in three groups. The first group was made close to the cattle pen (Zone A: 0-50 m). The second one was made farther (Zone B: 50-150), where the grazing is not so intensive. The third group contains the quadrats which were made farther than 150 m (Zone C). The animals use this area rarely, therefore this part of the pasture is undergrazed.

The rate of species which indicate degradation is the highest near to the cattle pen (0-50m). But farther than 50 m the rate of species which indicates naturalness is higher. Lower nature conservation values can be observed near to the cattle pen. In this area weeds and degradation tolerant species can be found in the highest amount. Their ratio grew in the second zone (50-150 m) too in the past few years, but the species which compose the natural vegetation also survived, so the species composition is able for regeneration. With the decreasing of grazing intensity the sample area could meet the requirements of nature conservation.

The research was supported by Research Centre of Excellence- 17586-4/2013/TUDPOL and Establishment of sustainable conservation of Natura 2000 sites in Hungary (Swiss-Hungarian Cooperation Programme: SH/4/8) projects and OTKA K-125423.

Poster

Chlorophyll and proline as functional markers capturing ecosystem properties during the successional process in abandoned vineyards in the Mediterranean basin (central Spain)

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Measures of chlorophyll content in plants is being used to assess the stress produced by warming (high temperature and irradiance) and how it affects to the photosystem level. Proline is another marker that helps to measure the water stress in plants. The results are more robust when we also study the values of recent month´s rainfall. This type of approaches are still over studied but they can help to understand the dynamics of plants in secondary succession.

In this study, we have measured the values of chlorophyll and proline content of 1-3 plants in each plot. This plants are annual or perennial species, and are the result of secondary succession in abandoned vineyards. These plots were abandoned in different years, from 2 to 42. We measured Chlorophyll content in fresh leaves according to Lichtenthaler and Wellburn method using spectrophotometer. In case of proline content, was performed using the ninhydrin-based colorimetric assay. Meteorological data (rainfall) helps us to establish a pattern in those metabolites during the growing season. In addition, we have appreciated a trend in the values of proline and chlorophyll contents about the year of abandonment.. In the results, we have obtained that chlorophyll content was higher in plots that were abandoned more lately. We propose this is due plants have established in a greater community with lower levels of stress.

By other hand, values of proline were high when the amount of rainfall on the previous months was lower. This is due to the proline is a marker that increases when there is a high-water stress. In other cases, we have observed a trend where the younger plots have lower proline values. We assume that proline content is related to successional gradient and soil water content.

Poster

Changes in species composition and diversity of remnant wetlands in southwest Illinois over the past 45 years

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Wetland ecosystems once covered 23% of the total area of Illinois but there has been a 90% loss of wetland ecosystems since European settlement. The main drivers of this loss include anthropogenic disturbances and invasion by non-native species. To better understand how the diversity and community structure of wetland plant communities are changing over time, this study resampled five remnant wetland nature preserves in southwestern Illinois, originally sampled in the 1970's Illinois Natural Areas Inventory (INAI). The wetlands were resampled in 2021 using the same methods as the original surveys. Transect coordinates were obtained from digitized INAI maps. Cover of herbaceous species was estimated using a modified Braun-Blanquet scale in 0.25-m^2 quadrats at 5 m intervals along the transect. Richness, Simpson diversity, and Shannon diversity were calculated from frequency data. NMDS ordination was used to visualize trajectories of change over time. Paired t-tests were performed to test for changes in richness and diversity, as well as changes in wetland indicator status. Fisher exact tests were used to test for changes in the frequency of species over time. There were no significant changes in diversity or richness. The ordination found no consistent pattern of change in composition among the sites. Four species had significant increases in frequency, three of which were floating aquatics. There was a significant increase in the abundance of obligate wetland species. The INAI surveys were performed in years with exceptionally low rainfall, leading to low water levels. Thus, the observed changes are attributed to the difference in hydrology, with 2021 being a normal rainfall year. This research is important because wetlands are one of the rarest natural ecosystems in Illinois, and very few high-quality examples were found in the INAI. Continued monitoring of these unique communities is essential for effective conservation management.

