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ORALES

A 124-year record of vegetation dynamics on the Santa Rita Experimental Range, Southwestern United States

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The University of Arizona - School of Natural Resources and the Environment & Santa Rita Experimental Range

LT6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Established in 1902, the University of Arizona's 20,000-ha Santa Rita Experimental Range (SRER) is the most thoroughly documented site of vegetation dynamics in the world. More than 120 years of experiments and systematic observations provide evidence of changes, stability, and resilience in desert grasslands under the influence of climate, livestock grazing, and soil conditions. The most conspicuous long-term change is the expansion of mesquite, which began before 1902 when livestock dispersed seeds, and the cessation of fire allowed mesquite to establish in open grasslands. Over the following decades, mesquite growth and recruitment transformed the area into a mesquite–grass savanna, a shift that has persisted despite reductions in livestock stocking rates, localized livestock exclusion, and occasional fires. Interannual and interdecadal fluctuations in grass cover following dry and wet years demonstrate the stability and resilience of native grasses even with mesquite encroachment and the increasing dominance of the non-native Lehmann lovegrass since the 1970s. Repeated eruption and decline of small shrubs and cacti exemplify cyclic desert plant dynamics that are primarily driven by precipitation and appear largely unaffected by livestock grazing or control efforts during the 1950s and 1960s. The SRER is the longest continuously operating rangeland research site in the United States. Its extensive long-term records of vegetation, precipitation, and livestock, combined with one of the world's largest and most accessible repeat-photography archives (https://santarita.arizona.edu/), have made the SRER a keystone for research on the restoration, protection, and management of desert grasslands in the arid Southwest.

Regeneration niche dissimilarity does not promote higher species richness in alpine communities

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CD15

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Understanding how regeneration and adult-plant traits interact is key to comprehending niche differentiation and community assembly. Yet, regeneration traits are less integrated into trait-based ecology. Using two alpine grassland communities as a case study, we investigate niche differentiation processes through FD metrics, encompassing both seed and adult-plant traits. Furthermore, we test potential patterns of trait divergence and their relationship with local richness. We found evidence of distinct niche processes between regeneration and adult-plant traits, but the results were contrasting across the study communities. In one community, seed niche differentiation was greater than adult-plant dissimilarity and showed significant seed trait divergence, whereas in the other community, we observed the opposite patterns. Microclimatic gradients significantly influenced niche differentiation, highlighting the importance of fine-scale environmental factors. Incorporating seed traits, such as germination, offers a complementary perspective on niche-based processes and partly drives community assembly, which appears to be highly context-dependent.

Divergent evolutionary legacies of Northern Hemisphere temperate deciduous forests

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PB8

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Temperate deciduous forests of North America, western Eurasia, and eastern Eurasia derive from a shared ancestral flora but have followed distinct evolutionary trajectories after being separated by major geographic barriers. In this presentation, I will explore how these trajectories are reflected in present-day patterns of biodiversity and evolutionary structure. Using ~9,600 vegetation plots across the Northern Hemisphere, we compared floristic richness, phylogenetic turnover within and between regions, and community evolutionary distinctiveness (CED). We also evaluated the influence of present-day climate and Last Glacial Maximum (LGM) conditions on CED. Eastern Eurasian forests showed the highest species richness, particularly among woody taxa, whereas western Eurasia was characterized by a richer herbaceous flora. Within-region phylogenetic turnover was lowest in eastern Eurasia, intermediate in North America, and highest in western Eurasia. Between regions, phylogenetic turnover was greatest between western and eastern Eurasia and lowest between North America and eastern Eurasia. North America exhibited the highest CED, followed by eastern Eurasia and western Eurasia. Climatic drivers of CED differed among regions: precipitation seasonality had a strong negative effect in eastern Eurasia, while temperature seasonality showed the strongest negative effect in western Eurasia. Overall, these results highlighted contrasting evolutionary legacies within temperate deciduous forests. The exceptional diversity of woody plants, gymnosperms, and ferns in eastern Eurasia was consistent with long-term climatic and geological stability, whereas the high evolutionary distinctiveness of North American forests likely reflected stronger climatic and tectonic dynamics over Quaternary and deeper timescales.

Broadleaved forests degradation caused by Russian war in Ukraine: remote sensing perspective

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IM1

Type: Oral

Subject: Special Sessions

Session: Impact of Military Conflicts on vegetation and habitats

Full-scale destruction of coniferous forests (plantations dominated by Scots pine, *Pinus sylvestris* L.) in the eastern and southern parts of Ukraine since 2022 is well documented in both media and research. These ecosystems are ravaged by direct shelling, smaller warfare-induced fires, and larger wildfires. In contrast, patches of deciduous forests are often overlooked despite their ecological importance for local landscapes. The level of damage to their vegetation remains uncertain, as many important massifs (e.g., patches on the Kinburn Peninsula) that were affected by warfare in 2022 have either fallen far behind the Russian occupation zone or exhibit heavy landmine contamination.

We used satellite imagery to derive tree species maps and annual layers of damaged forest cover at 20 m resolution. We focused on three protected areas in the eastern part of Ukraine: black alders (Alnus glutinosa (L.) Gaerth.) of Martynenkove Swamp, the along-the-river broadleaved part of the Serebrianskyi Forest, and large oak-dominated (*Quercus robur* L.) massif southeast of the town of Izium. We compared the progression of damaged patch areas between 2022 and 2024. Our analysis revealed that most forests in Martynenkove Swamp showed spectral recovery by 2024. A similar pattern was observed for the oak massif near Izium. In both cases, retreat of the frontline is a likely explanation. In contrast, floodplain part of the Serebrianskyi Forest exhibited severe expansion of damaged tree communities, as this area remained adjacent to a persistent warfare zone. These findings provide an indirect snapshot of war-affected areas with severely limited ground access.

The hidden age of tropical trees: growth patterns, functional groups, and the maximum lifespan

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TE3

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Tropical forest dynamics are fundamentally driven by diverse life history strategies of woody species, which often exhibit the "fast-slow continuum" between growth rate and the maximum lifespan. However, the limitation of age-determination methods in tropical trees has hindered our understanding on a standardized basis. The aim is to develop age-independent growth models and to identify life-history strategies across functional groups. This study utilizes long-term inventory data from the Nanjenshan plot in Taiwan. Based on the maximum net photosynthetic rate and vertical stratification, woody species were categorized into shade-tolerance groups (intolerant, mid-tolerant, and tolerant) and life forms (canopy, subcanopy, and shrub). Using the algebraic difference approach, we reconstructed growth trajectories without actual age data and estimated passage time representing the duration of growth starting from 1 cm diameter at breast height (dbh). The "fast-slow continuum" hypothesis was tested within functional groups where shade-intolerant species exhibit the fastest growth and the shortest maximum lifespan. The results revealed a clear continuum of growth patterns across functional groups, generally supporting the "fast-slow continuum" hypothesis. The passage time of growth peaks and senescence were progressively delayed across shade-tolerance groups and life forms. Specifically, shade-intolerant species reached senescence earliest, followed by mid-tolerant and tolerant species. Similarly, shrubs reached senescence earlier than subcanopy and canopy species. However, shade mid-intolerant canopy species exhibited highest dbh growth rates, which may be attributed to their resources acquiring and persistence strategies. These findings provide a comparable basis to characterize life history strategies and to estimate the time required for ecological restoration.

Cushion plant responses and ecosystem alterations in the Qinghai-Tibet plateau periglacial zone under global warming

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CD7

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Cushion plants of the genus *Arenaria* (including taxa such as *Arenaria polytrichoides*) are key species that maintain the stability and species diversity of periglacial ecosystems on the Qinghai-Tibet Plateau, yet they are highly sensitive to climate change—dynamic population changes of these taxa can exert extensive cascading effects on associated biotic communities. Taking eight plant communities distributed along a climatic gradient and dominated by *A. polytrichoides* as the research objects, this study systematically investigated the population dynamic characteristics of cushion plants, the potential ecological constraints driving such dynamics, and the consequent responses of associated plant communities. The results showed that climate warming can lead to the upward invasion of low-altitude species or alter the species composition and richness of communities, thereby disrupting the original interaction relationships between cushion plants and their associated species and promoting the formation of intense competitive exclusion effects between cushion plants and other species in the communities. Such competitive pressure may accelerate the decline and extinction of cushion plant populations. The above processes may trigger drastic changes in the structure and species diversity of alpine plant communities and further impair the functional stability of alpine ecosystems.

ChinaSoilSeedBank: A database on species diversity and composition of soil seed bank in China

Yantong Zhao

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SR2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

Databases on aboveground vegetation have been well established and used for comprehensive ecological and conservational studies. However, a comprehensive database for belowground vegetation, particularly one integrating the species composition of soil seed bank, is still lacking, limiting our understanding of belowground community structure and dynamics. Here, we systematically built a database for soil seed bank of China (ChinaSoilSeedBank). The database comprises 3,170 soil seed bank communities, of which 1,827 communities include species composition data encompassing 3,070 plant species and 33,488 occurrence records. The database also incorporates environmental variables and plant functional traits associated with the soil seed bank communities, and supplements paired aboveground vegetation when reported. The ChinaSoilSeedBank database can be used to identify key conservation areas of high belowground biodiversity, to complement current aboveground-focused conservation strategies, and to guide ecological restoration in degraded ecosystems.

Leaves and twigs serve as phosphorus reservoirs for mast seeding in Japanese beech in a cool-temperate montane forest

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ST6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

Masting, or mast seeding, refers to the phenomenon in which perennial plants exhibit highly variable fruit production across years. Phosphorus (P) is a critical nutrient for plant reproduction, yet its role in masting has received relatively little attention in cool temperate forests, where plant growth is typically limited by nitrogen rather than P. In this study, we present evidence that P storage in leaves and twigs contributes to fruit development in Japanese beech (*Fagus crenata*), a deciduous tree species renowned for masting with clear cycles of fruiting and non-fruiting years. Through the continuous monitoring of a cool-temperate beech forest on Mount Naeba, Japan, we observed a decline in leaf and twig P concentrations during fruiting. This decline was absent in non-fruiting individuals or during a non-fruiting year, suggesting that leaves and twigs act as internal P sources supporting fruit production in fruiting years. The declines in leaf and twig P concentrations were associated primarily with reduction in organic P, indicating that organic P pools were degraded and re-translocated to meet reproductive demand. This trend was especially strong in twigs, whereas declines in leaf P were partly associated with the reduction of inorganic P. In the talk, we will further discuss how these reductions integrate with shoot-level P allocation. Our findings provide an insight into the vegetation dynamics associated with masting in cool temperate forests.

The Mediterranean Basin vegetation and flora: A historic and ecologic approach

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DD10

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

This review summarizes the eco-morphological and evolutionary characteristics of the flora and vegetation of the Mediterranean Basin. It discusses the region's high flora diversity and high endemism rate and highlights its most notable adaptations from a historical perspective, focusing on events such as the Messinian Salinity Crisis and Pleistocene glaciations. The most relevant climatic and geographical aspects are discussed, focusing on the characteristics and geographical positioning of the Mediterranean climate on Earth within the context of the General Circulation of the Atmosphere model. It also discusses the evolutionary origin of sclerophylly as an adaptation to aridity that predates the recent emergence of the Mediterranean climate. Other widespread adaptations in this region, such as the therophyte biotype, are also addressed. The main adaptations of different plant species in defense against aridity are identified and the principal life forms into which they can be classified are listed alongside their ecological significance. The role of fire in inducing certain adaptations in plants and shaping the landscape is emphasized. Finally, some points regarding the study of Mediterranean vegetation are discussed.

Biodiversity stabilizes ecosystem productivity through functional trait–driven drought resistance

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MS7

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Biodiversity is widely recognized as a driver of ecosystem stability, yet it remains unclear when biodiversity stabilizes ecosystem functioning—through resistance to perturbation, recovery afterward, or both—and how functional traits mediate these effects. Using the Utrecht University Biodiversity and Climate Variability Experiment, the first field experiment to combine replicated plant diversity gradients with fully controlled drought manipulations, we provide causal evidence for the mechanisms linking biodiversity to stability. Across grassland communities spanning 1, 4, 8 and 12 species, higher species richness increased temporal invariability of productivity primarily by enhancing resistance to drought, with no detectable effect on recovery. Structural equation models revealed that this stabilizing effect was jointly mediated by dominant species traits and functional diversity. Communities dominated by slow-growing species (low specific leaf area and high leaf dry matter content) were more resistant to drought, consistent with mass-ratio effect, while higher functional diversity increased resistance and temporal invariability via compensatory dynamics. Together, our findings show that biodiversity stabilizes ecosystem functioning mainly by buffering productivity against climatic extremes, highlighting the importance of conserving functional composition and trait diversity under ongoing climate change.

Fine-scale mapping of tropical forest tree communities using open-source Earth observation data, field plots, and machine learning

Naveen Babu Kanda [(1)]; Debabrata Behera [(2)]; Ayushi Kurian [(3)]; Ayyappan Narayanan [(2)]

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EO13

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Understanding tree community composition is central to monitoring biodiversity patterns, and recent advances in Earth observation (EO) offer powerful means to study these dynamics across large landscapes. In this study, we present an approach for the classification of tree communities by combining field-based information with machine learning that incorporates EO data and their derivatives in the Western Ghats biodiversity hotspot, India. Five different scenarios with combination of different EO variables were constructed and tested for their performance in accurately mapping 13 tree communities using Random Forest classification approach. The evaluation results demonstrated that the utilization of integrated EO data in scenario 5 yielded notably enhanced performance in accurately classifying tree communities with an overall accuracy of 81%, accompanied by a Kappa of 0.78, surpassing the other four scenarios. The highest accuracy (F1-scores > 83%) was achieved for *Pinus roxburghii*, mixed semi-evergreen, *Hevea brasiliensis*, and *Tectona grandis* communities. The results of the variable importance analysis have indicated that Sentinel-2 bands from December (peak-growing season) and March (dry season), and bioclimatic variables were the most important predictors and highly advantageous in discerning tree communities. The final map depicted composition, with Tectona grandis community occupying the largest area at 132.45 km^2, followed by *Terminalia paniculata*-dominated community (109.15 km^2) and mixed semi-evergreen community (65.87 km^2) in the region. The obtained results indicated the robustness of the employed methodology for discerning fine-scale tree communities and its potential applicability to diverse landscapes, and facilitates future investigations concerning the management and conservation of forest ecosystems.

The Brazilian Cerrado through herbaria lenses: vegetation structure and composition across savanna, forest, and grassland biomes

Marco Chiminazzo

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TE9

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

The Cerrado is a biogeographic domain located in the heart of South America whose ecological peculiarities have attracted scientific attention since the first naturalist expeditions of the eighteenth century. Covering continental proportions, it harbors exceptional plant diversity distributed across a wide range of vegetation types. In recent decades, the Cerrado has gained increasing prominence due to its critical role in ecosystem services, including groundwater recharge and carbon storage. This growing interest, however, has also generated conceptual confusion, with different sectors of society interpreting its vegetation in contrasting ways. Here, I explore Cerrado vegetation patterns through a decentralized synthesis based on more than 300,000 herbarium records sampled across the domain. Collector notes associated with these records support the view that the Cerrado is a complex biogeographic domain composed of multiple vegetation types and biomes, despite its frequent classification as a single "savanna" or "Neotropical savanna." The vegetation mosaic includes over ten widespread savanna and forest types, as well as at least two extensive grassland formations. The coexistence of these vegetation types can be examined using herbarium data by comparing dissimilarities in community composition, plant height, and growth forms. By integrating herbarium records with in situ information on climate, soils, topography, fire regimes, and light availability, it is possible to disentangle vegetation types within the Cerrado and identify formations with ambiguous biome affiliations. These results provide a comprehensive overview of Cerrado vegetation diversity and offer insights into the drivers of community assembly in this threatened and ecologically enigmatic biogeographic domain.

Impacts of the invading shrub *Caragana arborescens* on vegetation structure and soil functioning in the southern boreal forests of Canada

Jude Bibkewich; Martin Hinojosa; Yadhiera Despeines; James Cahill; Viktoria Wagner

University of Alberta

AE15

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Caragana arborescens, having been introduced from Asia and widely planted since the 1880s, is a non-native shrub that is spreading throughout the Canadian Boreal Region. It possesses several traits characteristic of an ecosystem transformer, including an ability to fix nitrogen, with the potential to significantly alter ecosystem functioning. This study assessed the ecological impacts of *C. arborescens* within the southern boreal forest of the Canadian prairie provinces. We compared plant community structure and soil properties between invaded, recently invaded, and uninvaded sites across 24 locations in Alberta and Saskatchewan. Within each site, we recorded all vascular plant species and their foliar cover, and measured the base diameter of shrubs. In addition, we assessed light availability with hemispherical photography and analyzed soil nutrients. Our results show that invading *C. arborescens* forms a distinct, well developed tall shrub (2 - 5 m) layer which reduces understory light availability. The invaded communities were more compositionally homogenous and saw a reduction in plant richness and evenness, including an average loss of approximately a third of plant species compared to uninvaded communities. Furthermore, *Caragana arborescens* suppressed the abundance of both native shrub and herbaceous species. In line with its role as a nitrogen-fixer, there were elevated levels of available soil nitrogen in the invaded plots. Our results confirm that *C. arborescens* is associated with dramatic differences in plant communities and supports that *C. arborescens* is an invasive shrub which decreases plant biodiversity and alters soil functioning in the southern boreal forest of Canada's prairie provinces.

Co-occurrence-based measures of species habitat specialisation revisited

David Zeleny

National Taiwan University

CA7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Species habitat specialisation describes how narrowly or broadly a species tolerates environmental variation. Although central to ecology, its quantification typically requires high-quality occurrence and environmental data that are often unavailable. The numerical method introduced by Fridley et al. (2007) offers an alternative based solely on species composition data. For each species, it calculates a theta (θ) metric reflecting its co-occurrence with other species across subsets of a community dataset. This metric represents beta diversity, with higher values indicating more generalist species, and it can be applied to any dataset with plot-based data. I revisited the theoretical basis of this approach and reviewed the use of θ metrics in the literature over the past 18 years, focusing on the performance of alternative beta diversity formulations. Using a series of artificial community datasets generated by systematically varying community parameters, I evaluated how different indices respond to these variations. To facilitate these analyses, I developed the R packages *theta* and *simcom*, which provide tools for index calculation and simulation of artificial communities. The review shows that Whittaker's multiplicative beta diversity is the most commonly applied θ metric, and the most common studies focused on vegetation data. Simulations illustrate how community structure influences the behaviour of different index groups. I demonstrate that Whittaker's multiplicative metric can be computed more efficiently using rarefaction instead of repeated dataset subsetting and can be directly converted to the Ecological Specialisation Index (ESI). Finally, I discuss the strengths and limitations of the whole θ concept.

Recovery of wet grasslands after fire is constrained by failure in groundwater recharge in the Cerrado

Andra Carolina Dalbeto [(1)]*; Bruna Helena Campos* [(2)]*; Giselda Durigan* [(2)]

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FW1

Type: Oral

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Seasonally waterlogged grasslands in the Cerrado (Brazilian savanna) are ecosystems modulated and maintained by water table elevation at the end of the rainy season and by periodic wildfires during the dry season. Failure of groundwater recharge, however, has become increasingly frequent due to land-use change and climate variability. While monitoring plant community recovery after a prescribed fire in two wet grassland patches (A and B) under the same climate conditions, we also recorded water table depth in piezometric wells over three years. An extreme drought occurred during this period, hindering the water table elevation, with consequences for plant community trajectories. We sampled species richness, floristic and functional composition, and ground cover by graminoids and non-graminoids within 30 circular 1 m² plots per site every six months over two years. Community descriptors were compared with pre-fire conditions, and temporal trends were analyzed. Vegetation cover did not return to pre-fire levels in either patch: in patch A, non-graminoid cover declined, whereas in patch B, graminoid cover was more strongly reduced. In both patches, bare soil percentage increased relative to pre-fire levels. Functional composition shifted over time, with wet-specialist species decreasing in patch B. Floristic composition also changed between pre-fire and post-fire surveys, with stronger compositional shifts detected in patch A. Together, these results suggest that failure of groundwater recharge can constrain post-fire recovery and promote divergent community trajectories in Cerrado wet grasslands. Our findings highlight the importance of groundwater dynamics for maintaining biodiversity and resilience in fire-prone wetland ecosystems.

Long-term impacts of fire on grassland diversity and productivity: a meta-analysis

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[(1)] *University of Saskatchewan;* [(2)] *Canadian Prairies Prescribed Fire Exchange*

FP3

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Fire plays a key role in shaping grassland ecosystems, promoting the growth of fire-adapted species, preventing the encroachment of woody plants, and maintaining biodiversity. Natural fire cycles have been disrupted by fire suppression and ecosystem fragmentation; in many regions active prescribed fire programs are needed to return fire to the landscape. Here we report a meta-analysis of fire impacts on grassland diversity and productivity. Fire impacts on grassland biomass and species richness varied considerably across different ecoregions with studies showing both positive and negative effects common. Fire impacts varied with climate, with positive productivity responses to fire at sites with long-term annual precipitation between 600-1000mm yr and mean annual temperature between 10°C and 19°C. Much of the residual variance in fire effects is likely driven by seasonal moisture and temperature conditions in the first 3 years post fire.