Poster

Towards a unified checklist of high mountain vegetation for Northern and Central South America

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The Tropical Andes are one of the richest high-mountain environments in the world, developing a vast mosaic of plant communities. Countries like Colombia have a tradition in phytosociological studies, but much of the information is not readily available, and the nomenclature of the units is highly confusing. A project was proposed to unify the existing phytosociological information on Andean highlands from Venezuela to central Peru and some sister mountain systems (Costa Rica-Antilles-Bolivia). Around 1700 geobotanical-floristic sources were checked, identifying 157 documents containing plot-based descriptions (114 effective/43 unpublished-non effective) between 1934-2022, the earliest ones corresponding to contributions of J.Cuatrecasas (1934/1958) in Colombia, and V.Vareschi (1951/1953/1955) in Venezuela. 1317 units were evaluated with respect to the 4th Code of Phytosociological Nomenclature, including 880 syntaxa (709 original descriptions/171 treatments), 437 non-syntaxa (428 original/9 updates). The 709 original syntaxa comprise: 27 classes/45 orders/123 alliances/6 suballiances/413 associations/95 subassociations. 280 (40%) had no identifiable inaccuracies, 429 (60%) showed one-multiple inconsistencies, involving 381 invalid proposals (54%: 184 invalidum/103 nudum/94 ineditum), 49 ineptum (7%), 12 other cases (7 superfluum/3 illegitimum/2 dubium); 107 (15%) are synonyms (102 synonyms/3 subassociations replaced by autonyms/2 corresponding names). The 171 nomenclatural treatments on syntaxa responded to single/combinate procedures (95 circumscription changes/28 mutations/26 validations/9 corrections/9 synonymies/7 combinations/3 emendations/1 division). 63 treatments were precise (37%), 9 inadequate (5%), 91 invalid-illegitimate or superfluous (53%); 80 (47%) are synonymous. The 437 non-syntaxa proposals include 359 communities (82%), 69 variants (16%), 7 “association complexes” (2%); 50 are equivalent to known syntaxa, 20 are synonymous among them. 39% of the original syntaxa (279) and 46% of non-syntaxonomic units (195) described before 2007 are only known by their original description. Many plant communities have not been re-recorded in recent field studies, especially worrying because many of them represent assemblages of endemic-threatened species in vulnerable sites affected by human activities

Poster

Effect of legume overseeding with phosphorus fertilization in natural grasslands on the magnitude and stability of primary productivity.

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Aboveground Net Primary Production (ANPP) is an indicator of ecosystem functioning and a key variable for the sustainable and efficient management of pastoral livestock systems. Overseeding legumes in natural grasslands coupled with phosphorus fertilization (IG) is an intensification technology extensively used in pastoral livestock systems in Uruguay to increase ANPP. The effect of this practice has been scarcely evaluated beyond punctual controlled condition experiments. In this study we used Enhanced Vegetation Index (EVI) time series, a spectral index closely related to the amount of intercepted radiation and therefore to ANPP, to analyze the effect of this technology in livestock commercial farms under production conditions. We used EVI time series of 4 years before and 9 years after intensification of 20 natural grassland (NG) and IG paired paddocks under the same grazing conditions. Both treatments were compared in terms of both EVI magnitude and intra-annual and interannual coefficient of variation (CV) using factorial repeated measures ANOVA and Tukey's test adapted for multiple comparisons. Annual EVI mean of the IG was 4% higher than the NG ($P=0.0003$ and $F1,19=18.88$); the difference were concentrated in the June-November period where they reached 7.5%. NG were slightly more stable than IG both intra-annually (19% vs 21%, $F1,19=24.14$, $P<0.0001$) and interannually (15.8% vs 17.1%, F1, $19=14.80$, $P=0.0011$). Our results confirm that this technology generates an increase in ANPP concentrated in the period of greatest forage deficit in NG of Uruguay (winter-early spring), while showing a decrease in system stability, potentially associated with the loss of plant species diversity.

Poster

Betula etnensis woodlands of the Mt. Etna (Sicily): diachronic analysis and monitoring

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Betula etnensis Raf. (Betulaceae) is a narrow endemic tree species of Mt. Etna (Sicily). It typically grows on volcanic incoherent substrates, in high-mountain stands affected by the severe climatic conditions and by frequent volcanic events, particularly tephra fallouts. Just two stands of B. *etnensis* occur on Mt. Etna, both falling within the protected area (regional park); one is located in the north-eastern slope between 1,450 and 2,000 m a.s.l., while the other one is located in the western slope of the volcano between 1,700 and 1,900 m a.s.l. This vegetation type shows its optimum within the upper supra-Mediterranean humid-hyperhumid bioclimatic belt, with penetrations towards the oro-Mediterranean belt. This deciduous woodland, featured by a remarkable pioneer behavior, occurs within the area currently occupied by the pine woods of *Pinus nigra* J.F. Arnold subsp. *calabrica* (Loud.) A.E. Murray. From the phytosociological viewpoint, this plant community can be referred to the Cephalanthero longifoliae-Betuletum aetnensis, belonging to the Quercetea pubescentis class. This association comes in contact, at lower altitudes, with the edaphophilous vegetation referable to the Daphno laureolae-Pinetum calabricae, while at higher altitudes, with the high-mountain echinophytic vegetation of the Astragaletum siculi. In particular, by comparing historical maps and orthophotos, it was possible to evaluate the demographic trend of B. etnensis plant communities and their diachronic evolution. Preliminary outcomes show a relevant decrease of the area occupied by birch woodlands from the north-eastern stand and, most concerning, a very low degree of natural regeneration in both growing sites. In order to better understand and define the ideal ecological niche of *Betula etnensis*, our study is aiming at (i) mapping the natural populations, (ii) analyzing structure and composition of the surveyed plant communities, (iii) estimating diachronic evolution of the populations at issue over the last 80 years, (iv) evaluating demographic trends of the Betula-dominated phytocoenoses.

Poster

Effects of fire frequency on herbaceous layer of open savannas plant communities.

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Tropical savannas evolved in the presence of fire and thus depend on it to maintain its physiognomies and biodiversity. Open ecosystems of Brazilian tropical savanna frequently burn every 1-5 years, and therefore, changes in fire frequency can affect its plant communities. Thereby, we aimed to analyze the effects of different fire frequencies on the post-fire dynamics, composition, and structure of open savanna plant communities of the Cerrado. We conducted surveys on sites with distinct fire frequencies (fire exclusion, burned annually and biennially since 2013). Vegetation was sampled before, 12-, and 24-months after fire experiments of 2017. Species had their cover estimated visually and later were grouped into graminoids, forbs, and shrubs. Bare soil and dead biomass cover were likewise estimated. Regarding the post-fire plant community dynamic, we found that annually burned plots varied little in species richness and growth forms cover. Conversely, biennially burned plots displayed a high variation, with a large increase in species richness and growth forms cover in the first year post-fire, succeeded by an expressive decrease in the second year. The comparison among the plant communities six years after the beginning of the experiments indicated that fire frequency did not affect species richness and growth forms cover. However, it changed species composition and abundance, resulting in three dissimilar plant communities. Cerrado open savannas showed highly resilient to fire, even to annual fires, since after six years of fire treatments, species richness and growth forms cover were not affected. However, communities differed in species composition, indicative that fire frequency can affect functional diversity and ecosystem services. Our results encourage long-term investigations to evaluate the resilience of areas frequently burned, as well as longer fire exclusion periods.

Poster

Multifunctionality of restored urban grasslands is consistently affected by decreases in precipitation under climate change

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Grasslands in urban contexts are critical ecosystems to provide ecosystem services, protect biodiversity, and help adapt cities to climate change. To improve the potential of grasslands to meet these demands, restoration efforts based on ecological knowledge of grassland functioning against the background of a changing climate are needed. We investigated the effects of simulated climate change on individual functions and overall multifunctionality of experimental grasslands in a climate chamber experiment. We sowed target mixtures of forbs and grasses in four community types, controlling the evenness between the functional types “grass” and “forb”. Climate change scenarios RCP 2.6 (control) and RCP 8.6 were implemented, and watering was manipulated for normal vs. reduced precipitation during 10 weeks following the establishment of the grasslands. We measured 13 functions representing ecosystem functioning based on plant and soil characteristics in urban settings. Grassland communities responded to higher [CO2] and warmer conditions with increased vegetation cover, height, and flower production. Reduced precipitation negatively affected carbon cycling within the grasslands due to lower biomass production and less soil respiration. In turn, the precipitation pattern alone explained water regulation in the grasslands. Community composition dominated by either grasses or forbs was important for some single functions underlying tradeoffs in potential ecosystem services. Moreover, soil properties in our experiment were little influenced by the simulated climate change conditions. Multifunctionality of recently established grasslands was affected by climate change, community composition, and precipitation, the latter showing consistent negative effects for both approaches to multifunctionality tested. Overall, we found that communities evenly composed with forbs and grasses cope better with climate change, and thus may increase the benefits of urban grasslands to adapt to a changing world. We conclude that reduced precipitation during the growing season is the most serious challenge for the maintenance of ecosystem multifunctionality in urban grasslands.