Exploratory overview of plant ages in different types of old-growth tropical grasslands in Brazil using below-ground organs

Giselda Durigan [1]; Gabriel Assis-Pereira [1]; Lídio López [2]; Tiago Marcilio Gomes Pinto [3]; Cecília Leite Lemes [3]; Davi Neves de Lemos [3]; Maycon da Silva Teixeira [4]; Bruna Campos [1]; Lucas Nogueira Gonçalves [5]; Natashi Pilon [6]; Mario Tomazello-Filho [3]; Cláudia Fontana [1]

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TE7

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

The age of plant communities in pristine tropical grasslands is a mystery and so is the age of their small plants. In such ecosystems, fire, frost or large herbivores can recurrently suppress the aboveground biomass, hindering the age determination from stems. However, their belowground organs remain protected, repeatedly re-sprouting in many cases. We thus decided to explore the potential of belowground woody structures to (I) estimate the true age of small plants from pristine grasslands in Brazil, and to (II) verify if the distinctness of growth layers varies among taxonomic groups. We randomly collected samples from 204 plants (107 species, 28 families) occurring within the Atlantic Forest (mountain grasslands) and the Cerrado (dry and seasonally-wet grasslands). Discs from underground woody organs were cut, polished, and inspected under stereomicroscope to count growth layers. Of all samples, 55% exhibited distinct growth layers, highlighting the potential for centenarian chronologies, despite limitations in short-lived species or due to indistinct rings in some taxonomic groups. Most samples were less than 10 yr-old, but we found six individuals over 100 yr-old. Older ages were recorded in dry grasslands of the Cerrado (campo sujo/ campo cerrado). No plants older than 10 years were found in the mountain grasslands (campos de altitude), under humid and cold climate. The surprising old ages found are evidence that tropical grasslands are pristine ecosystems instead of degraded forests. The potential of using belowground organs to estimate the age of small plants opens a window for multiple innovative studies in tropical grasslands.

Role of species climatic niche in forest community resilience to extreme drought

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MS1

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Species' realized climatic niches are defined from information on populations' geographic occurrences and climatic information layers. For a given population and time, different metrics allow to estimate climatic suitability, distances to the niche core and edge, and climatic disequilibrium. These metrics can be scaled-up to community level by weighting for the co-occurring species abundance. Extreme drought episodes are becoming more frequent and intense under climate change, leading to forest die-back and generalized tree mortality. Forest community resilience to these episodes relies on the species' capacity to resist extreme drought and to recover later, largely through seedlings and sapling regeneration. Here, we summarize several studies illustrating how climatic niche metrics allow explaining the resilience of forests facing extreme drought episodes around the world. We found an overall decrease of forest resistance in locations with historical low climatic suitability. However, those locations historically close to the species' climatic niche core also experience die-back, particularly when combined with low climatic suitability during the drought event. The recovery of forest communities after drought is diverse, but in many cases shows a trend towards replacement by species with a climatic distribution more prone to occur in dry conditions. Both empirical and modelling evidences support the key role of recruits and their sensitivity to climatic conditions, translated to the respective species climatic niche. Overall, these studies highlight the relevance of incorporating community characterization based on species climatic niche to assess forest dynamics and resilience driven by climate change, particularly under pulses of extreme climatic events.

Are there trade-offs? Resource allocation between vegetative and reproductive traits in a tropical savanna

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FP5

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Resource allocation is a critical aspect of plant life strategies, influencing growth, reproduction, and survival, particularly in fire-prone ecosystems. In the Cerrado, where fire has shaped plant adaptations, resprouting plants face potential trade-offs between vegetative and reproductive traits. This study investigates whether fire frequency and time since last fire affect resource allocation between vegetative and reproductive traits in clonal and non-clonal resprouter species. We hypothesized that increasing fire frequency would negatively impact reproductive traits due to resource allocation toward resprouting, with clonal species being less affected due to their enhanced storage capacities. We collected data and traits from four Cerrado species - two clonal and two non-clonal - across areas with varying fire frequencies and histories. At a broad level, the only trade-off was found between macronutrient in belowground organs and full seed percentage at low fire frequency. At the species level, trade-offs became evident under particular conditions. Diplusodon punctatus showed a significant trade-off between starch allocation in belowground organs and seeds in areas with low fire frequency and recent burns. Results also showed positive relationships between non-structural carbohydrates and vegetative biomass affecting seeds and fruit number. Clonality affected only positive relationships between vegetative and reproductive traits. Our findings suggest that resource allocation strategies are highly species-dependent and context-specific, influenced by life history strategies and by fire regime parameters. These results highlight the importance of integrating fire regime dynamics into studies of plant resource allocation to better understand plant survival and growth strategies in fire-prone ecosystems.

More habitat, greater functional completeness: landscape context shapes observed and dark diversity in subtropical grasslands

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TE6

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Subtropical grasslands persist as fragmented patches within anthropogenic matrices, where habitat loss and isolation limit species recruitment. Many potentially suitable species are absent in local communities, constituting the dark diversity. The extent to which communities realize their potential species pool is quantified by the community completeness index, defined as the ratio between observed and dark diversity. We evaluated how local soil fertility and the proportion of native grassland within a 1 km buffer influence community completeness, taxonomic and functional diversity (both observed and dark) across 31 subtropical grassland landscapes (2 × 2 km). We sampled 827 plots (1 m^2) in subtropical grasslands of Southern Brazil. At the plot level, communities were taxonomically incomplete (–1.52 ± 0.24) but functionally complete (0.31 ± 0.33). Taxonomic completeness increased with spatial aggregation, whereas functional completeness remained positive across scales, indicating that although many species are locally absent at fine scales due to physical space limitation, this constraint is progressively relaxed as spatial scale increases, while trait space remains highly occupied. Continuous and less fragmented native grasslands supported higher local species richness ($\beta = 0.9$; $p = 0.04$) and higher functional community completeness ($\beta = 0.02$; $p = 0.04$), while functional dark diversity decreased ($\beta = -0.002$; $p = 0.02$). Soil fertility showed no effect. Although effect sizes were modest, these patterns emerged in relatively well-preserved landscapes (71.6 ± 25.1% native vegetation), indicating a central role of habitat integrity in sustaining species recruitment and reducing unrealized functional trait space.

Copy-pasting for persistence: a synthesis of how clonal mechanisms drive grass success and vegetation dynamics in fire-prone tropical grasslands

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FP2

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

The role of clonality in the persistence and dominance of the Cerrado grass layer remains underexplored, with inconsistent terminology hindering the understanding of clonal mechanisms and species' potential. Here, we provide a synthesis of the clonal strategies among Cerrado grasses, discussing their consequences for vegetation dynamics. By combining extensive field monitoring and literature review, we compiled a database encompassing over 130 clonal species and defined the four clonal mechanisms found in the grass layer: rhizomes, stolons, central die-back fragmentation, and sympodial fragmentation. We then assessed clonality-trait relationships and used permanent plot data to analyze population dynamics. Clonality is phylogenetically clustered and found in <20% of species, with most occurring in wet grasslands (47%) or forests (23%). Little association was found between clonality and life cycle, architecture, or phenology. While clonal species are rare within the grass layer (<15% of community richness), they drive vegetation dynamics by disproportionately succeeding in colonization. Under annual fires, clonal species increased their abundances by 265% over seven years, while non-clonal species remained unaffected. When unburned, clonal activity was reduced due to competition, yet their abundances still increased by 55% in the same period. Thus, clonality significantly enhances species' success and drives community dynamics, serving as an important resilience mechanism for these tropical grasslands. It also becomes a valuable source of regenerative potential for restoration, where clonal species could enhance multiplication and ground cover. Therefore, our synthesis establishes a long-awaited list of clonal grasses and their functional traits, assisting their use in restoration and conservation efforts.

Seven ways to rule them all – how you manage forests matters for boreal ericaceous species

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ST4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

Bilberry (*Vaccinium myrtillus*), cowberry (*V. vitis-idaea*) and heather (*Calluna vulgaris*), are foundation species in boreal forests, providing food and vital habitat for many species, and a diverse range of ecosystem services. In Sweden they cover approximately 25% of the forest floor, and changes in their abundance may have large impacts on the forest ecosystems. Asymmetric competition from the tree layer, together with the scale and frequency of disturbances, are important drivers of their abundances, and mainly regulated by forestry in Sweden. Although it is well known that forestry affects their abundance, these effects have yet to be quantified. Here we compared the effects of seven different forest management regimes (FMR) on the cover of the three species in >800 plots distributed over southern Sweden, by applying a decision support system for scenario analysis. First, we evaluated the effect of each FMR in all plots simultaneously. Secondly, we selected the optimal FMR in terms of coverage for each individual plot and calculated the relative distribution of FMRs across all plots. While most of the FMRs produced similar results, the highest cover of bilberry and cowberry was most clearly achieved by not managing the forest. However, this FMR also caused the lowest heather cover; pinpointing important differences in adaptations between these species. In contrast, optimization showed that it is possible to achieve a high cover of these species by balancing the distribution of different FMRs, while still managing the forest for other ecosystem services, which is a key target for sustainable management.

The power of scale: uncovering biodiversity patterns and environmental drivers in riparian forests

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SL3

Type: Oral

Subject: Special Sessions

Session: Scaling laws in (vegetation) ecology

The effects of spatial scale are fundamental in ecology and conservation planning, as patterns of biodiversity often depend on the size of the area considered. However, the influence of spatial scale on the taxonomic, functional, and phylogenetic plant diversity of riparian forests remains poorly understood. Aims: Our study aims (1) to characterize how multiple diversity metrics and the richness of several functional species groups change with increasing area, identifying their corresponding SARs (Species–Area Relationships); and (2) to analyse how broad-scale and fine-scale environmental variables influence SAR slopes (z-values) for both total species richness and forest specialist species richness. Location: High valleys of Ebro basin in northern Spain. Methods: We sampled 72 nested series of vegetation plots, with eight grain sizes ranging from 0.0001 m² to 200 m². We recorded all vascular plant species in the herb-layer and calculated multiple diversity metrics and the richness of functional species groups for each sampling unit in the different grain sizes. Additionally, we calculated the z-values for total and specialist species richness and modelled their responses to ecological gradients. Results: Our preliminary results found that z-values responded more strongly to fine-scale environmental conditions than to general macro-scale drivers, suggesting that local heterogeneity plays a dominant role in shaping spatial patterns. Conclusions: Research on spatial scaling in riparian forests is scarce, even though these systems are shaped by interacting variables and disturbance events across spatial scales. Therefore, we conclude that more studies identifying key environmental drivers of species–area patterns are needed.

Understanding the impact of global change on tropical canopies through epiphyte diversity

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TE5

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Vascular epiphytes are a major component of tropical forest vegetation and canopy biodiversity, yet they remain underrepresented in large-scale vegetation research compared to terrestrial vegetation. Understanding how epiphyte-rich canopy assemblages may respond to global change is essential for linking vegetation patterns to ecosystem functioning across the tropics. Here, we evaluate potential changes in the spatial configuration of Neotropical epiphyte diversity under combined climate and land-use change. We compile a taxonomically curated occurrence dataset for multiple epiphyte lineages using EpIG-DB and complementary biodiversity repositories, applying standardized data cleaning and spatial quality control. Current and future climatic scenarios will be predicted using species distribution models. Anthropogenic pressure projections will be integrated with spatially explicit land-use layers, enabling a joint evaluation of climatic suitability and habitat transformation. Model outputs will be summarized as vegetation-level metrics, including spatial patterns of predicted richness, hotspot persistence or displacement, and compositional turnover across scenarios, regions and elevational gradients. By combining a continent-wide resource on epiphyte occurrences with scenario-based modelling, this study provides a vegetation science perspective on canopy plant communities under global change. The framework is designed to support comparative analyses across biomes and to inform conservation prioritization in tropical forests where climate exposure and land-use intensity are increasingly overlapping.

Extending plant water-use strategies to flowers: evidence from trait correlations across plant organs

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CD8

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Despite the importance of flowers to plant fitness, it remains unclear whether flowers display eco-physiological strategies and how floral traits are associated with leaf economic traits.

Using a comparative analysis of flowers and leaves, we evaluated associations between seven homologous traits related to carbon and water economics in 245 plant species sampled at four locations spanning more than 100 degrees of latitude: Arctic tundra, tropical campos rupestres, Patagonian steppe, and a botanical garden in the Mediterranean-type climate of California. We used correlation analysis, standard major axes, principal component analysis, and trait networks to evaluate the associations among flower and leaf traits. We found flower trait combinations ranging from large-sized flowers with thick petals and lengthy water turnover times, to small-sized flowers with thin petaloid structures and high residual conductance (gres). There was positive scaling among flower and leaf traits such as gres, water turnover time, petal and leaf thickness, and area. Network analysis showed no modular structure of flower and leaf traits when all species were evaluated together. Our results showcase that flower phenotypes are distributed along a continuum of trait variation and are functionally linked to leaves through water- and size-related traits. This cross-organ correlation indicates that habitat filtering based on the ecophysiological strategies of one organ would influence the phenotypes of the other organ.

Ecosystem functioning in novel mixed forests: a global systematic map

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AE11

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Novel mixed forests formed by the spontaneous coexistence of native and non-native tree species are becoming increasingly widespread as a result of land-use change, abandonment of traditional management practices, and other human disturbances. These forests represent a growing challenge for forest ecology because their contribution to ecosystem functioning remains insufficiently understood. Consequently, this lack of knowledge limits management options, since these ecosystems differ from other ecosystems whose historical development is better known and documented. In this study, we developed a systematic map to identify, classify, and synthesize the available scientific evidence on ecosystem functions occurring in spontaneously established native–non-native mixed forests. A literature search was conducted across two bibliographic databases (Scopus and Web of Science) without temporal or geographical restrictions, resulting in more than 7,000 potentially relevant studies. Following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, we first screened titles and abstracts and subsequently assessed full texts to determine their eligibility for inclusion based on compliance with pre-defined criteria. For all retained studies, we extracted information on biogeographical region, native and non-native species involved, the ecosystem functions examined, bioclimatic variables, and other relevant contextual data. The number of studies increased markedly over the last years, and there was an uneven distribution of research across different regions of the world. Importantly, the systematic map reveals major knowledge gaps, which include a focus on structural proxies (e.g. plant diversity) over ecosystem functions such as carbon and water cycling, as well as a scarcity of long-term studies.

Scientific criteria for qualifying ecocide: insights from field studies of war-destroyed ecosystems in Ukraine

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IM2

Type: Oral

Subject: Special Sessions

Session: Impact of Military Conflicts on vegetation and habitats

Based on field studies conducted within ecosystems degraded by warfare in the Dnipropetrovsk, Donetsk, Zaporizhzhia, Kyiv, and Kherson regions, and a subsequent analysis of expert opinions, six verified criteria for ecocide have been formulated: five biocentric and one anthropocentric. The proposed framework for qualifying ecocide is built upon five key conceptual pillars: structural correspondence (alignment with the levels of living systems), criticality of existence (utilization of IUCN 'Endangered' or 'Critically Endangered' categories), spatial localization (linkage to natural areas), temporal verification (a three-year monitoring period), and alternative relevance (the sufficiency of meeting at least one criterion). The application of these criteria enables a clear distinction between environmental administrative offenses and grave international crimes—specifically crimes against peace, the security of mankind, and international law, which encompass ecocide.

In locust parentis: Fire, shade, herbivory, drought and grass effects on resprouting black locust and honey locust plants

David Ward

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IT4

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Disturbances are often associated with successful encroachment and invasion strategies. Frequently, successful invasion strategies are linked to vegetative reproduction in angiosperms. I investigated resprouting, which is often indicated through changes in non-structural carbohydrates. I studied black locust *Robinia pseudoacacia* and honey locust *Gleditsia triacanthos* trees, which are native in the United States, but have expanded their ranges within the U.S. and have also invaded many parts of world. I examined the effects of fire, shade, herbivory, drought, and competition with grass species on the black locust and honey locust. I found that fire had the most important effects on their growth although, in most cases, traits of control plants grew best. There were no significant differences among treatments for non-structural carbohydrates for honey locusts, and the highest values for black locusts were the control treatment. Nitrogen-fixing nodule formation in Black Locust seedlings decreased under drought, as did aboveground nitrogen concentration. There were no differences in nitrogen fixation among treatments for honey locusts under drought conditions. All four C3 grass species and all four C4 grass species were facilitated by honey locusts, whereas the same eight grass species were subjected to competition by black locust trees. Most grass species induce competition in tree species, so the facilitation effect in honey locusts across all eight species was of particular interest. We conclude that non-structural carbohydrates were not a major factor in storage in these two species, and disturbances were not important for invasion, despite claims to the contrary.

Herbivory and mosaic landscapes promote plant diversity across spatial scales in Mediterranean ecosystems

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VR3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration and management

Mediterranean conservation and restoration have long prioritised continuous wooded landscapes as the most "natural" and desirable state, often interpreting open habitats, landscape mosaics and herbivory—particularly by livestock—as signs of degradation or fragmentation. Consequently, actions have frequently focused on forest expansion and the exclusion of domestic herbivores. In contrast, alternative views emphasise heterogeneity, disturbance and herbivory as intrinsic drivers of biodiversity, and warn against relying on single descriptors that may mask scale-dependent patterns.

Here, we evaluate how landscape composition and ungulate pressure shape plant diversity across spatial scales in Mediterranean landscapes. Using plant communities sampled in 22 localities, we quantified alpha-, beta- and gamma-diversity using Hill numbers, together with species pools, completeness and dark diversity. Landscape diversity was a strong predictor of plant diversity. Gamma-diversity increased with landscape heterogeneity for all Hill numbers, both overall and when different species groups were analysed separately. Landscape heterogeneity also enhanced beta-diversity and local species richness of small plants, indicating a close link between heterogeneity and fine-scale compositional turnover. Ungulate pressure, quantified using a composite index, and largely dominated by domestic livestock (mainly sheep), showed consistently positive effects. Higher herbivory was associated with increased gamma-diversity, reduced dark diversity and higher species pool completeness, particularly in more wooded landscapes. Neither landscape mosaics nor ungulate pressure negatively affected rare plant species, suggesting that diversity gains are not driven by widespread generalists. Our results support the explicit inclusion of spatial heterogeneity and herbivory when defining reference states for ecological restoration in Mediterranean landscapes.

Trait-based insights into plant community assembly and diversity under fire: a belowground perspective from open ecosystems

Alessandra Fidelis; Aline Bombo; Marco Chiminazzo

Universidade Estadual Paulista

HH1

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Disturbance removes the aboveground components of plant communities, leaving their persistence dependent on germination or resprouting. However, community responses to fire are typically assessed using only aboveground traits. Recently, several studies have highlighted that the often-overlooked belowground traits may offer alternative insights into how plant communities respond to disturbance. Root traits, in particular, reflect important ecological strategies along the conservative–acquisitive and collaborative–do by yourself axes. Additionally, belowground storage organs, bud banks, and clonality are strongly linked to persistence and longevity. In tropical open ecosystems, fire is one of the major disturbances and thus, plants have fire-adapted traits that enable them to rapidly regenerate in post-fire environments. Here, we highlight the importance of using belowground approaches in tropical open ecosystems to enhance our understanding of plant community assembly and diversity under fire. We suggest the use the Belowground Persistence Index (BPI) — a novel classification system that categorizes plant species based on their longevity and persistence potential using belowground traits. Moreover, the measurement of the bud bank size, as well as the type of belowground storage organs showed to be the major traits related to the capacity of plants to regenerate after fire. This approach provides a more comprehensive framework for evaluating plant communities in tropical open ecosystems under disturbance

Early multi-species sowing enhances the recovery potential of restored grasslands

Réka Kiss; Katalin Lukács; Ágnes Tóth; Laura Godó; Balázs Deák; Orsolya Valkó

HUN-REN Centre for Ecological Research

VR1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration and management

Grassland restoration is widely applied to counteract biodiversity loss and ecosystem degradation, yet the stability of restored grasslands under subsequent anthropogenic disturbance remains poorly understood. In particular, ploughing may reoccur after restoration due to changes in land ownership, land use, or agri-environmental schemes, potentially compromising restoration outcomes. We therefore studied the recovery of recently restored sown grasslands (2–5 years old) following severe disturbance, focusing on the recovery potential of target grassland species. We conducted a field mesocosm experiment in eastern Hungary between 2014 and 2022. Grassland patches were restored using either a combination of grass and forb seeds or forb-only seed mixtures. Vegetation development was allowed for two to five years, followed by experimental disturbance by ploughing. Vegetation recovery was monitored for three years after disturbance, and post-disturbance communities were compared with the pre-disturbance state to assess recovery potential. Species composition recovered in two years after ploughing. Recovery of target sown forb species was more successful in older restored plots (4–5 years), indicating increasing recovery potential with increasing age of the vegetation. In younger plots establishment of sown forbs was hampered by the closed grass sward. However, ploughing successfully reduced grass domination and facilitated the establishment of sown forbs. Our results indicate that young restored grasslands can recover rapidly from disturbance. Controlled disturbance may promote the establishment of less competitive target species, but it should be applied cautiously, as open grassland patches may also facilitate weed encroachment.