Poster

Management of Spreading Pasqueflower Pulsatilla patens (L.) Mill. habitat in microreserve located in Eastern part of Latvia

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Specific form of the state level protection form – microreserve, was established in 2008 to protect large and vital Spreading Pasqueflower finding 8.4 ha in total area.

High vitality of plants is explained by the local hurricane on 2001. After the storm target area was open and sandy, so Pasqueflowers could spread rapidly with seeds.

Target habitat and microreserve surroundings are rich also in another protected vascular plant species: Fastigiate gypsophila *Gypsophila fastigiata* and Sand pink *Dianthus arenarius* ssp. *borrusicus*.

All those species are ecologically connected to light, sunlit forests and are so called regular disturbance dependant species. Accordingly, in shaded areas these plant species have mainly low vitality, weak flowering, occur mainly in vegetative stage.

Lack of necessary ecological disturbances since 2001 caused decrease in amount and vitality of Pasqueflowers in the microreserve. Canopies of pine trees make more shade to ground cover vegetation causing spread and competition of herbaceous plants, shrubs and mosses. Step by step, rare and protected disturbance dependant plants decrease. Till now no management except protection was made in the microreserve.

Since 2012 to 2021 flowering plants of Pasqueflowers decrease in 72 %, target habitat becomes less suitable for Pasqueflower existence and development.

Thus, explains need for active management which imitates necessary natural disturbances.

Within activities of EU Cohesion fund project Nr.5.4.3.0/20/I/001 management of Pasqueflower habitat takes place since January of 2022:

1) optimisation of light conditions maintaining partly opened and sunlit structures, thinning out and extensively branching pine trees, removing expansive leaf trees and shrubs;
2) thinning of expansive shrubs and mosses in ground cover, controlled burning of brunch piles and mineralisation of soil – to develop bare sand patches.

Implemented activities will support development of Spreading Pasqueflower with seeds and favourable conservation status of target habitat which is object of regular surveillance.

Poster

Regeneration results of pannonic sand steppe vegetation in urban environment (2006-2021), Hungary

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In spite of the dense population in Budapest, the capital of Hungary, valuable plant communities still remain but mostly in isolated fragments as in the case of the Homoktövis Nature Conservation Area. The high coverage of the invasive woody species as a result of abandonment required action in 2006 and since then long-term rehabilitation process of the pannonic sand steppe vegetation has been conducted by the volunteers of the BirdLife Hungary with the cooperation of the researchers and students of educational institutions in parallel with authorization of the Municipality.

The treatment started on the border of still existing sandy grassland areas. The shoots of the woody species were manually removed to keep the area's nutrient deficiency and both attentively that just small enough surface should be open at the same management phase. This prevents the sudden advance of weeds or resettlement of invasive species parallel supports the propagules to recolonize aiming the preservation and population increase of sensitive, rare or legally protected species.

Our follow-up (2006-2021) coenological research (partly supported by OTKA K-125423) was conducted on 7 treatment-attached sample sites with 10 fixed quadrats in each, therefore information could be provided on the effects of the maintenance 15 years retrospectively. During that period 9 hectares of new surface could be opened where the dominant species of grass became the Festuca pseudovaginata. Our coenological data showed that seven years after the treatment weeds and invasive species have gradually disappeared from the given rehabilitated area and species composition has also become more similar to the undisturbed Festuca vaginata dominated sandy vegetation. The population growth of Gypsophila fastigiata subsp. arenaria, Peucedanum arenarium, Allium sphaerocephalon, Alkanna tinctoria, Hippophae rhamnoides was proven. The finding of a new species for the science, Festuca tomanii should be highlighted, scientific description is under progress.

Poster

Vegetation response to management changes on Viszló wood pasture in Hungary

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The Viszló wood-pasture (North-Hungarian Mountains) was formed and preserved by permanent management therefore it is a semi-natural habitat in an area where the natural climax vegetation would be forest. Consequently any change in the management, even abandonment due to the natural succession process, has impact on its vegetation.

Since composition of the vegetation could be an indicative factor for landuse change coenological data were collected in 2011 (5 year abandonment after grazing) and 2016 (5 year mowing after abandonment) and evaluated with multivariate statistical methods and diversity indices. We separated the treeless grassland, wood-pasture, shrubland and woodland parts of the study site.

Based on our results it could be stated that the mowing was successful against shrub encroachment and preserved the appearance but not the floral composition. In the case of treeless grassland and wood-pasture habitat the proportion of predominating species increased while the proportion of accessorial species decreased. The vegetation of treeless grassland part has been shifted to the direction of the wood-pasture parts. In the shrubland areas a slight growth of weeds and disturbance tolerant species was detectable. In the case of treeless grasslands and shrublands the assessment of the Shannon and Simpson indices revealed an upward tendency, while the diversity decreased in the case of wood-pastures and woodlands. On the whole the slight growth of diversity indices from 2011 to 2016 was a sign of disturbance considering the change in management as one. Our results can underline although this semi-natural habitat was formed by human not only the landscape value is important but also the selection of the right conservation method which helps to preserve our natural and agricultural heritage moreover biodiversity.

Poster

Current vegetation on the “motas” and “matas” of the Albufera Natural Park (Valencia, Spain)

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The Albufera Natural Park (N.P.) is one of the most representative wetlands that expand along the Mediterranean coast from southern France to southern Spain. It has an area of 21.000 ha, of which 70% are rice lands that were built since the XVIII century through the incorporation of soil and the construction of “motas” and “matas”, which separate the paddy fields from the Albufera lagoon and from the adjacent fields respectively. The latest studies related with the vegetation developing in the Albufera paddy fields and their margins are more than 30 years old. During this time, pollution, land use changes, and globalization have drastically modified the ecosystem. In this context, we aimed to characterize the current vegetation that develops on the “motas” and “matas”, to compare it with previous works, and to discuss its contribution to the biodiversity of the N.P. Thirty phytosociological relevés were performed and grouped in homogeneous communities using multivariate statistical methods. Five different communities were observed, although four of them were very scarce and fragmentary. The adscription of these communities to known associations was difficult because they mainly represented ecotones between the vegetation found in paddy fields and in wetlands, with intermingled weedy, ruderal, and helophytic taxa. The presence of each community mainly depended on the morphology of “motas” and “matas”, rice cultivation practices, and other anthropogenic actions (such as water eutrophication). In the relevés 83 different taxa were found, which represents 18% of the total described plant biodiversity of the N.P. Due to the small area of the “matas” and “motas”, and because they can be considered as linear ecological corridors and ecotones, their management and conservation may be relevant.

Poster

Regional typology of spring vegetation in Parc Ela (Grisons, Switzerland)

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The spring habitats of Central Europe are insular biotopes of high ecological value. Although subject to severe exploitation pressures, they do not yet have a comprehensive protection status in Switzerland. Contributing to this challenge is the controversy involved with their syntaxonomic classification.

In the context of the development of a regional conservation strategy and the establishment of a national inventory of Swiss springs, we carried out a regional survey of spring vegetation in Parc Ela (Grisons, Switzerland) and aimed to translate this into a classification system. We made a selection of springs to cover different regions, elevations (montane-subalpine) and bedrock types within the park. In each of them, complete vascular plant and bryophyte composition as well as a range of environmental variables were recorded. After running an unsupervised classification in TWINSPAN, the distinguished vegetation units were characterized in terms of diagnostic species, species richness and environmental variables and placed within the syntaxonomic system.

Species richness was high (total species 264, mean 21.7 species in 1 m2). The two most important environmental gradients of the ordination were elevation/water conductivity and insolation/water pH/soil reaction EIV. We distinguished seven communities within two main groups. All unshaded springs, including those over siliceous bedrock, could be assigned to a broadly defined Cratoneurion. The petrifying springs were not strongly distinguishable floristically from other base-rich springs. The forest springs, although often not clearly differentiated from their unshaded counterparts, could be provisionally divided into the alliances Caricion remotae and Lycopodo europaei-Cratoneurion commutati. As there is a certain threat to these habitats in the park due to anthropogenic influence, protection measures are recommended, most importantly the appropriate management of alpine pastures.

Poster

Buzkyi Gard National Nature Park: an overlooked hotspot of vegetation diversity in Steppic Ukraine

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Buzkyi Gard National Nature Park (BG) is located in South-Western Ukraine. The territory of BG represents the landscape of steppic river valleys with ancient bedrocks of the Ukrainian Crystalline Shield. Owed to the geological history and complex relief, the National Park is known as a territory with diverse flora, including local endemics (e.g. Dianthus hypanicus, Moehringia hypanica). We conducted the study of floristic and vegetation diversity of BG in 2018-2021. We analysed 580 relevés using JUICE 7.1 and R for the data analysis. Habitat mapping was carried out using QGIS software.