Climatic resilience, climatic niche approach for quantifying environmental filtering

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CREAF

CA5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Climatic change trend is driving the replacement of cold-adapted species by arid-adapted ones. However, rapid climate velocities are preventing species from tracking suitable conditions, leading to climatic disequilibrium (CD, differences between their climatic optimum and actual climate experienced). Otherwise, disturbance can trigger that replacement by causing widespread community mortality. We present a framework using climatic niche traits to quantify how climate change filters species based on their preferences, effectively measuring environmental filtering. Through species climatic optimum, we characterized the climatic conditions more suitable to ensure the persistence of the community they conform (community inferred climate, CIC) and their community CD. This manner, we define climatic resilience as the community's ability to maintain their bioclimatic characteristics, accounted through changes CIC across disturbance stages. We applied this framework to a drought-affected Mediterranean shrubland. We assess the link between communities CD and components of their climatic resilience, and how adult resilience influences the climatic characterization of the next generation (recruits). Moreover, we tested whether canopy buffering drives persistence of endangered species. We found that resilience of high-CD communities was constrained by their resistance, demonstrating limited capacity of high-CD species for recovering. Nevertheless, some high-CD communities avoided significant filtering, probably due to biotic facilitation or local ameliorated climatic conditions. This is supported by the positive effect of adult resilience on CD of communities growing in vegetation gaps, suggesting abiotic facilitation is less critical then. Otherwise, under-canopy microclimate revealed permissive enough to allow the recruitment of high-CD communities independent of climatic resilience.

Are larger and more nutritious seeds more independent from mycorrhizal symbiosis?

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PC2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

Maternal care is a key component of fitness in all organisms and is shaped by selection on early-life mortality. Therefore, it is often fine-tuned to the expected environment in which the offspring develop. In plants, the key component of maternal care is the provision of resources to the offspring in the seed, which is primarily determined by the seed mass. During early establishment, seedlings cannot obtain resources from the environment on their own. The nutrients stored in the seed thus serve as an essential reserve to bridge this early developmental phase. Mycorrhizal symbiosis can substantially enhance nutrient uptake of soil-borne nutrients, but requires sugar investment (i.e. light-born nutrients) by the host plant. This suggests that maternal provisioning of nitrogen, phosphorus, and carbon may be adapted to plant species-specific mycorrhizal strategies. Therefore, we quantified nitrogen, phosphorus, and nonstructural carbon concentrations in seeds of 381 plant species spanning non-mycorrhizal, facultatively mycorrhizal, and obligatory mycorrhizal taxa. Combining these data with species-specific seed mass and leaf and root functional traits allows us to test whether seed nutrient stoichiometry is associated with mycorrhizal status and whether this relationship is mediated by seed mass or plant economic strategies. Given the strong phylogenetic signal in seed traits and symbiotic status, we are using phylogenetically informed models to partition evolutionary and ecological components of trait variation and to assess their interrelationships while accounting for shared ancestry.

Complementary ecosystem engineering by shrubs and wild boars structures above- and belowground vegetation in abandoned temperate grasslands

Orsolya Valkó [1]; Katalin Lukács [1]; Réka Kiss [1]; Rita Engel [2]; Csaba Centeri [3]; Natalia Pitta-Osses [3]; Ágnes Tóth [1]; Laura Godó [1]; Krisztián Katona [3]; Balázs Deák [1]

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ST1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

In semi-natural grasslands, biodiversity is maintained by management-driven patch dynamics, yet land-use abandonment promotes shrub encroachment and supports large herbivores that can substantially alter community assembly. Shrubs and wild boars may act as ecosystem engineers, but their combined effects on vegetation patterns and regeneration remain poorly understood. We studied abandoned dry calcareous grasslands near Budapest, Hungary, to assess how scattered shrubs and wild boar rooting influence microhabitat conditions, plant community composition, and soil seed banks. We compared undisturbed grasslands, shrub patches, rooting edges, and rooting centres. Shrubs and wild boars created contrasting microsites that increased fine-scale environmental heterogeneity. Shrub patches were cooler, shadier, and litter-rich, favouring species with lower light and higher moisture requirements, while rooting patches were warmer and more exposed, supporting light-demanding, warm-adapted species. Plant composition and ecological indicator values differed markedly among microsites. Rooting centres hosted the highest number of weeds and invasive alien species, but also rare weeds, whereas undisturbed grasslands contained the most grassland specialists. Seed banks across all microsites were dominated by ruderal species and showed limited potential for high-quality grassland regeneration. Rooting centres had the lowest seed densities, while rooting edges showed the highest seed density and the greatest similarity between vegetation and seed bank, likely due to soil redistribution. Shrubs and wild boars had partially complementary effects: shrubs reduced rooting intensity, while rooting limited woody establishment. Together, these interactions may stabilize early encroachment stages, enhance spatial heterogeneity, and promote niche differentiation, with important implications for community assembly and conservation in abandoned grasslands.

Enhanced autosuccession after wildfire in a transitional sub-Mediterranean forest ecosystem: Evidence from the Kras Plateau (Slovenia)

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FP6

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Wildfires are becoming an increasingly prevalent phenomenon in sub-Mediterranean regions, including areas where the vegetation is not historically adapted to fire. However, post-fire successional dynamics in these regions remain poorly documented. Vegetation was monitored annually for three years (2023–2025) after a major wildfire on the Kras Plateau (SW Slovenia). Monitoring took place in 50 permanent plots, which were assigned to five fire-severity classes. These included unburned control plots and four burned classes. We analyzed species composition, ecological indicator values, vegetation structure, and origin and habitat preferences of species, as well as plant functional traits, using ordination and trait-based approaches. Post-fire succession followed an initial floristic composition model and an enhanced autosuccessional pathway across all fire severity classes. The early dominance of ephemeral and ruderal species declined rapidly, while the abundance of perennial grasses, shrubs, and resprouting woody species increased. Functional traits shifted along the R-C axis of Grime's CSR strategy framework: from ruderal towards competitive and stress-tolerant, and successional trajectories consistently converged towards zonal thermophilous deciduous forest communities. A high amount of precipitation facilitated rapid structural recovery, with shrubland developing within three years. Sub-Mediterranean forest vegetation on the Kras Plateau exhibits high resilience to wildfire, despite limited historical adaptation to fire. Enhanced autosuccession, combined with favorable post-fire moisture conditions, enables rapid recovery and reduces the likelihood of long-term degradation or the establishment of persistent post-fire shrublands.

Epiphyte traits and host preferences influence urban epiphyte assemblages

Hannah Rogers

The University of Waikato

UR1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Urban plant communities

While host traits and microclimate are widely recognised as drivers of epiphyte community structure, few studies have investigated how epiphyte traits contribute to the structure of vascular epiphyte communities. Here, we investigated how epiphyte traits influence epiphyte-host interactions in urban environments. We assessed epiphyte-host patterns by analysing networks and metacommunities using data from 32 sites in two New Zealand cities. Host preferences were measured using three broad host types (tree ferns, angiosperm trees, and conifer trees) to account for the constrained urban host assemblages. We then measured rhizome and root traits of ten epiphyte species hypothesised to influence attachment mechanisms and epiphyte host preferences. Our results showed distinct epiphyte metacommunities associated with the host types, with tree ferns hosting the most diverse epiphyte assemblages. Trait analyses revealed that epiphytes with preferences for tree ferns had more abundant and longer rhizome hairs, whereas species associated with woody hosts had more abundant rhizome scales. Generalist epiphytes had wider rhizomes and longer roots. Attachment mechanisms differed according to host preferences. Epiphytes with preferences for tree ferns primarily used an interlocking mechanism, species associated with woody hosts used adhesion, and generalists employed both mechanisms, reflecting their morphological plasticity. Our results suggest that trait matching between epiphyte and host species contributes significantly to the structure of urban epiphyte communities. Given the importance of host quality in constrained urban host assemblages, protecting high-quality hosts and increasing.

Bryophyte-dominated communities related to human impact and management in Mediterranean coastal dunes

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AE5

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Mediterranean coastal dunes are heavily endangered habitats because of anthropogenic impact, for which conservation and management measures for these ecosystems are an urgent issue. Although bryophyte-dominated communities are understudied among plant communities in dune systems, they represent an interesting opportunity for monitoring coastal dune health. In this study, we conducted 410 plots in 17 coastal dune systems across the Balearic Islands. All the bryophyte, lichen and tracheophyte species were identified, and they were grouped in different communities according to the cryptogams present. Those communities were then analysed in relation to different natural and anthropogenic factors. A total of 5 cryptogam communities (most of them dominated by bryophytes) were identified, two of which were related to human impact. For one community, an increase in the relative coverage of the moss Bryum dichotomum was positively related to ruderal vegetation. Regarding the other community, corresponding to a mature bryophytic community, its presence in mobile dunes could be related to an excessive dune stabilisation. Bryophyte richness and cover were influenced by trampling (although there was an interaction between this factor and the distance to the sea) and management actions (including wood barriers for sand retention). Our results suggest that human disturbance affects bryophyte-dominated communities in Mediterranean coastal dunes. This includes an excessive mechanical management of the substrate, interfering on its dynamics and natural erosion processes. Some common and easily identifiable moss species and communities (and their coverage) show a promising potential as indicators of human disturbance in Mediterranean coastal dunes.

Unrealised biodiversity potential: functional and phylogenetic extensions of dark diversity

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University of Tartu

CA1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Species loss from natural habitats is often difficult to detect because observed plant diversity varies strongly across regions and environments. The dark diversity framework addresses this challenge by focusing on species that are ecologically suitable for a site but are absent, thereby quantifying unrealised biodiversity potential. Using the global DarkDivNet network, we have shown that regional human influence is associated with low community completeness, defined as the proportion of suitable species that are realised, even in vegetation that appears natural. Extending this approach, paired comparisons of natural and anthropogenically disturbed sites across DarkDivNet regions revealed consistently higher dark diversity and lower completeness in disturbed vegetation, despite similar observed diversity, indicating hidden and potentially lagged biodiversity loss. In this work, these findings are placed into a broader conceptual framework by integrating functional and phylogenetic dimensions of dark diversity. Functional dark diversity is defined as the part of regional functional trait space that is suitable but absent locally, while phylogenetic dark diversity represents absent evolutionary lineages. Initial analyses indicate that functional dark diversity is typically small, as many absent species occupy functional space already represented by observed species, and that contrasts between natural and anthropogenic vegetation are not evident at this level. Phylogenetic patterns are currently under exploration. Together, taxonomic, functional and phylogenetic dark diversity provide a unified framework to assess not only how many species are absent, but which functions and lineages remain unrealised, with implications for detecting biodiversity erosion, extinction debt and restoration potential in human-modified landscapes.

Climatic disequilibrium as a constraint of plant establishment: evidence from Mediterranean ecosystems

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DD8

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Climatic disequilibrium (CD), defined as the divergence between a species' climatic optimum and observed local macroclimatic conditions, has the potential to influence plant population dynamics in ways that are only beginning to be explored. This study investigates whether high CD jeopardizes recruitment success, a key process limiting population persistence in the Mediterranean region, where projected increases in aridity are expected to exacerbate CD over the coming decades. We then test whether facilitative interactions can buffer environmental stress and offset the negative effects of high CD. Analyzing the relationship between CD and ontogenetic transition probabilities (i.e., germination, seedling survival, first-year sapling survival, second-year sapling survival, >3 years sapling survival) across 128 Mediterranean plant species, we identified a significant negative correlation, particularly during early life stages. These initial developmental phases exhibit acute sensitivity to high CD, whereas late life stages maintain demographic stability across the disequilibrium spectrum. Notably, facilitation by nurse plants consistently increased transition rates; however, these rates still declined with increasing CD. Non-conspecific shrubs and trees emerged as the most effective nurses, providing essential micro-climatic relief while minimizing competitive resource overlap. These findings underscore the critical role of ontogeny and CD when modeling population responses to climate change. By quantifying the extent to which biotic interactions can alleviate CD, this research provides essential insights for ecological restoration and the development of climate-resilient management strategies in Mediterranean ecosystems.

Salinity and sand mobility as key drivers of vegetation in arid coastal dune systems

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DD9

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Arid coastal dune systems have received limited scientific attention, and their ecological functioning remains poorly understood. This study provides new insights into the environmental drivers shaping vegetation structure and composition in these ecosystems. Two arid coastal dune systems in the Canary Islands with contrasting sand mobility levels (intermediate and low) were selected. Species composition and abundance were recorded in 100 × 400 m plots, where all individual plants were geolocated. Soil samples were analyzed for salinity, pH, $CaCO_3$, NO_3 $_3$, total C, P, and N. Aeolian sedimentary activity (mobility proxy) was estimated from LiDAR data (2009 and 2015). Plots were subdivided into 25 × 25 m subplots, in which soil variables, sand mobility, species abundance and th Shannon index were calculated. Spatial variables were generated using distance-based Moran's eigenvector maps. Species–environment relationships were analyzed using partial redundancy analysis and variation partitioning. In the low-mobility system, several species were distributed along the entire coast–inland gradient, whereas in the intermediate-mobility system, high-mobility areas were dominated by a single species. Species richness increased with sand stabilization as environmental stress decreased. Vegetation abundance in the low-mobility system was mainly related to salinity and nitrate availability, while sediments mobility was the primary factor structuring vegetation in the intermediate system. Under low-mobility conditions, salinity modulated community composition, allowing the establishment of species with lower tolerance to sand burial. These results highlight that aeolian sedimentary mobility and salinity jointly regulate vegetation structure and diversity in arid coastal dunes.

Biodiversity-multistability relationships across ecosystem breakdowns

Pichon Benoît

National history museum of Stuttgart

MS6

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

How biodiversity supports ecosystem stability is a long-standing question that suffers from persistent challenges because studies often focus on a single stability metric, that is the temporal stability, and on a single facet of diversity, that is, species richness. Using a global dryland dataset, we assessed how taxonomic, functional, and phylogenetic diversity jointly influence multiple facets of ecosystem stability—resistance, recovery, resilience, and temporal stability along the aridity gradient. Along the aridity gradient, net biodiversity effects on stability abruptly decreased after crossing the aridity threshold of 0.75 but showed sequential collapse for the different facets of diversity. By comparing richness-based and dominance-based biodiversity effects, our results emphasize the importance of rare species diversity for drylands' stability. Our results also emphasize the strong interactions between local grazing pressure and aridity on the effect of biodiversity on ecosystem stability. By embracing the multiple attributes of biodiversity and of stability, our findings reveal that biodiversity can enhance facets of ecosystem stability but that its benefits are strongly dependent on environmental conditions: destabilizing under drier conditions and strongly dependent on the local grazing pressure.

Non-linear plant and soil biota responses to warming in subarctic tundra

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CD6

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

With ongoing climate change, rising temperatures impact plant communities and their interactions with soil biota. Subarctic tundra ecosystems are among the most temperature-sensitive systems, where soil macrofauna are scarce and smaller organisms, such as nematodes, play a key role in nutrient cycling. We investigated whether tundra community responses to warming are linear or non-linear across a temperature gradient, and how these responses are mediated by the presence of soil nematodes. In a growth chamber mesocosm experiment, we grew a model 12-species subarctic meadow community with either present or experimentally reduced soil nematodes. We exposed the mesocosms to five different temperature scenarios, ranging from ambient conditions to +9 °C. After one growing season, we measured above- and belowground plant functional traits, soil abiotic properties and assessed nematode communities. We found strong shifts in plant community functional traits across the 9 °C-temperature gradient. While total plant biomass increased linearly with temperature, most other functional traits responded non-linearly. The warming-induced shifts in plants traits were not affected by interaction with nematode reduction treatment. Rather, the nematode species composition itself changed with temperature and these changes had further effect on plant traits, indicating that nematodes act as an important pathway through which warming influences plant communities. Our results demonstrate that tundra ecosystems do not respond linearly to warming. In the short term, we observed a decoupling between linearly increasing plant productivity and other ecosystem functions, with potential implications for the long-term stability of tundra ecosystems under climate change.

Exploring biotic signals in vegetation assembly from the LGM to the Anthropocene

Ondřej Mottl

Charles University

LT4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Vegetation change is often summarised as compositional turnover, yet we know far less about how community structure—and potential biotic-interaction signals—vary across spatial scales and through major environmental transitions. Building on VegVault, a harmonised, plot-based infrastructure linking palaeo and contemporary vegetation with functional traits and climate over the last ~20 ka, I ask: How does the interaction-related (biotic) component of vegetation structure depend on spatial scale, taxonomic resolution and time? I test three expectations: biotic-interaction signals (1) weaken with increasing spatial scale, (2) strengthen during rapid change (late-glacial–early Holocene and recent centuries), and (3) persist to larger spatial scales under coarser taxonomy (a spatial × taxonomic-grain interaction). I quantify community structure across time slices and regions using complementary descriptors, including bipartite plot–taxon co-occurrence networks (connectance, modularity, nestedness) and standard community metrics (diversity, evenness, turnover). I then partition variation in co-occurrence patterns from JSDM among abiotic predictors (climate, soils), spatial structure, and biotic interactions derived from species–species association features, using scalable machine-learning models on HPC. Finally, I track how structural descriptors and variance partitions shift in time and with changing spatial extent and taxonomic resolution. By identifying when and where interaction-related signals are strongest, this work provides practical guidance for predictive biodiversity modelling under climate change: when environmental predictors may suffice, and when explicit representation of association structure is likely necessary to avoid systematic forecast failure.

Non-native plant species regenerate more effectively than co-existing native species

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AE3

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Understanding how native and non-native plant species differ in their regeneration strategies is essential for explaining patterns of invasion, community assembly, and long-term ecosystem dynamics. We conducted a meta-analysis of the global knowledge on seed regeneration niche of co-existing native and non-native vascular plant species. We synthesized data from 711 studies (out of 16,513 evaluated studies) spanning ~3,500 species. We compared seed bank density and persistence, seed germination, and seedling emergence, survival, and early growth in co-existing native and non-native plant species. We also evaluated the effect of abiotic (e.g., temperature, water) and biotic (e.g., herbivory, competition) stressors on the differences observed. We found that non-native plant species consistently outperform native species across multiple stages of the regeneration cycle exhibiting higher germination rates, faster seedling growth, and greater survival under diverse environmental conditions. These advantages may ultimately facilitate their dominance in invaded ecosystems.

Competition between soil microbial communities affects the outcome of plant-plant competition

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PC3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

Microbes influence ecological processes that affect plant community dynamics but whether they influence plant competition is unclear. We established an experiment to clarify the role of soil microbial communities (SMC) associated to different plant species on plant competition, using *Lycium intricatum* and *Maytenus senegalensis* growing in inter- and intra-specific competition. Plants, raised from sterilized seeds, were added with soil extracts collected in the field under either species with a factorial design. We found that *Lycium* was largest growing with *Maytenus* added with *Lycium* extracts. When both, *Maytenus* and *Lycium* extracts were added together, *Lycium* plants were smaller. *Lycium* grew overall significantly less when in intra-specific competition, and showed a pattern similar as above regarding added extracts. *Maytenus* individuals were much smaller than *Lycium* individuals, and their responses to competition and soil extracts paralleled that of *Lycium*, growing largest when added with its own extracts, followed by plants added with *Lycium* extracts. When both extracts were added together, growth was again smallest. Similar patterns were recorded under inter- and intra-specific competition, which was stronger than inter-specific competition. These data show that SMC had a clear effect on plant-plant competition, plants growing better with extracts from their soil of origin and less when extracts were mixed. Our data evidence that SMC assembled by each plant species compete with other SMC when plants grow in close proximity, and that the microbial competition greatly influences plant-plant competition outcome, suggesting that microbial competition may be as important as plant-plant competition for the overall interaction outcome.

Physiological limits to rooting depth in trees

Laughlin Daniel (1)

(1) ?

HH3

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Deep roots provide access to consistent water during drought and deliver numerous benefits to human societies. Rooting depth has primarily been attributed to environmental factors such as aridity, soil properties, and water tables, but the intrinsic physiological mechanism that governs tree depth remains unresolved. Here I use theory and data to show that seedling root elongation rate is the primary predictor of maximum rooting depth in trees. This unrecognized biological limit on root system depth is intuitive, yet not obvious, for it differs markedly from aboveground growth. The ecological importance of tree rooting depth is matched only by the methodological challenge of quantifying it, but radicle inertia theory provides a straightforward approach for estimating the potential depths of the unseen plant, with immediate implications for carbon accounting and conservation strategies.