Flora of the BG consists of 1080 vascular plant species, including 145 (13,4%) neophytes. According to the geographical analysis, the flora has a steppe character with notable extrazonal elements and links to the Mediterranean. The preliminary syntaxonomical scheme comprises 45 alliances of 19 classes of natural and semi-natural vegetation. We sampled the vegetation of 27 alliances for the first time within the study region. The largest number of alliances belonged to wetlands Phragmito-Magnocaricetea (8 alliances), while the most species-rich and diverse vegetation types were dry grasslands (Festuco-Brometea) and thermophilous oak forests (Quercetea pubescentis). In particular, we registered a new species richness record for the steppe zone: 107 species (102 vascular plants and 5 cryptogams) per 100 m2 and 73 species (69 vascular plants and 4 cryptogams) per 10 m2. Habitats of rare and endemic species were mainly rocky outcrops (Asplenietea trichomanis, Sedo-Scleranthetea) and dry grasslands (Festuco-Brometea). Habitat mapping showed the complexity and mosaic nature of natural habitats, which are represented by small areas (0,01-10 ha) and often overlap.

In comparison with other protected areas in the steppe zone of Ukraine, BG is distinguished by its rich flora and a high number of syntaxa. This allows us to conclude that this area is a local hotspot of vegetation diversity.

Poster

Vegetation types of Robinia pseudoacacia forests in the NW Balkan Peninsula

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Robinia pseudoacacia dominated forest communities have been intensively studied in the NW Balkan Peninsula (Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia). It is considered one of the most widespread and invasive alien tree species in temperate regions of the northern hemisphere, considered as both ecologically risky and economically important in many countries. Phytosociological literature data of the *Robinia pseudoacacia* stands in the area are very sparse with almost no published vegetation plots. Their classification into phytosociological system is based on the information from Central Europe. The aims of this study are to fill the gap in the field data on *Robinia pseudoacacia* stands in the area of NW Balkan Peninsula and to identify main vegetation types of *Robinia pseudoacacia* forests in the area. A database of 248 vegetation plots was established and numerically classified by agglomerative hierarchical clustering. 11 vegetation types classified into three alliances were obtained - Chelidonio majoris-Robinion, Balloto nigrae-Robinion and Lauro nobilis-Robinion. Their floristic composition, ecological conditions and geographical distribution were elaborated.

Poster

Fire modulates germination responses of dry and wet grassland species to simulated future temperatures and osmotic stress

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Seed germination is directly affected by the soil microclimate, which will inevitably be changed by the increase in temperature and irregular rainfall predicted for the future. We investigated how the caryopses of native grasses from populations occurring in dry and wet grasslands, subjected or not to a fire event, respond to water stress in current and future temperature regimes. Caryopses of 10 grass species from dry and wet grasslands, obtained from populations subjected or not to a fire event, were germinated under increasing osmotic potential (0 to -1.0 MPa) in a current (17/27 °C) and future (23/33° C) temperature regime. The influence of these conditions was assessed for germinability, median germination time and seed viability. Caryopses from dry grasslands showed greater tolerance to negative osmotic potential and germinate more slowly than those from wet grasslands under the current temperature regime, but this difference declines under a future temperature regime. After a fire, caryopses from resprouted individuals showed greater tolerance and germination under negative osmotic potentials than caryopses from individuals not subjected to fire. Temperature increase may reduce the ability of dry and wet grasslands to germinate, thereby impacting the recruitment potential of these species. Moreover, more intense water stress can affect the survival of caryopses from wet grasslands, compromising the conservation of this ecosystem in a future scenario. Caryopses collected from resprouted individuals exhibited greater germination potential; however, this effect seems to be lost in a future climate.

Poster

Past and present drivers of phylogenetic diversity of grassland communities in south eastern South America

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Grasslands of southeastern South America are one of the largest temperate grassland regions in the world and dominate landscapes in this region since the Pleistocene to mid-Holocene. Little is known on patterns of phylogenetic diversity along climatic gradients in grassland communities, especially in the context of evolutionary and macroecological processes. Here, we aimed to understand the relationships of phylogenetic diversity and present climate, soil conditions, human impact and historical climate instability.

We analyzed the phylogenetic structure of 666 grassland vegetation plots across southeastern South America, including southern Brazil, northeastern Argentina and Uruguay through mean pairwise distance (MPD) and mean nearest taxon distance (MNTD). Their standard effect sizes (SESmpd and SESmntd) tell us whether our diversity indices are higher or lower than expected given the community species richness. Values ≤ -1.96 indicate clustering, while values ≥1.96 indicate phylogenetic overdispersion. We investigated diversity patterns along gradients of historical and current climatic variables and edaphic conditions through generalized linear models (GLM).