Explaining plant distribution and richness on four extinct volcanoes of Waikato, New Zealand

Bruce Clarkson ; Hannah Rogers

University of Waikato

LT5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Current ecological theory highlights the importance of habitat extent, isolation and past climates for understanding flora distributional patterns at a landscape scale. We investigated processes contributing to vascular plant distributions of four extinct volcanoes in the Waikato region, North Island, New Zealand. Specifically, we focused on the effect of elevation on fern and woody plant species richness, the environmental variables driving these relationships and the contribution of upland habitat to the subalpine flora of the mountains. Species observational data were collected by the authors and compiled with data from online repositories such as iNaturalist NZ. We analysed key environmental predictors of species distributions by extracting data from the New Zealand Environmental Data Stack (NZEnvDS) in a geographic information system (GIS). Using these data, we completed species distribution models of uncommon subalpine species in the Waikato region to illustrate differences in suitable habitat across the mountains. Previous research suggests that changes in vegetation with elevation are driven by temperature, precipitation and cloud cover, and speculated on differences in richness across the Waikato region. Early volcanic processes also influence species composition and richness, although geomorphology and erosional processes have a more significant effect on dormant or extinct volcanoes. Our study highlights how habitat extent, heterogeneity, connectivity, and isolation have a marked impact on the floristic patterns of the Waikato mountains.

Intra- and interspecific variation in understory leaf traits across seasons and years in forest ecosystems

Stefano Chelli [(1)]; Alessandro Bricca [(1)]; Jozsef Pal Frink [(2)]; Bogdan Plesca [(2)]; Stefan Leca [(2)]; Alexandru Zaharia [(2)]; Giandiego Campetella [(1)]; Luciano Ludovico Maria De Benedictis [(1)]; Marco Cervellini [(1)]; Roberto Canullo [(1)]

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IT6

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Functional ecology is often based on fixed species trait values, overlooking the role of intraspecific trait variability (ITV) across spatial and temporal dimensions. While ITV along spatial gradients is increasingly considered, temporal variation (inter- and intra-annual) remains neglected. Collecting species trait data multiple times across seasons and years can improve our understanding of how intra- and interspecific trait variation mediates plant responses to climate change. We measured specific leaf area (SLA) and leaf area (LA) during spring and summer from 2023 to 2025 in 15 plots of the ICP Forests Level II network in Italy and Romania, encompassing different biomes (alpine coniferous, temperate beech, temperate deciduous oak, and Mediterranean evergreen oak forests). In each plot, we selected the five most abundant understory species and collected leaves from five individuals per species. At community level, we investigated how the relative contribution of intra- and interspecific trait variation changes across years during summer, considering different biomes. Additionally, we assessed whether seasonal trait variation was consistent among biomes. The relative contribution of ITV to temporal trait variation was trait-, biome-, and year-dependent. ITV was highest for SLA in deciduous oak forests and for LA in Mediterranean evergreen oak forests. Seasonal variation in SLA was consistent across biomes, with higher values in spring. In contrast, LA showed biome-specific seasonal patterns, with higher summer values in coniferous forests and higher spring values in the other biomes. Overall, the summer season showed higher ITV compared to the spring season, regardless of the biome.

Climatic niche position explains compositional change in Doñana shrublands under increasing aridity

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DD4

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Mediterranean shrublands in Doñana National Park (southwestern Spain) are increasingly exposed to warming, aridification and drought, raising concerns about their long-term persistence. Using a 15-year dataset (2007-2022), we examined how shifts in the populations position in the species climatic niche influenced the dynamics of monte blanco shrubland, after a drought-induced canopy loss.

We quantified climatic niche position as the climatic distance between local climatic conditions and species-specific climatic niche centroids (climatic distance, hereafter). We then analyzed temporal trends in this climatic distance at both species and community levels and examined how these trends were associated with changes in shrub cover and community composition. We found that climatic conditions progressively shifted toward greater aridity, increasing climatic distance for all species, with varying between-species magnitude. Species initially best suited to local climatic conditions, such as *Halimium halimifolium*, experienced the largest increase in climatic distance and the strongest cover declines. In contrast, species showing smaller increase in climatic distance, such as *Rosmarinus officinalis*, increased in cover. Although total shrub cover increased over the study period, species dominance shifted, i.e., the formerly dominant *H. halimifolium* was gradually replaced by *R. officinalis*. This pattern reflected species-specific responses to climate explained by their position within climatic niche. Overall, our results indicate that Doñana shrublands are undergoing significant compositional change, shifting toward species better suited to emerging drier conditions. While overall cover recovered after the drought episode, these changes may have important consequences for ecosystem functioning and long-term persistence of Doñana shrublands under ongoing climatic change.

Tropical seed germination: a global meta-analysis

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SR5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

Seed germination is a critical demographic bottleneck and a key component of regeneration strategies, yet tropical germination evidence remains few and disgregated. We compiled a global database and quantitative synthesis of seed germination experiments spanning tropical and subtropical regions. Data extraction and harmonization were assisted by chatGPT-5.2 to pre-populate structured templates from articles (e.g., treatments, species, germination traits). All extracted records were subsequently checked by human reviewers, with targeted re-extraction in ambiguous cases. The dataset includes 212 peer-reviewed articles, ~11,000 germination records, and ~1,800 species across ~180 families. For each study we extracted germination outcomes and experimental cues, with a focus on temperature regimes, photoperiod/light conditions, and scarification treatments, together with species identity, geographic context, and growth form (tree, shrub, herb). We analyze these data using hierarchical meta-analytic models that account for non-independence among effect sizes within species, and integrate phylogenetic information to quantify evolutionary signal in germination responses. Our objectives are to (I) provide an openly structured, reusable dataset for tropical regeneration research, (II) describe the distribution of germination responses to major cues across lineages and growth forms, and (III) identify consistent predictors and sources of heterogeneity attributable to experimental design and taxonomic composition. By framing experimental cues as proxies of the "germination niche", this work supports comparative ecology, improves parameterization for recruitment models, and shed new light on the germination strategies of tropical species.

Transfer functions: reconstructing past climate and lake-water chemistry through recent aquatic and wetland vegetation

Anna Šolcová

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LT7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Quantitative reconstructions of past environmental changes are essential for understanding ecosystem resilience to abrupt climatic shifts. This presentation demonstrates the broad applicability of plant macrofossil-based transfer functions, utilizing newly developed calibration datasets of modern aquatic and wetland vegetation. The reconstructions presented here represent a significant methodological shift in the application of plant macrofossils for quantitative environmental reconstructions, targeting key drivers of aquatic and wetland ecosystem change: regional climate and local hydrochemistry. By applying this framework across geographically diverse sites, we provide insights into multiple environmental dimensions. Using a comprehensive pan-European calibration dataset, we reconstructed Lateglacial mean July temperature variations in the northern Pannonian Basin (Hanšpíle and Santovka-PB, Slovakia), revealing intense thermal maxima during the Bølling period (~14.7–14.1 kyr cal BP) with temperatures reaching ~20 °C—comparable to present-day levels—and rapid cooling during the Older Dryas (~14.1–13.9 kyr cal BP). Additionally, by utilizing a North-Central European calibration dataset, we demonstrate the reconstruction of past lake-water chemistry at the Linówek site (NE Poland), focusing on conductivity and alkalinity. The integration of these findings underscores that plant macrofossils are exceptionally sensitive proxy indicators. Looking forward, the potential of this approach is being further expanded through the integration of plant ancient sedaDNA—to supplement often species-poor plant macrofossil records—and the development of a new European plant macrofossil database. These advancements will allow for a more detailed reconstruction of the past environmental conditions that fundamentally shaped former aquatic and wetland European ecosystems.

The role of dominance, asynchrony, and averaging effect in stabilizing plant communities across a species loss gradient

Aleš Lisner [1]; Jules Segrestin [2]; Marie Konečná [3]; Petr Blažek [3]; Eva Janíková [3]; Markéta Applová [3]; Tereza Švancárová [3]; Jan Lepš [3]

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MS9

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

A growing number of studies have demonstrated that biodiversity positively predicts ecosystem temporal stability by affecting multiple mechanisms, namely dominance, asynchrony and averaging effects. However, no study has yet disentangled the relative contribution of these mechanisms in real-world biodiversity experiments. We created a species richness gradient by mimicking a loss of rare species and assessed the role of species richness on community stability and quantified the relative role of three stabilizing mechanisms - dominance (stabilization due to stable dominants compared to the rest of the species in the community), asynchrony (stabilization due to temporal asynchrony between species), and averaging effects (pure effect of diversity) on community stability across a species richness gradient.

Extreme species loss reduced community stability, yet just three species were sufficient to stabilize biomass production to levels comparable to highly diverse communities. Similar overall stability emerged from different combinations of mechanisms depending on diversity. Because rare species were more temporally variable, their loss stabilized the remaining populations. Species loss reduced dominance and averaging effects but increased asynchrony. As a result, asynchrony was the primary stabilizing force in species-poor communities, whereas averaging effect dominated in species-rich communities. Dominance played a minor role overall (5–15% of stabilization), while asynchrony and averaging together accounted for ~85–95%. This study highlights the importance of biodiversity and the contrasting roles of dominant and rare species in long-term stability, and for the first time disentangles the relative contributions of dominance, asynchrony and averaging in a real-world biodiversity experiment.

Effects of macro- and microclimate on dwarf-shrub litter decomposition across boreal and subarctic Norway

Kristine Birkeli [1]; Sonya Rita Geange [1]; Mika Helene Kirkhus [1]; Victoria Haaversen Møllerhaug [1]; Maria Steinli [1]; Inge Althuizen [2]; Vigdis Vandvik [1]

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CD5

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Dwarf-shrub-dominated ecosystems in alpine and arctic areas are key carbon sinks, while being highly sensitive to climate change. The warming is increasing the above-ground biomass and in turn the litter input, and, as a result, altering the internal nutrient cycle. This could weaken the ecosystem's previously slow and stable soil carbon storage. A better understanding of the decomposition process is therefore needed to improve predictions of carbon cycling under future climates. To address this knowledge gap, a litter transplant experiment was established across contrasting macro- and microclimates in Norway: Lygra (boreal, coastal), Sogndal (boreal, continental), Senja (subarctic, coastal), and Kautokeino (subarctic, continental). At each site, open and a forested heathland were included to assess microclimatic effects on decomposition. Leaf litter from four dominant dwarf-shrubs (*Calluna vulgaris*, *Empetrum nigrum*, *Vaccinium myrtillus*, and *Vaccinium vitis-idaea*) was transplanted horizontally, vertically, and within sites and habitats. Each of the species has different patterns of carbon allocation, ranging from small to broad-leaf structure, and conservative to more resource-acquisitive, all of which affect the decomposition. Our findings suggest both local adaptations and species-specific responses. In Kautokeino, *V. vitis-idaea* shows a clear "home advantage": forest-origin litter decomposes most rapidly in both local and transplanted forest habitats, whereas open-origin litter decomposes more slowly. These patterns likely reflect microclimate-driven trait differences, as litter from the more sun- and cold-exposed open habitat exhibit more conservative traits, such as thicker leaves, leading to a slower decomposition.

Are invasive plant species a real problem to nature conservation in Denmark?

Camilla Tvede Colding-Jørgensen

Copenhagen University

AE12

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: Human-disturbed habitats, invasions, and novel communities

Invasive species are often highlighted as a key driver of biodiversity loss. Simultaneously, dominant native plants are frequently classified as "problem species" and subjected to similar management measures as invasive species. However, for both invasive and native problem species, it is rarely established whether they are true drivers of biodiversity loss or instead symptoms of land-use change and suboptimal management. Using data from the Danish protected area surveillance program (42,365–51,280 sample plots collected between 2004 and 2022), we aimed to (1) assess current occupancy and recent trends of invasive plant species, (2) compare invasive species with problematic native species, and (3) evaluate spatial co-occurrence patterns between sensitive species and invasive, problematic native, and widespread native species. Invasive plant species showed surprisingly low incidence in protected areas: only seven of 32 species occurred in more than 0.2% of the surveyed plots, together accounting for 20% of all plots. Of these, only *Prunus serotina* exhibited a significant increasing trend, while *Pinus mugo* declined; overall, invasive species occupancy showed no significant temporal trend. In contrast, native problem species were widespread, occurring in 64% of plots, with three species (*Calamagrostis epigejos*, *Cytisus scoparius*, *Pteridium aquilinum*) showing increasing trends. Spatial associations between invasive species and sensitive species were not more negative than those of several problematic or widespread native species. The results suggest other drivers are more important for biodiversity conservation than invasive plant species. We therefore propose changing the focus in conservation management from eradication of species to restoration of natural ecosystem processes.

Plant community diversity, assembly, dynamics, and evolution in a forest cathedral

Guillaume DECOCQ

Jules Verne University of Picardie/CNRS

UR2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Urban plant communities

Wild plants have long been a source of inspiration for artists who have represented them in paintings and carvings since at least the Antiquity. Many religious buildings are adorned with plant sculptures, including ancient temples, Roman churches, medieval abbeys and cathedrals. Surprisingly, the Gothic architectural flora received little attention from vegetation scientists. Here I analyze the carved flora of the cathedral of Amiens, one of the biggest Gothic cathedral in the world, which has been built between 1220 and 1269, with some additions at the 14th and 16th centuries, and restorations at the 19th and 20-21st centuries. I answer the following research questions: (1) Which plant species have been "grown" among the stone carvings of the cathedral and how did they assemble? (2) Can we evidence a community succession over time? (3) What do variations in leaf traits teach us about speciation and diversification processes? Results reveal the high species richness (>100 species) of the carved flora, including common and rare species, whose distribution does not match any environmental gradient or habitat partitioning. Early-, mid- and late-successional plant communities involve different, with a recent trend towards invasion by few exotic species and a general degradation of plant communities, which is not counterbalanced by restoration operations. Leaf trait variations evidences that novel species emerged from evolutionary simplification and fractal construction, as well as from misinterpretation of trait convergence. I conclude that artificial plant communities deserve attention from vegetation scientists as they shed light on how biodiversity is perceived and represented.

Are oak woodlands endangered? A century of mesophication in old-growth forests of the Southern Appalachians (USA)

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CA4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Understanding the impacts of climate, invasive species, and changing disturbance regimes is paramount to predicting the state of future forests, but patchy survey data in space and time across wide environmental and land-use gradients has limited inferences about the drivers of change. We compared two large forest inventories of Great Smoky Mountains National Park (GSMNP) in the Southern Appalachian Mountains (USA) surveyed in the 1930s and the late 2010s. We used joint species distribution models to predict the occurrence of woody species across gradients of elevation and topographic exposure, accounting for canopy and understory layers, old-growth vs. secondary forest, and functional trait data. We found large compositional changes across all GSMNP forests since the 1930s. Low-elevation, exposed sites showed the largest extent of change in both old-growth and secondary forests, reflected in the understory loss of oaks, hickories, pines, and other xeric species. Mid- and high-elevation forests were the most compositionally stable for both canopy and subcanopy populations, particularly in mesic locations, which may indicate fewer large disturbances and greater climatic stability at higher elevations. Changes in mean community trait values support these interpretations, with decreases in bark thickness as one of the best predictors of species turnover and indicative of altered fire regimes as well as potential impacts of elevated CO_2. Our analysis suggests historically oak-dominated, low-elevation communities are the most susceptible to anticipated climate change in Eastern North America, particularly given their recent shift toward mesophilic species that are at highest risk of drought- and fire-induced mortality.

Seed mix diversity and planting season influence restored grassland plant communities, with effects persisting for more than a decade

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VR5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration: Recovering plant communities with native seeds

Understanding how restoration approaches can modify community assembly can help to achieve restoration goals related to species composition. During seed-based restoration, important considerations are the size of the seeded species pool and the timing of the seeding (autumn vs. spring). We investigated the effects of seeded species pool size and seeding season over 11 years on target species richness, species composition, and functional traits. We conducted an experiment in tall-grass prairies at three sites in Michigan with 60 plots each from 2014 to 2025 at one site and 2014 to 2019 at two further sites. We tested four forb pool sizes of (6, 12, 18, and 33). We observed a positive effect of the pool size when plots were seeded in autumn. However, there was no effect of species pool size when plots were seeded in spring, except for the largest pool which reached similar values to the autumn seeding with 33 forb species. The patterns were similar over eleven years for one site, while another site showed the opposite effect in the first five years. Species composition differed between autumn and spring seeding even after eleven years including functional trait differences, e.g., in seed mass. We conclude that timing of seeding has a long-lasting effect, while the variation among sites can be considerable. Moreover, a large pool is beneficial for establishment even though the efficiency declines with pool size. A large pool can counterbalance negative effects of seeding in unfavorable seeding time.

Uprooting the understory: intraspecific and interspecific variation in xylem vessel diameter of herbaceous plants in beech understory communities

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HH6

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Water transport links the aboveground and belowground dimensions of plants, with xylem traits —in particular vessel diameter (VD)— being linked to photosynthetic performance, growth rate, and tolerance to drought and frost, with major implications for plant growth, survival, and species distribution. Research on this functional trait has mostly focused on woody species, despite herbaceous species also displaying a wide diversity of xylem anatomical features. Furthermore, most studies focused on either interspecific variation or intraspecific variation across environmental gradients, rarely considering both at the same time, and to our knowledge, rarely, if ever, had understory communities as their subject matter. The aim of this study is to fill these gaps, learning more about the xylem anatomy of forest understory herbaceous species, considering both intraspecific and interspecific variation in understory communities and relating them to differences in ecological strategies and forest management: over 100 individuals (totaling 15 species) were collected from 16 beech forest sites in central Italy, and for each individual 120 xylem vessels were measured from the root collar region. Our results show that: 1) There were significant differences in VD between the communities of differently-managed sites, due mainly to species composition rather than intraspecific differences. 2) Interspecific differences account for most of the observed variation in VD, but intraspecific differences are still notable, especially in certain species. 3) Ecological strategy appears to affect VD, with ruderal and generalist species tending to have larger values (associated with rapid growth strategies) compared to forest specialists.

Between trunks and canopies: the hidden diversity of epiphytic bryophytes in a Peruvian montane forest

Angela Melgar Vilchez

Universidad Nacional Agraria La Molina

TE4

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Epiphytic bryophytes are essential components of tropical forests, where they play an important role in biodiversity and ecosystem functioning, closely linked to their vertical distribution, which depends on both abiotic and biotic factors. In Peru, ecological information on epiphytic bryophytes remains limited; therefore, this study aimed to describe the diversity and vertical distribution of epiphytic bryophytes along the height gradient of phorophytes in a montane humid forest. The study was conducted in Oxapampa, Pasco, Peru. Ten canopy phorophytes were selected following the criteria and methodology proposed by Gradstein et al. (2003). Around each selected tree, a 100 m² plot was delineated to sample understory bryophytes associated with the phorophyte. Canopy trees were stratified according to Johansson's zones (1974). A total of ten canopy phorophytes and 198 understory trees were sampled, recording 122 species of epiphytic bryophytes, including 73 liverworts, 48 mosses, and one hornwort. Lejeunaceae and Plagiochilaceae were the dominant families. Species exclusive to the understory were twice as numerous as those exclusive to the canopy. Liverworts showed a relatively homogeneous distribution of species richness between canopy and understory, whereas mosses were more diverse in the understory. The highest diversity was recorded in the inner canopy and the lowest in the outer canopy. Species composition along the vertical gradient was generally similar, although high dissimilarity was observed between the outer canopy and other zones. These results highlight the importance of vertical forest structure in shaping the diversity and distribution of epiphytic bryophytes in montane rainforests.

Impacts of center-pivot irrigation on flora and plant communities in the El Oued region, northern Sahara algerian

Abdelkrim Hacene

National High School of Agronomy

DD3

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

The El Oued region is located approximately 600 kilometers south of the capital, Algiers. The plant communities that structure the hamadas are dominated by the *Calligono-Aristidetea pungentis* Quézel 1965, Géhu et al., 1994, found on the dune masses of the Grand Erg Oriental. Numerous associations are found within this class, notably with the remarkable shrubs of *Ephedra alata* subsp. *alenda* and, in many places, *Traganum nudatum*. The halophytic zones are defined by the *Sarcocornietea* class R. Tx and Oberdofer 1958. They surround the chotts, particularly Melghir, and the vast salt and gypsophila expanses. The dominant taxa in this community are the *Limoniastrum guyonianum* and various *Salsola* species. These communities, dedicated to camel feeding, have been affected by the new agricultural practices. Due to their abandonment or sometimes due to speculation, the adventitious groups of row crops described as *Stellarietea mediae* Tüxen, Lohmeyer and Preissing in Tüxen 1958 take place. This practice causes the disruption of formerly stabilized sand dunes in order to level the terrain and establish arable land for cultivation, employing farming techniques adopted by local farmers for various crops such as potatoes, barley, and vegetable produce. These various actions result in significant changes in plant communities, causing long-established vegetation assemblages to disappear and relocate to newly formed dune ridges. This study examines phytocenotic changes before and after human intervention across all dune systems in the region.