Most sites (76.7%) showed clustering at deep phylogenetic levels (SESmpd range: -7.88 to 0.61). SESmpd increased with increasing minimum temperature of the coldest month, annual precipitation, precipitation seasonality, soil nutrient availability and historical temperature instability, while human footprint and soil clay content led to reduced values (GLM results: $R2 = 0.37$; $P<0.01$). For SESmntd, relations were weak with no clear patterns.

Both past and present environmental conditions explained patterns of phylogenetic diversity of grasslands in South America. Communities with higher PD could be offering environmental conditions suitable to species with different tolerances, creating a niche overlap of warm and cold adapted species. This suggests that different lineages evolved different strategies to cope with environmental fluctuations. Our results offer insights into how ecological and evolutionary processes act to shape current patterns of phylogenetic diversity in grassland ecosystems in South America.

Poster

Seasonality affects biomass allocation on tropical and subtropical grasslands

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Tropical savannas and subtropical grasslands are fire-prone ecosystems driven by seasonality. Tropical systems have two main seasons: dry and wet, with constant annual average temperature. Subtropical grasslands have precipitation well-distributed all over the year, with contrasting averages temperatures. High allocation to the belowground compartments is a common strategy to persistence and resistance in those ecosystems. If allocation is also affected by seasonality it remains unclear. Our study aimed to understand the role of seasonality (precipitation and temperature) to drive biomass allocation in open ecosystems. For three grassy systems, i.e. tropical open savanna, tropical wet grassland, and subtropical grassland, we measured: aboveground live and dead biomass for at least 30 0.25 m^2 plots, and root biomass using soil core samples of 5 cm diameter and 20 cm depth.We calculated the root:shoot ratio as the ratio between total dry root biomass and aboveground live biomass. We observed important seasonal variation in dead, live and root biomass in tropical open savanna, with an increase of the root:shoot ratio during the dry season. Live aboveground biomass did not vary according to season. In the wet grassland, dead biomass increased 6% during the rainy season but live and root biomass did not vary. In the subtropical grasslands, biomass variations were primarily due to a decrease in dead (16%) and live aboveground (19%) biomass during winter compared to summer, an increase in root biomass (6%) and root:shoot ratio in winter compared to summer. Our results showed that biomass responded to seasonal variation in open savannas and subtropical grasslands, with an increase in biomass allocation belowground during the dry season and winter respectively. In wet grasslands, because of water saturation of the soil, seasonality played a minor role for variation in biomass allocation that may be more responsive to edaphic factors.

Poster

A test of the Enemy Release Hypothesis in three grasses invasive to the Canadian Prairie

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The enemy release hypothesis (ERH) predicts that plant species introduced into a new geographic range are released from co-evolved enemies in their native range, such as soil pathogens, which could result in a higher plant fitness in the introduced range compared to the native range. However, despite its intuitivity, the ERH has received mixed support in empirical research. We verified the ERH in a growth experiment using three grasses that are native to Eurasia's steppe grasslands and non-native and invasive in North American prairie grasslands: *Agropyron cristatum* (Crested Wheatgrass), *Bromus inermis* (Smooth Brome), and *Poa pratensis* subsp. *angustifolia* (Kentucky Bluegrass). We planted seeds collected from populations in the native and non-native range (14 seed populations for *A. cristatum*, 16 populations for B. inermis, and 17 populations for P. *pratensis* subsp. *angustifolia*) into sterilized soil inoculated by one of four treatments: soil from Eurasian (native soil) and Canadian (introduced soil) grasslands, as well as two controls (local control soil, control soil), yielding a fully crossed design of seed and soil origin (total number of pots: 752). We quantified germination success (assessed after four weeks), plant growth via the maximum length of leaves (assessed every two weeks), and above and belowground biomass. Our preliminary results indicate only weak support for the ERH and species-specific signals. Specifically, *A. cristatum* in Eurasian population was the only species to show higher plant growth in introduced soils compared to the native soils. Lastly, we found that our inference depended on the response metric that we assessed, with growth and germination success showing contrasting patterns. Overall, our study shows limited support for the ERH. Future studies need to explore other explanations for the invasiveness of the three grass species in Canadian prairies.

Poster

How do functionally rare plant species affect ecosystem processes in mesic grasslands?