Plant invasions in grasslands of Switzerland: invaders, spatial patterns and effects on biodiversity

Jürgen Dengler [(1)]; Pascal Reutimann [(1)]; Katharina Genucchi [(1)]; Rahel Araujo dos Santos [(1)]; Regula Billeter [(1)]; Klaus Ecker [(2)]; Hallie Seiler [(2)]; Manuel Babbi [(1)]; Serge Buholzer [(3)]; Eva Knop [(4)]; Eliane Meyer [(3)]; Stefan Widmer [(1)]; Thomas Wohlgemuth [(2)]; Steffen Boch [(2)]

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AE8

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: Human-disturbed habitats, invasions, and novel communities

Neophytes are perceived as a major threat to biodiversity, but the evidence for this assumption is rather mixed. We thus asked for the grasslands of Switzerland: (1) How frequent and dominant are neophytes? (2) Which effect do neophytes have on plot-scale vascular plant species richness? We extracted 8,108 10-m2 vegetation plots from the three biodiversity monitoring programs of Switzerland and used a subset with sampling weights to calculate the area-representative average frequency, richness and relative cover of neophytes. We then created GLMMs to explain plot-scale species richness by main ecological niche dimensions (represented by mean indicator values) and the presence of the 21 neophyte species with at least five occurrences in the full dataset. We found a total of 42 neophytes in the representative dataset, with *Lolium multiflorum* (20.9%) being most frequent. Richness and cover of neophyte species strongly decreased with elevation. Plot-scale plant diversity was significantly negatively related to six neophytes (*L. multiflorum*, *Medicago sativa*, *Bromus inermis*, *Impatiens glandulifera*, *Onobrychis viciifolia*, *Artemisia verlotiorum*) and positively to five (*Veronica persica*, *V. filiformis*, *Erigeron annuus*, *Conyza canadensis* aggr., *Solidago gigantea*). These findings only partly match with the national rating of neophytes as problematic to biodiversity ("invasive alien species") or non-problematic. We thus used local invasion gradients to test the effect of the cover of *Lolium multiflorum* and *Erigeron annuus* on native plant diversity and again found a negative impact of the first and none of the latter species. Generally, the assessment of neophytes would benefit from more evidence-based approaches.

Subindividual Diversity as a Source of Non-Genetic Functional Diversification

Mar Sobral

University of Santiago de Compostela

IT1

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Subindividual variation is increasingly recognized as an important but often overlooked source of biological diversity, reflecting the capacity of different organs or tissues within the same organism to develop distinct traits. In plants, environmental stress can trigger epigenetic and functional mosaics within a single individual, causing different organs to develop distinct phenotypic states despite sharing the same genetic background. This process increases subindividual diversity, meaning that variation emerges not only among individuals, but also among tissues and organs within the same organism. Here, we tested whether these stress-induced subindividual mosaics can persist across generations and whether they have functional consequences for plant performance. Using a unique >25-year drought experiment spanning two generations in *Quercus ilex*, we show that chronic water stress promotes the transgenerational maintenance of subindividual diversity through stable epigenetic and functional differentiation among organs within individuals. Our results demonstrate that developmental plasticity expressed at the organ level can persist across generations, creating enduring patterns of subindividual diversity that act as a novel source of non-genetic functional diversification, linking stress memory with plant performance and potentially enhancing resilience under long-term environmental change.

How well do mean ecological indicator values predict soil variables? A comparative assessment with large datasets

Van Meerbeek Koenraad [1]; Gillet François [2]; Dengler Jürgen [3]; Data contributors NA [4]

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VD6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

The Ecological Indicator Values for Europe (EIVE 1.5) database represents a groundbreaking effort, integrating 56 regional systems into a continental framework. It is, however, not yet known how well the new EIVE system captures environmental conditions across its application area and if regions exist where the EIVE system might perform less optimally. Utilizing five large vegetation datasets from Great Britain, Sweden, France, the Netherlands, and whole Europe that include field measurements of environmental variables, we subjected EIVE 1.5 to a European-wide validation, which entails a comparison of directly measured soil variables with the community-weighted mean indicator values. The key indicator variables considered were soil moisture, nutrients, and reaction. The accuracy of EIVE predictions was compared with a selection of regional indicator systems, specifically developed for the regions of the datasets. The analysis additionally explored the performance of several weighting approaches to calculate the mean indicator values (community-weighted means): unweighted, weighted by species cover, inverse niche width or EIVE coverage. The results of this study will guide future refinements and applications of ecological indicator systems.

What goes up may not come down: Wind Dispersal in Epiphytes

Marie Hoensbroech [(1)], *Juliano Sarmento Cabral* [(2)], *Gerhard Zotz* [(1)]

[(1)] *University of Oldenburg,* [(2)] *University of Bonn*

SR1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

True epiphytes—non-parasitic plants structurally dependent on host trees throughout their lives—occur along the entire forest height gradient, from trunk bases to the outermost crowns, and many are wind-dispersed. Their diaspores must escape the "inhospitable ground" (Benzing 1990), making vertical air movements central to dispersal success. Yet epiphyte dispersal remains understudied, and forest wind-dispersal research has largely focused on canopies, overlooking thousands of epiphytic species beneath the crowns. There, steep microclimatic gradients are widely invoked to explain vertical stratification—the role of dispersal remains unquantified.

We measured vertical air movements along tree vertical profiles in a Panamanian tropical rainforest and used these data to drive the first mechanistic dispersal model applied specifically to epiphytes (*EpiDisp*), simulating diaspore trajectories and fates across terminal velocities (V_{term}=0.01–1 ms^{-1}) and release heights spanning the full forest profile.

Model results reveal a strong dispersal bottleneck: only ~15% of diaspores settled on bark (successful dispersal), and of those, ~10% dispersed >5 m vertically and >15 m horizontally. Under specific conditions—lower V_{term}, higher release height, and daytime—success rose to ~19%, maximum distances to ~30 m vertically and ~125 m horizontally, and long-distance dispersal probability from <0.5% to ~8%. Importantly, because epiphytes produce vast numbers of diaspores, they are not necessarily dispersal-limited, as often assumed: even small probabilities can translate into substantial absolute numbers of diaspores colonising other forest strata or distant trees. This shows that dispersal can contribute to—yet cannot alone explain—vertically stratified epiphyte distributions.

Unveiling the Pattern of Iran's Endemic Plants Diversity across Geographical and Environmental Space

Naqinezhad Alireza [1], Ramzi Soghra [2], Valavi Roozbeh [3], Jafari Naser [2], Antonelli Alexandre [4], Naimi Babak [5], Svenning Jens-Christian [6]

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LT11

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Southwest Asia remains one of the least explored regions in global biodiversity research, despite its long evolutionary history and high levels of plant endemism. In this study, we applied a multi-species deep learning framework to investigate how climate change may reshape the distribution of Iran's endemic flora. By training a neural network to capture complex, non-linear relationships between plant occurrences and environmental conditions, we projected patterns of species richness of 1100 species in both geographical and environmental space. In geographical space, mountain systems currently function as cradles of diversity, supporting pronounced hotspots of endemic richness. However, projections into environmental space, defined by gradients of temperature, precipitation, soil nitrogen, and topographic heterogeneity, reveal climate as the primary driver of richness patterns, outweighing the buffering role of complex topography. Under future climate scenarios, we project a substantial decline in endemic plant richness across Iran, with the strongest losses concentrated in present-day richness peaks of the northern Zagros and parts of the Alborz Mountains. Responses to climate change diverged strongly among plant life forms. Drought- adapted annuals (therophytes) and xeric shrubs (phanerophytes) showed surprising resilience, while the specialized mountain-specialist geophytes and chamaephytes were pushed toward the brink. The results suggest that climate change will reduce the ability of topographic refugia to endemic plant diversity.

Global trends in alpine plant species composition under climate change

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CD12

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Accelerated climate change is increasingly affecting remote alpine ecosystems above the treeline, where warming is predicted to be disproportionately high. These shifts may facilitate the upslope expansion of species from lower elevations, exposing alpine specialists to unsuitable climates and increased competition. Although evidence of climate-driven change in alpine systems is growing, global patterns in alpine plant community composition remain poorly understood. This project leverages the GLORIA (Global Observation Research Initiative in Alpine Environments) long-term monitoring network to quantify trends in alpine vegetation under climate change. We hypothesize that alpine communities are shifting toward more warmth-demanding and widely distributed species, while cold-adapted and endemic species decline, leading to biotic homogenization across regions. We further expect the magnitude of compositional change to be modulated by regional climate velocity, topography, and the size, isolation, and biogeographical history of alpine areas. We will compile and harmonize the standardized GLORIA vegetation data from over 100 regions distributed across the main mountain ranges and ecozones worldwide. We will derive community metrics capturing temperature affinity, range size and beta-diversity, and relate temporal changes in species composition to climatic trajectories using mixed-effects models. By disentangling global trends in alpine vegetation change and their drivers, this work will provide novel, synthetic insights into the ecological consequences of rapid warming in alpine ecosystems.

The Big Replacement: invasive species take over functional and phylogenetic space of native grasslands in Brazil

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AE7

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Tracking invasion in natural remnants is essential to detect changes in the phylogenetic and functional structure of native communities in southern Brazilian grasslands. We assessed whether invasive alien species occupy phylogenetic and functional space already filled by native species or introduce novel lineages and trait combinations into invaded communities. We analyzed plant communities from 284 sites across three grassland regions, recording the cover of native and alien species. We evaluated how invasive cover affects (I) overall community phylogenetic and functional diversity (PD and FD), (II) PD and FD of native species, and (III) the phylogenetic and functional distance between invaders and native communities. We recorded 1087 species, of which nine were invasive. Increasing invasion generally changed species richness and functional structure, although responses varied among regions, with consistent changes in composition of native communities. While overall PD remained stable when considering all species, PD of native communities increased with invasion, indicating that invaders preferentially replace phylogenetically redundant native species, leaving a flora composed of more evolutionarily distinct lineages. FD responses varied among regions, suggesting loss of functionally unique species and increasing functional redundancy in invaded communities. Additionally, phylogenetic and functional distances between invasive species and native communities decreased along the invasion gradient, indicating ecological filtering. Overall, invasive species occupy a subset of the phylogenetic and functional space already used by native species, promoting biotic homogenization rather than ecological novelty. This pattern suggests that invasions may undermine functional complementarity and reduce ecosystem resilience, potentially compromising key ecosystem processes in subtropical grasslands.

WorldVegChecklist – towards a global checklist and revision of vegetation classes

Denys Vynokurov [1]; Jorge Capelo [2]; John T. Hunter [3]; Corrado Marcenò [4]; Aaron Wells [5]; Wolfgang Willner [6]

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BC1

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

Vegetation classification plays a fundamental role in ecological research by structuring continuous vegetation into ecologically meaningful units. Despite many advances, global-scale consistency remains a challenge: similar ecological units are often described under different names in different regions, leading to syntaxonomic inflation and limiting cross-regional comparisons. A standardized global reference list of vegetation units is therefore needed to support comparability, reduce redundant descriptions, and provide a stable backbone for future classification work. The Vegetation Classification Working Group (VCWG) of the International Association for Vegetation Science (vcwg.org) has launched WorldVegChecklist as a coordinated initiative to inventory and critically revise all described phytosociological vegetation classes worldwide. Building on the experience of the EuroVegChecklist, the project is implemented in collaboration with regional experts and follows a standardized data-entry workflow. To date, 121 vegetation classes have been entered into the checklist, with varying levels of completeness. For each class, WorldVegChecklist compiles standardized geographic and ecological information (e.g., continent/region, broad vegetation type, biogeographic region, biome, altitudinal belt, distribution, and a concise ecological-physiognomic description). It also records key nomenclatural details, including validity, protologue, type, and diagnostic species as specified in the original diagnosis. Beyond cataloguing and revision, a central goal is to align each phytosociological class with corresponding units in the EcoVeg approach (formation class, formation subclass, formation, and division). This crosswalk is intended to improve interoperability among major vegetation-classification frameworks and facilitate integration with global biodiversity and conservation assessments.

Long-term dynamics of epiphyte communities

Gerhard Zotz

Carl von Ossietzky Universität Oldenburg

TE2

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Tropical tree communities have been monitored directly for decades in a number of permanent plots, producing important insights into patterns and processes of vegetation dynamics in these hyperdiverse systems. Information on the long-term dynamics of other lifeforms is much more scarce. Here, I discuss our current understanding of community dynamics of vascular epiphytes, which make up about 10 % of global plant diversity. My presentation relies on theoretical models and on the results of three long-term projects in Panama, which run now for up to 30 years. Theory predicts that the dynamics on individual trees is characterized by constant increase of species numbers and abundance, reflecting the increase in tree size, microhabitat complexity and the factor time. This increase can also be observed in situ. At the plot level, however, one would expect a steady state is reached, but the temporal scale of this dynamic is at the order of decades or centuries. The unique system of epiphytes in the tree *Annona glabra*, established with the building of the Panama Canal and thus existing for100 years, shows a more or less linear increase in occupancy and abundance. Currently, the system is still not saturated. Here, but also at a forest site at the Caribbean coast, there is no indication of species replacement, early colonizers are not replaced over time. As a final point: a more realistic view of the dynamics in undisturbed systems has also important consequences for the interpretation of studies that focus at restoration.

Partitioning functional diversity using trait probability densities

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IT7

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Trait probability densities (TPD) allow estimating the functional diversity of an assemblage while accounting for the intraspecific trait variability. However, partitioning functional diversity across nested scales currently requires collapsing TPD into binary representations (e.g., functional richness), losing the probabilistic information they contain. Here, we extend the TPD framework to estimate functional diversity in terms of equivalent numbers: the number of equally abundant and functionally non-overlapping species in an assemblage. The method weights species' TPDs by the relative abundance of the dominant species, and integrates the maximum function across species, yielding a value between 1 (complete overlap) and the number of species (no overlap, equal abundances). A key advantage of equivalent numbers is that they allow partitioning functional diversity across nested scales, including taxonomic, spatial, or temporal. To illustrate this approach, we present a case study using a dataset of 40 plots in a Mediterranean grassland containing individual-level data for plant height and specific leaf area. For each plot, we partitioned functional diversity into intraspecific and interspecific components. We compared partitioning results using traits individually versus the two-dimensional trait space to evaluate how dimensionality affects diversity estimates. The partition using the two-dimensional trait space indicates higher importance of the interspecific component compared to the partition using traits individually, reflecting that species differences are more noticeable as more trait dimensions are used. This novel approach, that aims at partitioning trait spaces while accounting for the probabilistic information contained within TPDs, opens an avenue to understand how functional diversity is organized across scales.

What do we really learn from resurveying vegetation plots, and how could we do better?

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VD4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

Vegetation plot resurveys offer significant potential for tracking changes in vegetation community composition, structure, and even ecological functioning over time. Compiled databases of resurveys enable analyses of change at large spatial and temporal scales, but inconsistencies (e.g. in nomenclature, survey protocols) within and between the datasets they contain reduce analytic insight and utility. We set out to identify data problems— at the plot, survey, dataset, and/or database levels—for users of vegetation databases, where they arise, and how to mitigate them. This work follows a mixed-methods, Science and Technology Studies (STS) approach to examine the practices of vegetation plot data collection and analysis, with a focus on plot resurveys. Here, we present selected results from four lines of inquiry: 1) an online survey that asked data contributors to the vegetation resurvey database ReSurveyEurope (https://euroveg.org/resurvey/) about their studies' methodology and context; 2) walking interviews and participant observation with scientists conducting vegetation plot resurveys; 3) desk interviews with researchers who analyse quantitative data from ReSurveyEurope and other vegetation databases; and 4) field interviews with land managers responsible for conserving and/or shaping vegetation patterns. Data collection and analyses will continue through mid-2026. Broadly, preliminary analyses reveal that methodological discrepancies between survey rounds in a resurvey study can significantly reduce data quality. Relocation error—where a plot's spatial location varies between survey rounds—is one common problem. Utility of vegetation databases could be improved by incorporating standardized metadata as multiple quantitative or categorical fields, increasing transparency and allowing rapid filtering.

IT-V net: the ITalian Intraspecific Trait Variability network

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IT5

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Plants, as sessile organisms, experience environmental variation across spatial and temporal scales, producing phenotypic differences among and within populations (intraspecific trait variability, ITV). At the global scale, ITV can contribute up to 31% of total plant trait variation within communities, depending on the trait–habitat combination. Yet, particularly at local to regional extents where ITV may be most influential, we still lack consistent, plot-level datasets that quantify the magnitude and structure of ITV across many ecosystems. We present ITV-net (ITalian Intraspecific Trait Variability Network), launched in 2021 as a national collaborative platform that harmonises georeferenced vegetation plots with field-measured, individual-level plant traits. By coupling replicated trait measurements with community context (relative abundances of co-occurring species) and plot descriptors, ITV-net enables analyses of within-species trait distributions in real assemblages rather than relying on species-mean values. The first data call compiled >8,000 individual measurements for two key leaf traits (Leaf Area and Specific Leaf Area) covering >700 species across 1,043 plots distributed throughout Italy. We describe the network's rationale, sampling principles, data-standardisation workflow and first results. Finally, we outline next steps to broaden trait coverage and expand participation beyond Italy, positioning ITV-net as a transferable framework for coordinated ITV research. In the context of accelerating global change, such coordinated, plot-level ITV data are essential for understanding and forecasting communities' functional responses in situ.

Reconciling diversity–productivity relationships in natural grasslands

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EO7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

The relationship between plant diversity and primary productivity is one of the most intensively studied topics in ecology, yet results from natural grasslands remain inconsistent. While biodiversity experiments typically report positive diversity–productivity relationships, observational studies along natural diversity gradients often yield neutral or even negative trends. One explanation is that natural diversity gradients are often associated with strong species turnover, modifying the identity and functional traits of dominant species. This makes it difficult to isolate the pure effect of diversity. Here, we revisit the diversity–productivity relationship in natural grasslands by focusing on a diversity gradient within a given species pool. We aim to test whether grassland productivity increases with community completeness, defined as the proportion of the potential species pool realized in a local community. By assessing diversity–productivity relationships across spatial scales, our study also addresses an important knowledge gap concerning the scale-dependency of biodiversity–ecosystem functioning relationships. Vegetation composition was sampled in more than 30 grasslands within a single region, and productivity was quantified using remotely sensed vegetation indices, combining high-resolution Sentinel-2 NDVI with complementary drone-based data collected at finer spatial scales. Across sites, NDVI increased significantly with the species diversity, revealing the key role of species abundance distribution in determining grassland productivity. Importantly, this positive relationship contrasts with the neutral or negative patterns commonly reported from observational studies.

Community visualisation from vegetation plots: Algorithmic reconstruction of vegetation profiles

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VD2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

Vegetation plots provide detailed information on species composition and cover, yet they remain primarily textual and lack an explicit representation of spatial structure and the visual appearance of plant communities. This study presents an approach to the visual algorithmic reconstruction of vegetation profiles derived directly from standard phytosociological data. The aim is to enable reproducible generation of vegetation profiles and their practical use for visualising and comparing plant community structure. The method combines species lists, estimates of cover, and plant height with a library of standardized two-dimensional plant silhouettes. Individual plants are generated with controlled random variation in size, orientation, and horizontal position, while a heuristic placement algorithm limits excessive clustering. The resulting visualisation is a vegetation plot profile that includes key quantitative properties, enabling intuitive interpretation. The presentation demonstrates the workflow of vegetation profile construction and illustrates its application to visual comparison of vegetation records, rapid inspection of community structure, and didactic purposes. Although the profiles simplify real three-dimensional vegetation and rely on idealized plant forms, they provide a transparent and repeatable link between numerical vegetation data and visual representation. Algorithmically reconstructed vegetation profiles represent a complementary approach to traditional vegetation analysis by providing a reproducible, informative visual link between standard vegetation plot data and plant community structure. The method, software tools (JUICE.NET, R scripts), and example data are openly available at https://www.sci.muni.cz/botany/juice/NET/community-visualisation.htm.

Between Humboldt and the Third International Botanical Congress: plant lists and altitudinal belts as tentative approaches to the study of vegetation types in the 19th century

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BC4

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

Alexander von Humboldt (1769-1859) is recognized as the first to address vegetation as a scientific subject. Nonetheless, a precise definition of plant association was only proposed by Flahault and Schröter in 1910, during the Third International Botanical Congress. Thence, several schools evolved in Europe, structuring the study of vegetation units, their patterns of physiognomy, species composition, distribution, habitat, etc. The prevailing view is that, during the 19th century, the focus of plant science was on taxonomy and plant anatomy, developmental morphology and evolution; the study of plant communities and their distribution was restricted to the work of a few authors, e.g. Schouw (1823), Grisebach (1838), von Post (1851) and Flahault (1900), lacking a unifying conceptual framework. We argue that the attempt to conceptualise vegetation units played a more important role in the work of botanists in the 19th century than is usually recognised; that lists of plants, generally thought of as mere catalogues used by taxonomists to document plant biodiversity of an area, were also an essential working tool for those who, following Humboldt's approach, sought to identify and describe plant communities. Plant lists were commonly compiled, re-copied and subsequently added, published as commented lists. In this process, plants were gradually sorted according to environmental gradients and arranged in distinct aggregates, corresponding to topographical or environmental compartments. Namely, following Humboldt's work, altitudinal belts were used to structure the delineation of vegetation types. We support our argument with examples from the islands of the Macaronesian archipelagos—Madeira, Azores, and the Canaries.

An urgent call for better practices in phylogeny-derived trait-based biogeography and macroecology

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PB6

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Trait-based biogeography and macroecology increasingly rely on phylogenetic imputation to address pervasive gaps in trait databases. While phylogeny-based estimation can be a valuable tool for exploiting incomplete datasets, it is often used as a substitute for empirical measurements, creating an illusion of completeness that obscures substantial uncertainty. Recent large-scale trait compilations reveal a growing tendency to publish single-value phylogenetic estimates without explicit evaluation of their accuracy or lineage-specific reliability. Here, we show that for many plant functional traits—particularly those with weak phylogenetic signal and sparse empirical coverage—phylogenetically estimated values perform no better than trivial baselines such as the mean of observed values. Even when phylogenetic signal is stronger, improvements in accuracy are frequently modest and highly heterogeneous across the phylogeny. Uncritical use of such estimates can bias trait–environment relationships, distort inferred patterns, and misinform conservation planning. We argue that trait-based biogeography and macroecology must move beyond single-value imputation and adopt more rigorous and transparent practices. To this end, we present a practical framework for the responsible use of multiple phylogenetic imputation, designed to explicitly quantify uncertainty and propagate it into downstream analyses. Our framework integrates lineage-specific assessments of imputation accuracy, the identification of phylogenetic ignorance zones to guide targeted empirical sampling, and probabilistic imputation workflows that generate distributions of plausible trait values rather than point estimates. By providing clear guidelines for when and how phylogenetic information can be used reliably, this framework enables robust inference while avoiding the illusion of completeness that undermines many current trait-based studies.

The relative effects of climate and human activities on grassland beta diversity have changed over the past four decades in Europe

Manuele Bazzichetto [1]; Marta Carboni [2]; Gabriel Roberto Ortega Solis [3]; Michael Glaser [4]; Marta Gaia Sperandii [5]; Stephan Kambach [6]; Gabriele Midolo [3]; Riccardo Testolin [1]; MOTIVATE consortium [7]; Francesco Maria Sabatini [1]

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VD5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

Changing land use and climate are profoundly impacting vegetation patterns across regions and scales. However, whether the relative importance of these factors has changed over time remains unclear. We investigated this by quantifying changes in the importance of climate and human activities in explaining grassland beta-diversity patterns across Europe over the last four decades.

We focused on 13 European ecoregions, spanning wide latitudinal, longitudinal and ecological gradients, and on two time periods: 1980-1999 and 2000-2022. We compiled vegetation data from the European Vegetation Archive and collated information on climate (temperature and precipitation), anthropogenic pressure (quantified using the Human Modification framework), and topography for more than 100,000 vegetation plots. Using statistical matching, we ensured that data from the two periods were comparable in terms of topography. We then applied Generalized Dissimilarity Models, separately for each ecoregion and time period, to estimate the relative importance of climate and human activities on beta-diversity patterns and to compare their effects between the two periods. We found that the importance of human activities has increased across most ecoregions, especially in the Alps and Cantabrian mixed forests. The relative importance of temperature and precipitation showed more nuanced changes. In some ecoregions, such as Baltic mixed forests and Celtic broadleaf forests, temperature has overtaken precipitation as the dominant climatic driver of beta diversity. Although preliminary, our results indicate that the relative importance of the drivers of grassland beta diversity shifted between the two periods, highlighting the need for studies on long-term vegetation dynamics to account for this.

The role of soil microbial communities on plant-plant interactions

Gaia Micco; Francisco Ignacio Pugnaire de Iraola

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PC6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

The role of soil microbial communities on plant–plant interactions is increasingly recognized as a main driver of plant community dynamics. Plant–soil feedbacks (PSFs) provide a useful framework for addressing interactions among plants, soil, and microbiota; however, the mechanisms underlying PSFs and their link to plant interactions remain poorly understood, particularly in Mediterranean forest ecosystems. We tested how soil microbial communities, extracted from different soils, and neighbour species identity influenced plant interactions and modulated functional traits in *Quercus ilex* and *Pinus halepensis* seedlings growing in inter- and intra-specific competition. We also quantified PSFs and assessed whether microbial effects depended on neighbour identity. Although there were no differences in plant biomass, we found significant changes in seedling specific root length (SRL) in response to microbial communities from different provenances. Oak seedlings had higher SRL when growing with oak soil extracts, whereas pine seedlings showed opposite responses, particularly when growing in interspecific competition and added with pine soil extracts. Overall, both tree species experienced neutral to negative PSFs, particularly when in interspecific competition. Our results show that changes in fine-root traits are a main response of plants to competition between soil microbial communities, and have implications for species coexistence and successional dynamics in Mediterranean mixed forests.

Alien plant invasions in the landscape: the role of structure and connectivity across spatial scales

Francesco Boscutti [1]; Francesco Liccari [2]; Maurizia Sigura [1]; Giovanni Bacaro [2]; Giacomo Trotta [3]

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AE4

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Human activities have profoundly reshaped terrestrial ecosystems, creating anthropogenic habitats where biological invasions structure novel plant communities and accelerate biodiversity loss. Invasions strongly interact with land-use change and landscape fragmentation. While landscape structure is widely recognized as a determinant of invasion dynamics, landscape connectivity remains comparatively underexplored. Understanding how invasive alien plants establish and spread across human-disturbed landscapes therefore requires integrating processes acting across multiple spatial scales. This study synthesizes evidence from vegetation-based analyses conducted in anthropogenic lowland landscapes of Friuli Venezia Giulia (north-eastern Italy), characterized by a mosaic of urban areas, agricultural systems, and natural and semi-natural habitats. Metrics describing landscape structure and ecological connectivity were used to evaluate their effects on alpha- and beta-diversity patterns of native and alien vascular plants, accounting for habitat-specific responses across scales. Alien plant invasions emerged from the interplay between local habitat conditions, disturbance regimes, and landscape properties. At fine scales, soil characteristics, resource availability, and biotic interactions shaped early invasion stages during community assembly following disturbance. At broader scales, landscape composition, configuration, and connectivity governed propagule pressure and invasion pathways, with urban and agricultural matrices acting as both sources and conduits for alien species spread. Peripheral and weakly connected patches supported higher native species richness and floristic uniqueness, functioning as refugia for native biodiversity. In contrast, central and highly connected patches favored alien species richness and biotic homogenization. These responses were habitat-dependent, with fragmentation effects particularly pronounced in wooded habitats. Effective invasion management requires landscape-level planning that reduces fragmentation and manages connectivity.

Multi-scale patterns of plant co-occurrence and functional diversity in the patchy Succulent Karoo vegetation

Pia Maria Eibes [1]; Julia Blumensaat [1]; Liesl Eichenberger [2]; David R. Kienle [3]; Katharina Meyer [4]; Ute Schmiedel [4]

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DD5

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Biotic interactions are key drivers of species composition and the spatial configuration of vegetation communities, particularly at local scales. They are especially important in arid, water-limited ecosystems, which host highly specialised plant species that often co-occur in discrete patches. Despite its status as a global dryland biodiversity hotspot, the role of biotic interactions and species co-occurrence in structuring vegetation of the Succulent Karoo has been addressed by relatively few studies, particularly from a functional trait perspective and across spatial scales. In this study, we investigated how species co-occurrence influences functional diversity at multiple spatial scales, ranging from individual patches to plots and the broader landscape. We analysed the vegetation in three regions of the Succulent Karoo (Knersvlakte, Little Karoo, Namaqualand) and compared patterns between zonal habitats and azonal habitats (quartz islands). Species co-occurrence was more frequent in zonal habitats, whereas patches in azonal habitats were more often composed of single species, a pattern that was consistent across spatial scales. When species co-occurred within patches, they showed a weak trend towards functional trait similarity in most cases. Our results indicate that the strength and expression of biotic interactions vary across spatial scales and habitat types. Considering scale-dependent co-occurrence patterns and functional complementarity may therefore be crucial for understanding community assembly and for guiding restoration and conservation efforts in drylands such as the Succulent Karoo.

Tales from the Czech forests: Who is responsible for the loss of vegetation diversity?

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LT9

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Temperate forests are the main natural biome in Europe. Their biodiversity has been shaped for a long time by human activity, particularly through regular management. A significant pool of biodiversity is linked to forest vegetation, which has gradually changed over past decades. We are now able to capture these changes effectively using long-term time series. Here we present the results of an analysis for the Czech forests based on 3,500 repeated vegetation relevés. Altitude ranging from 180 to 1,250 m serves as a proxy for the main variability in vegetation, environment, and management. Overall, species diversity declined both in terms of species richness and heterogeneity. However, endangered species have not decreased significantly, and invasive species have increased only marginally. So what or who is responsible for the decline in diversity? We attempted to reveal this by examining changes within three ecological groups: species associated with forest habitats, light-demanding species, and nitrophilous species. Forest species significantly increased across the entire range of altitudes, meaning that the vegetation gradually became more typical of a forest environment. Nevertheless, there has been a significant decline in light-demanding species, while nitrophilous species have increased. This has occurred dependent on altitude – both trends are pronounced in lowlands, while no change has occurred higher up. We interpret this as the influence of gradual succession towards denser, more fertile forests. There are certainly several interacting factors at play. However, the contrasts along the altitude are likely due to an asymmetric decline in the intensity of forest management.

Hidden reservoirs in harsh landscapes: tissue traits, not rainfall, shape water storage in African grassland forbs

Frances Siebert [1]; Derek Van der Merwe [1]; Morgan Kruger [2]; Joris Cromsigt [3]; Mariska te Beest [4]

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HH2

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

African grassland plants are exposed to frequent defoliation by large herbivores and fire, together with prolonged seasonal droughts lasting up to seven months. Persistence under these conditions depends strongly on plant functional traits, particularly those expressed belowground. In grassland forbs, underground storage organs (USOs) are key response traits enabling resprouting after disturbance and buffering seasonal water stress. Despite their presumed importance, the role of USOs in plant water storage remains poorly quantified in disturbance-prone grassland ecosystems.

We quantified water storage capacity in 94 forb species sampled across three grassland sites spanning an approximately 1 000 km precipitation gradient (450–800 mm yr^{-1}) in South Africa. Plants were excavated, separated into above- and belowground organs, and weighed fresh before oven-drying (~40 °C) to constant mass. Belowground organs were classified into two functional trait categories: herbaceous versus woody/lignified USOs. The difference between fresh and dry mass was used as a proxy for water storage capacity. Water storage capacity was not significantly influenced by organ position (above- vs belowground) or mean annual precipitation across sites. In contrast, USO tissue type had a significant effect: herbaceous USOs stored significantly more water than woody USOs. Our results identify lignification of belowground organs as a key functional trait constraining water storage capacity in grassland forbs, independent of aridity. These findings highlight the ecological importance of belowground tissue traits in shaping plant persistence under recurrent disturbance and seasonal drought in African grassland ecosystems.

The EVMac initiative: update and crosswalk of European Macaronesia vegetation with the EuroVegChecklist and the International Vegetation Classification

Jorge Capelo [1]; Eduardo Dias [2]; Alfredo Reyes Betancort [3]; Miguel Menezes de Sequeira [4]; Marcelino Del Arco Aguilar [5]; Arnoldo Santos Guerra [6]

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BC6

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

The syntaxonomy of the vegetation of Macaronesia, according to Braun-Blanquet principles, has been used for a long time in Macaronesia. Several propositions, either for the whole or part of archipelagos, are available. Moreover, some comprehensive syntheses exist at the national level (Portugal and Spain). Accounting for the European part of Macaronesia, i.e. the Azores, Madeira, Salvage and Canary Islands archipelagos, we now propose to i) set a single coherent and updated syntaxonomy following the original EuroVegChecklist and its updatesas backbone, complemented by new syntaxa and re-classification proposals; ii) set up a cross-walk of syntaxa, a the level of phytosociological alliance or higher, to the International Vegetation Classification (IVC/EcoVeg), at least, at the macrogroup level. For the latter, we rely on phytosociological characterisation and other alternative floristical-physiognomical-ecological systems locally available. We present some paradigmatic examples for the main Macaronesian endemic classes where novel syntaxonomical changes are greater (e.g. *Kleinio-Euphorbietea canariensis*, *Oleo-Rhamnetea crenulatae*, *Aeonio-Greenovietea*, *Pruno hixae-Lauretea novocanariensis*, *Lauro azoricae-Junipereteа brevifoliae*). The group EVMac will maintain the initiative, enlarging it to other experts, and actively propose changes to the European Vegetation Classification Committee (EVCC).

Intraspecific trait variability within and across generations: assessing its role in coexistence and stability

Francesco de Bello

CIDE-CSIC

IT2

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

To understand ecosystem responses to global change, we must unravel how biological diversity and ecosystem functioning vary through time. While ecologists have long debated mechanisms linking biodiversity to ecosystem stability, including resilience, most evidence focuses on species turnover, leaving stability effects within populations comparatively unexplored. Yet ecological mechanisms act first on individuals, scaling up to population dynamics, where they shape—and are shaped by—intraspecific trait variability (ITV). Crucially, ITV can arise from genetic differences, but also from non-genetic inheritance (e.g., epigenetic or parental effects) that alters phenotypes without changes in DNA sequence. Importantly, the relative contribution of genetic versus non-genetic heritable mechanisms to phenotypic variation and stability remains largely unknown. Regardless of its origin, increased ITV (i.e., functional diversity within species) is expected to promote stability via bet-hedging and insurance mechanisms, by providing a broader repertoire of strategies to cope with environmental fluctuations. However, empirical evidence remains scarce. Key challenges include disentangling genetic and non-genetic sources of ITV, testing whether non-genetic effects accumulate across generations, and determining their reversibility when environmental conditions shift—particularly under predictable versus unpredictable stress regimes. The presentation will synthesize examples from existing and ongoing studies, and outline experimental and analytical approaches to quantify how genetic and non-genetic inheritance jointly shape short- and long-term phenotypic variation, coexistence, and temporal stability.

Determinants of range size variation in temperate woody plants

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PB10

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Species range sizes vary widely, yet the determinants of this variation remain poorly understood. Candidates to explain this variation include biogeography, climate, occupancy of suitable habitats, and species' features that confer the ability to colonise or persist in a region; however, synergistic tests of their effects on range-size variation are scarce. We analysed the effects of multiple potential range size determinants in vascular plants using a Structural Equation Model that allows testing multiple hypotheses within a common analytical framework. Our model explained 69% of the variation in range size, with the proportion of occupied suitable habitat emerging as the strongest predictor, which, in turn, depends on temperature seasonality, species' dispersal ability, and abiotic stress tolerance. We also found a weak phylogenetic signal in range size; North American species have smaller ranges than European species, but there is no difference between angiosperms and gymnosperms. We demonstrated that range size variation can be explained by a few interacting drivers, significantly advancing the current understanding based on isolated hypotheses and paving the way for further predictive frameworks.

Predicting species richness change with model-based ordination

Bert van der Veen

University of Bayreuth

CA3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Two of the most commonly used methods in community ecology include univariate regression and multivariate analysis using classical ordination. However, neither approach is particularly well suited for studying change in diversity along ecological gradients. Univariate regression makes unrealistic assumptions of data from vegetation surveys, such as independence and homogeneity of species' niches, while ignoring species' identities. Classical ordination methods make similarly unrealistic assumptions, cannot accommodate hierarchical study designs appropriately, do not produce a reliable measure of statistical uncertainty, confound location and dispersion effects, and cannot predict. In this presentation, we highlight the shortcomings of species richness regression, while demonstrating model-based ordination as the alternative, much more appropriate tool using real data. In the last decade, such model-based ordination methods have been introduced, while they still see continuous development and improvement for community ecology. In short, model-based ordination methods greatly improve the ability of community ecologists to study how the diversity of vegetation changes along gradients, but have unfortunately seen limited uptake. Model-based ordination methods leverage conceptually from regression and classical ordination, but outshine both for the analysis of plant community data. Unlike univariate regression, model-based ordination includes species-specific responses to covariates, while avoiding unrealistic assumptions such as the independence of species. Unlike classical ordination methods, model-based ordination operates in a fully probabilistic framework for unconstrained, constrained ordination, or beyond, that does not rely on the use of distance measures at all. In summary, model-based ordination can serve to answer (almost) every question a community ecologist would ask.

Root outsourcing to micorrhizeae determines population temporal stability in grasslands

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MS4

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Understanding which plant belowground foraging strategies promote long-term population temporal stability is critical for understanding species coexistence in grassland ecosystems. Root trait variation is increasingly framed within a multidimensional root economics spectrum that contrasts do-it-yourself soil exploration via fine, acquisitive roots with outsourcing of resource acquisition to mycorrhizal symbionts. While these strategies are known to shape belowground resource use, their consequences for temporal population stability remain poorly understood. Here, we tested whether root strategies predict long-term population stability using 18 years ofannual vegetation data from 150 plots in three regions of temperate grasslands in Germany. Temporal stability was quantified as the coefficient of variation in species cover and related to a comprehensive set of belowground and aboveground functional traits measured for 82 species. Populations investing in outsourcing to micorrhizeae symbionts showed higher temporal stability, while populations with stronger do-it-yourself strategies exhibited lower temporal stability. At the trait level, collaboration-related anatomical traits, particularly cortex fraction, consistently promoted stability, while acquisitive fineroot traits were associated with higher variability. In contrast, aboveground leaf economic traits showed comparably little explanatory power. Our results demonstrate that root outsourcing to micorrhizal symbionts enhances long-term population stability in temperate grasslands' plants, identifying belowground collaboration as a key axis of temporal niche partitioning and offering new insight into mechanisms underpinning species coexistence and grassland ecosystem functioning.

Extending community stability metrics to account for directional changes in species abundance and composition

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MS5

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Identifying the mechanisms behind ecosystem stability is keystone for ensuring their long-term functioning. However, most stability and synchrony metrics are affected not only by annual species fluctuations, but also by long-term directional trends in their abundance and composition. These trends can lead to biased estimates of community (anti)synchrony and stability, as species that increase (or decrease) their abundance simultaneously over time will show spurious correlations, even if they fluctuate discordantly from year to year. Thus, ignoring directional changes in species abundance and composition may limit our understanding of potential ecological mechanisms behind synchrony between species and thus community stability. Here we present the detrendr R package, a suite of tools intended to estimate community stability with the possibility of taking into account trends in the abundance and composition of species in the community. It offers an integral approach to community stability analysis, including classic metrics of synchrony and stability as well as more recent approaches capable of disentangling the effects of dominance, species diversity and synchrony on the stability of communities. The package also includes multivariate analogues of stability metrics to assess changes in community composition, along with tools for trend detection and manipulating and simulating data. To demonstrate the capabilities of detrendr, we analyze 12 years of data from alpine snowbed plant communities across a snowmelt gradient in the Pyrenees. This package addresses an important source of bias in current tools for community stability analysis, contributing to improve our understanding of ecosystem dynamics in a changing world.

Greening signals in Mediterranean dune ecosystems: insights from Landsat time series and vegetation resurveys in Italy

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EO11

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Greening trends, defined as increases in vegetation productivity detected by remote sensing (RS), have been documented across many ecosystems. However, evidence for Mediterranean coastal dunes remains limited. It is still unclear whether greening dynamics observed at broader scales are detectable in these systems using both field-based and RS approaches. We investigated long-term vegetation dynamics (1984-2024) in Italian coastal dunes relying on 244 plots from a collaborative resurvey national project (ReSurveyDunes database) spanning three EUNIS habitats: upper beach vegetation (N12), shifting dunes (N14), and fixed grey dunes (N16). Field-based changes were assessed through changes in species richness and abundance between two survey times, analyzed using non-parametric tests and rank–abundance curves. RS greening was quantified using Landsat time series composites. Pixel-based vegetation indices (NDVI and MSAVI) and sub-pixel fractions of vegetation, soil, and water derived from spectral unmixing (SU) were used to characterize long-term trends. Greening trajectories were summarized using Mann–Kendall tests, slopes, and coefficients of variation. Linear models evaluated field-RS greening relationships across different coastal dynamics. Field-based analyses revealed increases in species richness and abundance, although dune-building species showed a decline in dominance. RS metrics indicated greening trends across Italian coastal dunes, with increasing productivity signals. Relationships between field-based and RS-derived metrics were partially supported, with NDVI and SU showing the strongest associations with abundance, and across different coastal dynamics. Overall, our results provide convergent evidence of greening in Mediterranean coastal dunes and highlight the added value of sub-pixel RS approaches for capturing long-term changes in heterogeneous coastal landscapes.