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It has been hypothesized that functionally rare species (rare species with unique functional trait attributes) significantly contribute to ecosystem functioning. With their unique trait attributes, they may be able to use resources that are not available to other species and consequently affect ecosystem processes. However, this assumption has not been tested yet for plant communities. In a German mesic grassland, we established an experiment in which we simulated the loss of functionally rare species by removing the functionally rarest 25% or 50% of species in 4 m² plots with five replicates per treatment. We controlled for the effect of the induced disturbance in coupled control plots by removing the same biomass of randomly selected species and established a control treatment without any removal of biomass. From April to August 2021 we measured three parameters to quantify ecosystem processes (biomass production, soil respiration and flowering phenology) in each of in total 25 plots (five treatments with five replicates each) on a weekly basis. Using linear models and comparison tests (ANOVA, Kruskal-Wallis-Test) we investigated if the loss of functionally rare species affected ecosystem processes at our study site. Treatments did not differ in terms of any measured parameter showing that neither the loss of functionally rare species nor the random loss of biomass affected the investigated processes. Although we did not find support for our initial hypothesis, we discuss different options why the loss of functionally rare species did not influence ecosystem processes in grasslands on this local scale. This way, our findings provide a good starting point for further research to better understand the ecological relevance of functionally rare species in plant communities.

Poster

The effect of fire exclusion on aboveground biomass of tropical old-growth grasslands

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Fire is a major factor acting on the structure and maintenance of old-growth grasslands (OGG), composed of a species-rich herbaceous layer. Fire is a major driver in open physiognomies, favoring the herbaceous species and, in some cases, limiting woody species establishment. In different OGGs, changes in fire regime might lead to the accumulation of the aboveground biomass, impacting therefore their community structure, suppressing the open vegetation and associated herbaceous species. Here, we analyzed the variation in aboveground biomass and its components (i.e. dead and live biomass) in nine different Brazilian OGG, to access how changes in fire regime influence community structure and biomass accumulation. We quantified total aboveground biomass, live (graminoid, forb, and shrub biomass), and dead biomass in two fire treatments: frequently burned and fire exclusion. We then analyzed biomass accumulation of dead and live biomass, along a fire exclusion chronosequence in different OGGs. Dead biomass increased two-fold in most fire-excluded areas compared to burned ones in all OGGs. Graminoids composed >80% of the live biomass in all areas. Biomass accumulation throughout the fire exclusion chronosequence was different among OGGs. In some OGGs the variation in total biomass presented a hump-shape pattern with an increase and then a decrease of the total biomass with time without fire, whereas in other OGGs we only observed an increase of the total biomass without fire. In conclusion, fire exclusion leads to changes in the structure of the OGG communities, potentially influencing the fire behavior as the amount of dead biomass can increase the system's flammability. Differences in biomass accumulation in a fire exclusion chronosequence may also be influenced by environmental conditions, such as edaphic factors. Finally, we need to consider fire management to avoid fuel load accumulation in OGGs to the maintenance of open physiognomies and reduce extreme fire events.

Poster

Fire changes biomass allocation to vegetative and reproductive structures in Cerrado plants

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Fire plays a major role in many ecosystems affecting community structure and dynamics. In many fire-prone ecosystems, such as tropical savannas, fire affects plant biomass allocation and regeneration strategies. Therefore, our aim was to investigate how fire affects the biomass allocation to vegetative and reproductive structures in Cerrado plants. Specifically, we focused on answering the following questions: (a) how fire affects the proportion between vegetative and reproductive biomass allocation after fire in Cerrado plants? and (b) if the biomass allocation changes when comparing species from recently burned with species from fire-excluded areas? We collected aboveground biomass of graminoids, forbs and shrubs from different areas that were recently burned in Central Brazil. We harvested five to ten individuals of each species only when plants were in their reproductive stage (flowering). At the laboratory the biomass was sorted into vegetative and reproductive structures, dried at 80ºC for 48 hours and then weighed separately. We also sampled eight species at a recently burned area and at a fire-excluded area to compare how fire affected the biomass allocation of those species. We analyzed the mean vegetative and reproductive weight for all species. Our results showed that after fire, graminoids have greater allocation towards reproductive biomass(RB) (RB= 42.3±1.8%) compared to forbs (RB=28.2±1.5%) and shrubs (RB=13.7±1.7%). Also, fire affected the biomass allocation of five out of the eight species studied. All five species from recently burned areas had a significant ($p<0.05$) increase of allocation to reproductive structures, when compared to individuals from fire-excluded areas. Thus, fire directly affects the reproductive phenology of Cerrado plants, influencing the post-fire resprouting and reproduction. Finally, by affecting reproductive and vegetative biomass allocation fire can lead to a future change in the community dynamics in Cerrado.

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