How to map northern boreal flora: the value of hierarchical clustering and classification

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E05

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Detection of vegetation patterns with remote sensing (RS) requires (1) delineation of vegetation into categories that can be remotely sensed and (2) assessment of which remote sensing datasets and classification methods can be used to distinguish vegetation categories. We hypothesize that a hierarchical clustering of vegetation data combined with a separate RS classification at each cluster node allows meaningful and accurate integration of vegetation and RS data and assessment of data type importance in separating different plant communities. Therefore, focusing on a diverse northern boreal mosaic landscape in Pallas, Finland, we (1) produce a data-based divisive hierarchical clustering of an extensive vegetation inventory, (2) employ random forest RS classifications of the plant communities based on multispectral Sentinel-2 time series and topographic and vegetation-structural information from airborne laser scanning, (3) compare hierarchical with non-hierarchical flat classification, and (4) identify RS data types that are important for vegetation delineation in different parts of the hierarchical classification tree. The vegetation clustering results in five hierarchical levels and 21 plant communities. Hierarchical RS classification consistently outperforms flat classification by 2–8 percentage points but its accuracy declines as the compositional separability of plant communities decreases. Flat predictions tend to overestimate common classes while producing less noisy maps. Important RS variables vary along tree nodes with near-infrared-reflectance-based variables being generally the most important. Our results support the use of time series spectral data, complemented by topographic and vegetation-structural features when available. The results also indicate clear benefits from incorporating hierarchical relationships among vegetation types.

Limiting factors of Northern Hemisphere tree species: revisiting Darwin's hypothesis through the Law of the Minimum

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PB4

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Understanding which environmental factors limit species distribution and performance is a central question in biogeography. Darwin's classic hypothesis suggests that abiotic variables become more restrictive both towards higher latitudes and elevations, while biotic constraints predominate at lower ones. Although different approaches have been proposed to assess this hypothesis, it appears that the perspective of Liebig's Law of the Minimum has not been explicitly considered, which posits that a single variable limits species' performance at any given time and location. In this study, we use this law to test Darwin's hypothesis by analysing over 260 tree species in c. 248,000 national forest inventory plots in Europe and North America. We modeled potential performance (tree basal area) using 0.95 quantile regressions across latitudinal (15° - 70° latitude) and elevation (0 m - 3500 m) gradients. We quantified the limiting effects of biotic (density and mean tree size) and abiotic (winter temperature, aridityindex, soil pH and nitrogen) factors, identifying the primary limiter in each plot. Our results indicate that all biotic and abiotic variables act as limiting factors in specific contexts. However, Darwin's hypothesis was largely unsupported: only 7,84% and 9,31% of species followed the predicted latitudinal and elevational patterns significantly, respectively. These findings suggest a need to revise classical biogeographical assumptions and adopt new macroecological frameworks to accurately assess species limitations.

Unintentional seed dispersal via the trade of container-grown garden plants: Seed density and composition vary among exporter countries

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AE2

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

The global ornamental plant trade is an important source of non-native plants, but the unintended dispersal of seeds as contaminants of this trade is rarely considered and largely understudied. We sampled the substrate of imported container-grown plants in several garden centres in Hungary to answer the following questions: (I) What species' seeds are present in the substrate of imported garden plants and in what quantity? (II) Do the substrates of plants imported from different countries contain seeds in different density and composition? (III) Do characteristics of the host garden plants affect the number and diversity of seeds found in their substrate? We detected altogether 2,181 seeds of 80 taxa in the substrates. On average, 1 litre of substrate contained 36 seeds of five species. Most species were non-native in Hungary and considered invasive in Europe. The majority of samples contained at least one seed of a species invasive in Europe. We found that the substrate of plants imported from different countries contained seeds in different number, diversity, and composition. Thus, the structure of the horticultural trade network can shape the non-native flora of importing countries. Furthermore, the substrate of needle-leaved ornamental species contained more seeds than the substrate of broad-leaved ornamentals. Our findings demonstrate that the ornamental plant trade can disperse a large number of seeds of numerous species and introduce non-native species into the importing countries. We conclude that this introduction pathway deserves greater attention in invasion biology and more studies of this phenomenon are urgently needed.

Direct and indirect impacts of *Carpobrotus acinaciformis* invasion on dune ecosystems of Lazio, Italy

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AE1

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Invasive alien plants can directly modify ecosystem functioning, as well as indirectly by altering the native plant biodiversity supporting functions like productivity and decomposition. However, these cascading effects and their underlying mechanisms remain unexplored, especially the role of plant intraspecific trait variability (ITV). Therefore, we investigate the direct and indirect effects of invasion on ecosystem functions and soil fauna by focusing on Iceplant (*Carpobrotus acinaciformis*), a widespread invader native to South Africa, in dune ecosystems of central Italy. Field sampling was conducted on the coastal dunes of Passoscuro, Lazio, in 2024 and 2025, using 15 pairs of invaded and control plots. In each plot, we measured plant richness and cover, soil nematode and springtail abundances, productivity and decomposition. Functional traits (height, specific leaf area and leaf dry matter content) were collected accounting for species mean traits and ITV. Structural Equation Models (SEM) were applied to disentangle direct and indirect invasion effects mediated by changes in plant community structure, quantified through community-weighted means (CWM) and functional diversity (FD) with and without accounting for ITV. Results revealed strong direct effects of Iceplant invasion on plant community structure, productivity and soil fauna abundance. Significant indirect effects on productivity, decomposition and soil fauna were also detected, mediated by shifts in CWM and FD. Importantly, incorporating ITV revealed additional indirect effects like the mediation of plant height on productivity. These findings show that plant invasion impacts may not be immediately apparent, highlighting the need for deeper analyses to fully understand the threat to invaded ecosystems.

Quartz islands at macro-scale: alpha, beta and zeta diversity across southern Africa

Katharina Meyer [1]; Alexander Bürger [2]; Pia Eibes [2]; Pieter van Wyk [3]; Jens Oldeland [4]; Norbert Jürgens [1]; Severin Irl [2]; Ute Schmiedel [1]

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DD7

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Quartz islands are distinctive edaphic habitats that contribute substantially to habitat heterogeneity in in the summer- and winter-rainfall drylands of southern Africa. However, despite their ecological importance, existing studies on the vegetation of quartz islands are largely restricted to local or regional scales, limiting our understanding of broader species composition and relationships among different quartz islands regions. This study, therefore, investigated macro-scale patterns of species composition and diversity (alpha, beta and zeta diversity) and their environmental drivers across quartz islands of southern Africa. We sampled over 1000 vegetation plots and associated soil data on quartz islands over a 32-year time period, spanning seven regions and almost 1000 km from southwest Namibia to southeast South Africa. Our results revealed clear regional differentiation in species diversity and composition, with topography and soil properties emerging as important drivers of species composition patterns across spatial scales. Rather than forming a uniform vegetation type, the vegetation of each region consists of its own flora with a different set of environmental variables. A decline in zeta diversity indicated the dominance of non-random deterministic processes of species formation for regional communities (power law decline), while transregional species showed the dominance of stochastic processes of community formation (exponential decline). Zeta diversity analyses across distance revealed that spatial stochastic effects influence the structure of quartz island communities within and across regions, particularly for rare species (low zeta orders). These findings underscore the contribution of quartz islands as unique habitats at different scales of biodiversity across southern Africa.

Mountain plant species revealed high pollinator dependence that increases with elevation

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CD10

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Climate change is increasingly disrupting ecological interactions, with plant-pollinator relationships considered among the most vulnerable. In mountain systems, where sexual reproduction is already constrained by harsh conditions, such disruptions may strongly affect plant reproductive success and population persistence. Despite growing concern, we still lack a clear understanding of how strongly mountain plant species depend on animal pollinators for seed production and whether this dependence varies among species. Here, we quantify pollinator dependence (hereafter PD) across 31 (sub)alpine plant species from the Northern Apennines (Italy) using *in situ* pollinator-exclusion experiments. We compared seed production and seed quality between naturally pollinated flowers and pollinator-excluded treatments. We quantified the level of PD across the species pool using a standardized index, accounting for species phylogenetic distances. We then modelled PD variation along the elevation gradient. For species able to produce seeds without pollinators, exclusion effects on seed germination were tested using GLMMs. Average PD was high (estimate = 0.63, 95% CI = 0.47-0.79), indicating strong reliance on insect pollination for seed production, with limited phylogenetic signal (sd = 0.02). Moreover, a significant PD variation was estimated as +0.49 every 1000 m of elevation increase. No consistent directional effect of pollinator exclusion on seed germination was detected, with species showing contrasting responses. High PD and its significant increase with elevation suggest that sub(alpine) species may be particularly vulnerable to climate-driven disruptions of plant-pollinator interactions. However, variability in PD among species may help identify more vulnerable taxa and guide conservation activities.

Altered precipitation amount and seasonality reduce productivity and change community structure in two semi-arid grasslands

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DD6

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

In the US southwest, most annual rainfall occurs during the summer monsoon (July to September). Climate models predict a future with decadal droughts and delayed monsoon seasonality. We used rainout shelters in two semi-arid grasslands in New Mexico, USA, to remove 66% of growing season rainfall for 7 years followed by 5 years of recovery under ambient rainfall. From 2013-2024 we used complete rainout shelters to capture and store all precipitation during July and August and reapplied this water during September and October to change seasonality. The two sites represent endpoints along a transition zone from Desert grassland dominated by *Bouteloua eriopoda* to Plains grassland dominated by *B. gracilis*. The dominant grasses declined rapidly at both sites under drought. *B. eriopoda* was eliminated from drought plots after 5 years, whereas *B. gracilis* barely persisted throughout the drought. ANPP declined rapidly under drought but recovered completely at both sites during the first year of ambient rainfall, a response driven by subordinate species, especially the native subshrub *Gutierrezia sarothrae* and the non-native annual *Salsola tragus*. In contrast, the two grasslands responded differently to the delayed monsoon treatment. *B. eriopoda* disappeared from delayed treatments after 8 years whereas *B. gracilis* persisted. This region is undergoing aridification and *B. eriopoda* is replacing *B. gracilis* across this transition zone. Our results demonstrate that these grasslands have little resistance but are highly resilient to prolonged drought, but as this Plains grassland to Desert grassland transition continues these grasslands will become more vulnerable under climate change.

Diversity comes at a cost: multifaceted diversity reduces plant community stability in peatlands

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FW5

Type: Oral

Subject: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Understanding how ecological stability relates to diversity is of crucial importance under global change. Greater biodiversity is expected to stabilize communities through compensatory dynamics, as species fluctuate asynchronously and offset one another. Yet, diversity-stability relationships are not straightforward and can vary across and within ecosystems. We examined how multiple facets of diversity and functional trait identity relate to temporal stability and species asynchrony in peatland vegetation. We used a 17-year field experiment in a montane peatland complex spanning a bog and a transitional poor fen, combining open-top chamber (OTC) passive warming with natural hydrological contrasts. Hydrology was the dominant driver of plant community composition and long-term dynamics, whereas experimental warming had no detectable effect at the community scale. Communities under drier conditions exhibited higher temporal stability and greater species asynchrony than wetter communities. Contrary to insurance hypothesis predictions, temporal stability decreased with multiple biodiversity facets, particularly phylogenetic diversity and species richness, but increased with deeper-rooted plant strategies, after controlling for experimental conditions. Species asynchrony showed weak relationships with biodiversity, and the stability-asynchrony association weakened substantially after accounting for hydrological conditions. Our results reveal that in peatlands, hydrology simultaneously structures biodiversity patterns, temporal stability and species asynchrony, yielding negative diversity-stability relationships. These findings suggest that in peatlands, stability arises primarily from hydrological constraints, with limited contribution from compensatory dynamics. In strongly constrained, species-poor ecosystems, conservation may prioritize maintaining or restoring the key abiotic conditions that favor functionally adapted communities over increasing diversity to sustain stable ecosystem functioning under global change.

Misguided compensation measures: soil and vegetation responses to pine plantations in grasslands

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VR7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration and management

In the current context of growing ecological awareness, environmental compensatory measures are increasingly implemented to offset the impacts of infrastructure development. However, their effectiveness is critically dependent on prior assessment and ecosystem-specific design. A frequently observed instance showcasing the shortfalls of uninformed compensatory actions is the introduction of tree plantations into non-forested systems. Although afforestation is often perceived as having positive environmental effects, it can result in fundamental alterations to ecosystem function when not implemented appropriately. The present study evaluates the effects of establishing pine monocultures within a native grassland ecosystem as a compensatory measure for road construction. A comparison was made between the soil properties and vegetation communities of grassland plots that had been afforested with pines and those that were adjacent but unaltered. Soil samples were analyzed to assess key physicochemical properties such as soil structure, nutrient availability and chemical composition and vegetation surveys were conducted to evaluate changes in plant community composition. Our results reveal significant shifts associated with pine establishment. These transformations suggest that poorly targeted compensatory actions can drive ecosystem trajectories away from their original state, potentially undermining native biodiversity and ecosystem functioning. Rather than restoring ecological integrity, monoculture plantations in grasslands may generate novel conditions incompatible with the conservation of open-habitat species. Our findings highlight the importance of ecosystem-specific planning and pre-intervention ecological assessment in compensation strategies. Effective mitigation requires aligning restoration actions with the ecological identity and processes of the impacted system, rather than applying generalized afforestation approaches that may be counterproductive.

Traditional grasslands in transition: how vegetation, soils, and farming practices are changing in rural Romania

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ST3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

Romania is known for its heterogeneous landscape, widespread organic farming, and well-preserved historical grassland management, all supporting extraordinary grassland biodiversity. However, even here, traditional agriculture is gradually being abandoned, leading to transitions in rural livelihoods and semi-natural grasslands. We examined how farming conditions and management practices changed between 2010 and 2024, and how these changes were reflected in vegetation and soil properties, recorded in 2018 and 2024. Across 54 permanent plots distributed among nine villages in six counties of Romanian countryside, we investigated grassland vegetation at seven spatial scales (0.0001–100 m²), soil characteristics, and both recent and historical management applied to each parcel. In addition, we interviewed farmers about changes in farming conditions, livestock numbers, grassland productivity and biodiversity. Regarding land use, two-thirds of plots remained stable throughout the study period. The dominant trend was a strong decline in grazed meadows and an increase in pastures, reflecting a shift from labor-intensive mowing to grazing-based systems. In 67% of plots, mowing advanced by approximately two weeks, indicating a shift toward earlier mowing. Changes in land use and management intensity affected vascular plant richness in a scale-dependent manner, with stable management showing the most positive effects across all scales, most pronounced at the intermediate (plant interaction) scale of 1 m². Soil dynamics appeared independent of local management, exhibiting a uniform trend of nutrient depletion across all management types. We conclude that recent farming developments increasingly challenge the maintenance of traditional practices at the intensity optimal for Carpathian grassland biodiversity.

Belowground non-structural carbohydrates in temperate herbs: quantification and phylogenetic diversity

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HH8

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Non-structural carbohydrates (NSC) play a central role in plant survival by supporting metabolism, stress tolerance, and regrowth after dormancy or disturbance. In temperate herbaceous perennials, belowground organs act as key storage compartments that buffer seasonal imbalances between carbon supply and demand. These storage forms comprise a chemically diverse set of compounds, including starch, fructans, raffinose family oligosaccharides (RFOs), soluble sugars, and sugar alcohols, which differ in molecular size, solubility, and physiological function. Understanding how this diversity is organized across species is essential for linking carbon storage strategies to plant persistence and adaptation. Quantifying NSC diversity requires analytical approaches capable of resolving both polymeric and low-molecular-weight carbohydrates. Commonly applied methods include enzymatic assays, chromatographic techniques such as high-performance anion-exchange chromatography with pulsed amperometric detection (HPAE-PAD), and integrative approaches that quantify total non-structural carbohydrate (TNC) contents. Combining these methods enables comprehensive assessment of NSC composition and comparability across species. We applied this framework in a phylogenetic analysis of belowground NSC composition in 77 temperate herbaceous species. Starch, fructans, and RFOs were dominant storage carbohydrates and showed strong phylogenetic signals, while ecological traits explained little additional variation. Clustering analyses revealed several conserved NSC syndromes, reflecting recurring carbohydrate storage strategies across lineages. These results highlight the dominant role of evolutionary history in shaping belowground NSC composition and the value of integrating detailed quantification with phylogenetic approaches.

Who writes the rules? Fire regime and plant community assembly in the Cerrado

Mariana Dairel; Alessandra Fidelis

Universidade Estadual Paulista

FP7

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Fire is a major ecological driver shaping plant communities, particularly by promoting a species-rich herbaceous layer in Cerrado savannas. In these fire-prone ecosystems, variation in fire frequency, extent, and timing, collectively known as the fire regime, plays a key role in maintaining biodiversity and ecosystem functioning. Alterations in fire regimes can modify plant community structure, leading to biodiversity loss and reduced ecosystem services, representing a major threat to tropical savanna conservation. To assess how fire regimes influence plant community assembly, we established 21 plots (1 m^2) across ten areas subjected to contrasting fire regimes over the last 40 years (1985–2025). These plots covered gradients of fire frequency (1–28 burn events) and time since the last fire (1–20 years). We hypothesized that areas experiencing frequent fires would exhibit higher species richness and diversity. Additionally, we expected time since fire to influence community assembly over short temporal scales. Among the fire regime variables, time since fire emerged as the main driver of species richness, while fire frequency showed no significant effect on species richness or diversity. Longer fire-free intervals promoted community homogenization, resulting in lower species richness and reduced biodiversity in the herbaceous layer ($p < 0.001$). In contrast, areas with shorter time since fire exhibited higher species diversity ($H = 4.37$) than areas with longer intervals ($H = 3.41$). Our findings show the role of fire in maintaining plant community diversity in Cerrado savannas, highlighting fire regime manipulation as a potential tool for tropical savanna restoration.

Climate–land use interactions drive diversity and future distribution of woody medicinal plants across ecological zones in Ghana

Reginald Tang Guuroh

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TE10

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

This study examined how climate, land use/protection status, and soil factors interact to shape the composition, diversity, and distribution of woody medicinal plants in Ghana under current and future climate conditions. A combined gradient approach across six ecological climate zones and two land-use types (protected and non-protected areas) was applied. In total, 120 vegetation plots (0.1 ha each) were sampled across the zones. Data on species identity, height, diameter at breast height, and soil properties were collected, while interviews with herbalists identified commonly used medicinal tree species. Nineteen bioclimatic variables from WorldClim were used for species distribution modelling. A total of 306 woody species were recorded, of which 59 were cited as medicinal by herbalists. Species diversity increased along with the moisture gradient and was consistently higher in protected areas. Protection status and its interaction with climate significantly influenced diversity indices. Linear mixed-effect models identified temperature, soil nitrogen, and base saturation as key drivers of species richness and diversity. MaxEnt modelling of *Khaya senegalensis* and *Azadirachta indica* showed high predictive accuracy (AUC > 0.90), with precipitation and temperature variables emerging as major predictors. Currently, only small portions of Ghana provide highly suitable habitats for these species; however, projections for the 2070s and 2100s indicate an expansion of suitable areas under both low and high emission scenarios. The findings highlight the complex interactions between climate, land use, and soil in shaping plant diversity and provide valuable guidance for conservation planning and sustainable land management of medicinal tree species in Ghana.

Forest-steppe: the core zone of vascular plant diversity in northern Eurasia

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PB11

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Previous research has identified extremely high local plant species richness in the peri-Carpathian forest-steppe, but it remains unclear whether high richness is a general feature of forest-steppe. We tested this by sampling a 2700 km north–south transect across ten vegetation zones of Siberia and Kazakhstan, from the Arctic Ocean to the Tian Shan foothills. At each of 52 regularly spaced sites, we sampled 5–12 vegetation plots to capture the major vegetation types. We calculated plant diversity measures and related them to latitude, climate, and soil variables, using local regression and generalized additive models. Alpha and gamma diversity showed nearly identical latitudinal patterns, peaking in the central part of the transect within the subtaiga and forest-steppe zones, and also in two southern, extrazonal forest-steppe areas in the mountains. Both diversity measures were lowest in the northern and middle taiga and in deserts. Beta diversity was low in tundra and taiga, intermediate in forest-steppe, and highest in steppe. Diversity was strongly related to climatic and soil variables, although many relationships weakened or disappeared after accounting for latitude. Our results highlight that forest-steppe and subtaiga are the most species-rich vegetation zones in the northern Eurasian lowlands. Their high diversity likely reflects non-extreme climatic conditions (neither too cold nor too dry) and near-neutral soils, which are suitable for many plant species. The coexistence of open forests and grasslands is probably also important. Many species occur in both habitats and can disperse between them during periods of climate change to track suitable conditions.

How the timing and duration of experimental heat waves shape alpine grassland plant communities: a remote-sensing upscaling approach

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EO10

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Summer heat waves are becoming more frequent in the Alps, threatening ecosystem stability and the biodiversity-rich primary alpine grasslands that provide key ecosystem services. Although drought and heat can jointly affect vegetation from species to community level, how heat-wave timing and duration shape responses across the growing season is still unclear. We test stage-dependent heat-wave effects using a manipulative experiment, combining field measurements with multispectral remote sensing. We simulated heat waves with shelters that excluded rainfall while increasing temperature in two primary alpine grasslands on contrasting substrates: on calcareous substrate at Mount Peralba (Sappada, Italy) and on siliceous substrate at Gavia Pass (Sondrio, Italy). Four treatments (six replicates each) varied in stress timing and duration: (I) stress from season onset to peak (~2 months), (II) early-season stress for 1 month after growth resumption, (III) late-season stress for 1 month before peak, and (IV) control. At the species level we measure physiological and morphological leaf traits of sedges, grasses and forbs; at the community level we quantify aboveground biomass. We link these responses to vegetation indices (NDVI, ARI, CRI) from close-range imagery and UAV surveys. We expect early-season heat waves to advance phenology and boost short-term growth, whereas prolonged or later stress will reduce final production and promote premature senescence, with forbs showing the strongest shifts. Responses are expected to be comparatively attenuated at the siliceous site. UAV-based scaling links plot processes to landscape patterns and opens new perspectives for upscaling across the entire Alpine arc.

Classification of subtropical high-mountain dwarf bamboo and scree vegetation in Taiwan

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BC5

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

The high-mountain grassland-like vegetation in subtropical and tropical mountains is distinct and different from the temperate and boreal regions, but remains poorly studied. Therefore, our study establishes the first comprehensive hierarchical syntaxonomic classification for Taiwan's high-mountain herbaceous and dwarf bamboo *Yushania*-dominated vegetation using the Braun-Blanquet approach. Utilizing a random sampling design and remote sensing data, we sampled 811 relevés across the Central, Hsueshan, and Yushan Mountain Ranges. Vegetation data were processed via TWINSPAN and hierarchical cluster analysis in JUICE, with spatial and environmental relationships visualized through DCA and CCA. The classification identifies two classes, three orders, five alliances, and ten associations. We formally define the insular high-mountain chasmophyte and scree vegetation (*Scabioso lacerifoliae-Brachypodietea kawakamii*) and the insular high-mountain grassland-like dwarf bamboo shrub (*Carici pocilliformis-Yushanietea niitakayamensis*). Key environmental drivers of community differentiation include elevation, slope inclination, aspect, gravel ratio, soil moisture, and precipitation seasonality. Our findings suggest that *Yushania* communities, traditionally termed "alpine grasslands," are more accurately characterized as dwarf bamboo shrubs heavily influenced by post-fire succession. We also propose a schematic successional model illustrating the transition from bare scree to stable shrublands modulated by topographic and edaphic constraints. By providing a standardized syntaxonomic schema, this research offers a vital baseline for monitoring the impacts of climate change and informs biodiversity conservation strategies for subtropical alpine ecosystems.

Modelling New Zealand's pre-human forested landscapes

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Bioeconomy Science Institute

LT2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Since human arrival c. 750 years ago, around 70% of New Zealand's forests have been cleared. Mapping these pre-human forests, which once covered almost all the non-alpine landscape, is essential for understanding historical ecosystem cover. This can support conservation and land-use planning and serves as a companion to maps depicting current ecosystem cover. We produced a national-scale map that reconstructed the distribution and composition of forested ecosystems immediately before human arrival. We integrated contemporary forest plot data collected from remnant vegetation with palaeoecological data, particularly fossil pollen records that acted as proxies for past vegetation in cleared areas, to infer broad spatial patterns in forest structure and the assemblage of communities. We developed models using environmental predictors to estimate the distribution of different forest types across the landscape and generated spatial predictions with associated confidence metrics to reflect variation in model certainty. By harnessing contemporary forest plot data and combining them with long-term palaeoecological records, we produced a nationally consistent reconstruction of New Zealand's past forests. This map provides a robust foundation for policy development, meeting global targets for protecting natural ecosystems, ecological restoration planning, and the ongoing refinement of methods for modelling historical ecosystems.

Stable scaling relationships mask hidden community changes in a mountainous landscape

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SL2

Type: Oral

Subject: Special Sessions

Session: Scaling laws in (vegetation) ecology

Are ecological scaling relationships stable through time, or can shifting parameters signal "quiet" community reorganization before diversity loss becomes evident? Using a century-long resurvey of subalpine and alpine vegetation along an elevational gradient in Norway, we tested whether key scaling relationships linking (I) spatial extent to diversity, (II) elevational distance to compositional and functional dissimilarity, and (III) species commonness to occupancy have remained stable through time. In 2008 and 2022, we resurveyed semi-permanent plots in central Norway first sampled in 1923–1933 along 995–1495 m.a.s.l., aggregating plots into 50-m elevational belts. We quantified spatial scaling of diversity with area, community differences across elevation, and relationships linked to species commonness and occupancy. Scaling relationships revealed a reorganization that is not captured by richness alone. Large-scale community structuring across elevation remained remarkably stable over the past century, with largely unchanged species–area relationships, beta and zeta diversity, and abundance–occupancy relationships. Despite this, absolute dissimilarity across elevational belts declined with beta diversity increasingly driven by species turnover while the nestedness component weakened. Communities also became progressively characterised by more widespread, common species and a more even abundance distribution, in addition to a convergence of ecological preferences. While the elevational gradient has not collapsed into a uniform assemblage, key scaling parameters within the gradient have shifted. These changes suggest a gradual compositional and functional reorganization of the vegetation that might for now maintain ecosystem functioning through dominant generalists, while quietly eroding long-term ecosystem resilience through species losses.

Disentangling temporal vegetation dynamics through trait-based trajectory analysis

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LT8

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Long-term vegetation resurveys are essential for understanding community assembly processes. Commonly used metrics capture only partial aspects of temporal change; for instance, differences in species richness ignore compositional reorganization, while beta diversity measures the magnitude of change without providing information on its direction. Beyond these, trajectory analysis integrates both magnitude and direction of compositional change, offering a powerful tool to investigate community dynamics. However, species-level trajectories may be strongly affected by pseudo-turnover, whereby replacement among functionally similar species inflates apparent change and obscures interpretable long-term trends. To reduce pseudo-turnover, we compared trajectories derived from species-level composition with those obtained after aggregating species into functional groups defined by morphological and functional traits. Functional groups were constructed by combining species sharing similar values of key traits, capturing dominant ecological strategies rather than taxonomic identity (sensitivity analyses using alternative grouping schemes were performed). We tested this approach on a long-term vegetation resurvey dataset by analysing vegetation dynamics in 80 permanent plots along an elevational gradient in the Central Apennines (Italy), resurveyed four times between 2005 and 2025. Results showed that species-based trajectories were generally long and weakly directional, reflecting extensive compositional reordering across surveys. In contrast, functional-group-based ordinations produced shorter and more directional trajectories, revealing coherent temporal patterns across plots occurring at similar elevations. Thus, functional aggregation reduced noise derived from pseudo-turnover, improving the interpretability of long-term community dynamics. Trait-based trajectory analysis, therefore, provides a robust methodological framework for disentangling directional change in vegetation time series, advancing the study of community assembly processes.

Reconciling changes in water use efficiency and stomatal conductance in Mediterranean plant communities along an aridity gradient.

Francisco Javier Muñoz Gálvez [1]; Ivan Prieto Aguilar [2]; Enrique García de la Riva [2]; José Ignacio Querejeta Mercader [1]

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DD2

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

The seasonal nature of the Mediterranean climate, with long periods of drought interrupted by heavy rains, makes water a limiting resource for plant communities. The aim of this study is to explore how climatic variation along an aridity gradient across the south-eastern Iberian Peninsula influences water and nutrient use strategies in six different plant communities. We measured leaf morphological traits (SLA, LDMC), nutrient contents, leaf gas exchange (photosynthesis, stomatal conductance, water use efficiency), and foliar isotopic composition as proxies for intrinsic water use efficiency ($\delta^{13}C$), stomatal conductance ($\Delta^{18}O$) and water uptake depth (xylem water $\delta^{18}O$) in the most abundant species present in each community (42 in total). We also assessed the dominance of different resource use strategies along an acquisitive-conservative spectrum based on community-weighted means of plant traits. Our results show that plants inevitably increase stomatal conductance to avoid leaf overheating and photosynthetic machinery damage toward the warmer and drier end of the gradient, even though they also achieve higher leaf-level intrinsic water use efficiency than communities from cooler and wetter areas. This can be explained by the fact that communities at the warmer and more arid end of the climate gradient present more sclerophyllous leaves with higher nutrient content per leaf area, which allows higher photosynthetic rates per area that favour a high intrinsic water-use efficiency despite high transpiration rate. These findings advance current understanding of the ecophysiological mechanisms that dryland plants use to cope with the increased evaporative demand of the atmosphere with ongoing climate warming.

Structure, composition, and activity of fungal and bacterial communities in sub-Mediterranean areas

Clara Maluenda

Universidad de León

PC4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

The Sub-Mediterranean zone, one of the most diverse areas on Earth, lies at the boundary between Mediterranean and Eurosiberian vegetation. It includes communities dominated by Eurosiberian species (*B. alba*, *Q. petraea*), Mediterranean species (*Q. ilex*), and mixed communities with co-dominance. The effects of these communities' structure and composition on microbial communities and soil multifunctionality remain unclear. This study evaluated whether microbial community structure and composition, together with soil multifunctionality, vary among forest types. Soil samples (0–15 cm) were collected from five plots in five communities: *B. alba, Q. petraea*, mixed *Q. petraea- B. alba* forest, *Q. pyrenaica* and *Q. ilex*. Microbial communities were analyzed using Illumina sequencing, and multifunctionality was calculated from regulation (field capacity and total carbon) and support services (indicators associated with fertility and nutrient cycling). Bacterial richness was higher in Mediterranean (*Q. ilex*) and temperate (*Q. petraea*) forests than in pure Eurosiberian (*B. alba*) forests. Bacterial diversity was highest in Mediterranean, and lowest in the remaining communities. Actinobacteria were most abundant in Mediterranean and temperate *Q. pyrenaica* forests, whereas Acidobacteria predominated in Eurosiberian forests. Fungal richness was higher in Eurosiberian than in *Q. pyrenaica* forests, though dominance did not differ among communities. Ascomycota abundance was marginally lower in mixed than in *Q. pyrenaica* forests. Soil multifunctionality was highest in mixed and lowest in *Q. pyrenaica* forests, with no differences among other communities. Regulation and support services followed a similar pattern. Overall, Mediterraneanization is expected to favor more specialized microbial communities adapted to drought conditions, while maintaining relatively stable soil multifunctionality across communities.

Effects of climate change on functional strategies and water use in sub-Mediterranean forest communities

Iván Prieto [1]; Clara Maluenda [2]; Elena Marcos [2]; Francisco Muñoz [3]; Gonzalo G. Barberá [3]; José I. Querejeta [3]; Marco Lehmann [4]; Leonor Calvo [2]; Enrique G. de la Riva [2]

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DD11

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

The Iberian Peninsula is home to one of Europe's most important biogeographical boundaries: the contact zone between the Mediterranean and Eurosiberian regions. These sub-Mediterranean areas are highly sensitive ecotones where minimal environmental variations can drastically alter plant composition and functionality, increasing their vulnerability to global warming and increasing aridification. This study analyzes variations in functional plant resource use strategies and water uptake along a Mediterranean-Eurosiberian gradient (*Q. ilex*, *Q. pyrenaica*, mixed *Q. petraea-B. alba*, *Q. petraea* and *B. alba* dominated forests). The objective is to predict the evolution of these communities under future climate scenarios. We measure leaf economic spectrum (LES) traits and gas exchange (photosynthesis: A, stomatal conductance: gs, and intrinsic and transpirational water use efficiency: WUEi and WUEt). In addition, we measured leaf carbon and oxygen isotopic composition ($\delta^{13}C$ and $\delta^{18}OL$) as indicators of time-integrated physiological performance, along with xylem ($\delta^{18}Ox$) and soil ($\delta^{18}OS$) water isotopic composition to determine root water uptake depth. Principal component analysis (PCA) revealed a continuous functional gradient; Mediterranean communities were characterized by conservative traits, higher WUE, and greater water extraction from topsoil layers (< 20 cm), reflecting adaptation to shallow and seasonally limited water availability. Contrastingly, Eurosiberian communities exhibited acquisitive traits, lower WUE, and deeper soil water extraction. In conclusion, the projected climate warming and precipitation reduction in these zones will likely limit the viability of species with acquisitive traits, favouring a shift towards communities with progressively more conservative traits and strategies.

Dynamics and environmental drivers of epiphytic bryophytes in an urban environment

Martin Diekmann

University of Bremen

UR3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Urban plant communities

Bryophytes are often fast colonizers and respond to environmental changes more rapidly than vascular plants. This also applies to epiphytic bryophytes that had disappeared from vast areas in Central Europe because of atmospheric pollution. Owing to improved air quality, however, many species have started a fast recolonization especially in cities. This study aims to track these changes in an urban environment and to examine the distribution of different species and the underlying environmental drivers. The study was conducted in Bremen, North Germany. The epiphytic bryophyte flora was recorded in several areas of the city, including forests, parks and avenues. I surveyed all taxa growing on selected tree stems between 1 and 2 m height. Tree characteristics were noted and, for a sub-set of trees, bark samples were collected for pH measurements. In some areas, the spatial configuration of occupied trees was examined in detail. Several species of epiphytic bryophytes had recolonized both forest parks and tree rows along streets. The fast spread was notable, especially in liverworts. Species occurrences were related to tree size, partly in a non-linear way. The most important predictor was tree species identity, most likely caused by pronounced differences in bark pH and roughness between species. The occurrence of some species on trees was strongly affected by the distance to other occupied trees. The results show that large habitat diversity in terms of tree species, size distribution and other tree characteristics is highly beneficial for the recolonization of epiphytic bryophytes.

Intraspecific trait variation across ecological scales: where we're coming from and where we're going

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IT3

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

As the use of plant traits has risen in popularity to predict species distribution and their role in ecosystem functioning, so has the use of databases compiling trait values across habitats, species and organs. Many of the community- and ecosystem-level predictions rely on the debated mean field theory, which assumes that between-species trait variation (BTV) is significantly higher than intraspecific trait variation (ITV), which comprises acclimation and adaptation. However, diversity within species is an important factor in ecosystems, and the unprecedented loss of populations on a global scale may have important implications for communities and ecosystems, as populations' demographic resilience and evolutionary potential are decreased. To understand the role of ITV in ecological processes, we set out to review and synthesise the growing literature on this subject and support the general findings with a meta-analysis of an initial selection of ca. 2000 articles establishing causal links between ITV and higher-level processes. The goals of this ongoing study are to: 1) investigate ITV's potential cascading effect across ecological scales (population, community, ecosystem), 2) evaluate the importance of ITV in the prediction of ecosystem functioning, 3) highlight critical knowledge gaps, and 4) present a roadmap of questions and good practices to fill them. We will present our findings in the form of a bibliometric analysis, as well as the methodology of the meta-analysis and its preliminary results.

Divide to unify: differences in growth form trait combinations to disentangle plant diversity

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CA8

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Trait-based approaches have synthesised the diversity of plants into four main dimensions of trait variation, identifying trait combinations shared by plants worldwide and associated with size and resource-use economics. However, a unified consensus on global plant strategies remains elusive, with ongoing debate regarding both the number and nature of the dimensions defining plant investments. Moreover, it is unclear how unrepresentative sampling among different growth form may influence the definition of dimensions of plant trait variation. Here, we disentangle the strategies available to different growth form by testing how varying proportions may influence plant trait spaces. Investments associated with woodiness and secondary growth among growth forms may not be directly comparable, thereby constraining trait combinations to specific growth-form while excluding them from others. By constructing separate trait spaces for different growth form, we show that differences in woodiness are associated with distinct dimensionality and patterns of trait coordination. We identify a previously unrecognised dimension linking denser stems with thicker leaves, as well as a coordination between leaf and root nitrogen that is present in herbs but absent in woody species. Furthermore, we demonstrate that varying the proportion of growth-form included in the global trait space can alter the ecological interpretation of trait dimensions, with potential consequences for how trait spaces are understood. Our results suggest that disentangling plant adaptation from community assembly processes requires a reconciliation between historical growth-form classifications and modern functional ecology. Finally, we highlight the importance of incorporating growth-form proportions that reflect natural assemblages to capture global diversity in plant traits.

Policy relevant remote sensing EBVs for conservation status assessment in mountain protected areas

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EO6

Type: Oral

Subject: Earth Observation of vegetation: Linking in-situ data with remote sensing

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Monitoring the conservation status of mountain habitats requires robust, spatially explicit indicators capable of capturing temporal and spatial changes in ecosystem composition, structure, and function. This study identifies, compiles, and operationalizes a suite of remote sensing–derived Essential Biodiversity Variables (EBVs) for characterizing and mapping mountain habitats in areas vulnerable to global change, such as the Mediterranean Region, by translating conservation status assessment frameworks and expert-based requirements into operational indicators. Based on a review of technical guidelines from the Spanish Ministry for the Ecological Transition, European frameworks, and scientific literature, a set of biotic, abiotic, and landscape variables was identified as relevant for capturing key ecological attributes across major mountain habitat groups, and those specific to particular habitat types where internal differentiation exists. For each variable, we compiled measurement approaches, metrics, and available thresholds defining favorable and unfavorable conditions, highlighting those measurable through remote sensing. The assessment revealed that approximately 45% of the variables used to evaluate ecosystem conservation status can be directly measured or robustly complemented using remote sensing–derived data. The resulting multisensor database, integrating satellite, LiDAR and bioclimatic data, provides a coherent and reproducible framework for deriving EBVs across spatial and temporal scales. The inclusion of available remote sensing variables increases the efficiency and robustness of ecological assessments, providing consistent inputs for the mandatory reporting cycles established under European directives. The framework delivers an operational, data-driven basis for assessing habitat type condition in vulnerable mountain landscapes, ensuring that remote sensing EBVs can be effectively used in conservation planning and reporting obligations.

Identifying the dominant drivers of plant compositional change in Italian protected mountain areas undergoing land abandonment

Martina Livornese [1]; Manuele Bazzichetto [1]; Gianmaria Bonari [2]; Michele Di Musciano [3]; Riccardo Testolin [1]; Francesco Maria Sabatini [1]

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ST5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

Mountain landscapes across Europe have been profoundly reshaped by land abandonment. The reduced direct human pressure linked with ongoing climate change potentially drives substantial shifts in plant community composition. However, the relative importance of land use change dynamics and climate in shaping long-term compositional change remains poorly quantified. Here, we assess patterns and drivers of plant compositional change in Italian protected mountain areas experiencing human abandonment since the early 1990s. We integrate long-term vegetation plot data with spatially explicit information on climate, land-cover legacy, and topography. Plant community changes were analysed using a Bayesian spatial generalized dissimilarity mixed model (spGDMM). By accounting for spatial dependencies among plots and enabling fine-grained mapping of compositional turnover through time, we tested the relative importance of land-use legacies and climate on plot dynamics. Our analyses reveal pronounced spatial heterogeneity in plant compositional change across study areas. Climatic gradients, particularly temperature and precipitation, consistently emerge as major drivers of compositional dissimilarity, while geographic distance captures additional spatial structure not explained by environmental variables alone. Land-cover legacy and micro-topographic factors show more context-dependent effects, modulating compositional change within areas undergoing land abandonment. By disentangling the relative influence of climate, past land-cover dynamics, and spatial processes, our study highlights that compositional changes in protected mountain landscapes are shaped by the interaction of both large-scale and locally contingent factors. In addition, we identified hotspots of plant community change, where the strongest compositional reorganization occurred and where adaptive conservation actions may therefore be most urgently required.

Assessment of the impact of fires caused by warfare on Ukraine's natural ecosystems

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IM5

Type: Oral

Subject: Special Sessions

Session: Impact of Military Conflicts on vegetation and habitats

The full-scale Russian invasion of Ukraine has caused catastrophic damage to natural ecosystems, with NASA satellites recording 131,498 fire incidents between February 2022 and 2024. Due to intensive mining and ongoing hostilities, remote sensing has become the primary tool for environmental assessment. Research indicates devastating impacts on key conservation areas, and one of the most affected areas has been the largest forest areas in the eastern regions of Ukraine. In the "Holy Mountains", approximately 1915.34 ha (18.83% of the territory) burned between 2022-2024, affecting pine stands, floodplain, and alder forests, with unique chalk pine forests nearly destroyed. And an additional 6,199.5 ha have been affected by 23 fires in 2024 alone. In the "Kreminsky Lisy", our preliminary estimates suggest 60-70% of the area (up to 30,000 ha) has been damaged. In "Kamianska Sich", where a significant area is occupied by grasslands, 776 ha burned in the period from May 31 to November 15, 2022, with the most significant fires coinciding with military operations in October 2022. Furthermore, the "Ivory Coast of Sviatoslav" has been severely hit; by June 2023, over 56% of the Kinburn Peninsula (5627.23 ha) was affected, and by early 2025, only 13.9% of its original pine stands remained. The scorched earth tactics employed by Russian troops have intensified these losses, necessitating new management strategies for effective ecosystem restoration amid climate change and widespread mine contamination.

Integrating forest inventory and hyperspectral remote sensing data to understand canopy spectral organization

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EO1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Understanding how forest demographic structure shapes canopy spectral organization is a key goal in vegetation ecology. Variation in stem diameter distributions can alter remote sensing spectral properties by modifying vertical layering, crown overlap and light interception. Using hyperspectral imagery and forest inventory data from 2023 across ten Norway spruce (*Picea abies*) dominated sites spanning a latitudinal gradient in Norway, we examined how stem diameter distributions relate to hyperspectral organization at the plot-level. Each site included paired plots representing typical and poor conditions for Norway spruce, allowing us to assess whether demographic–spectral relationships were modulated by growing conditions. We quantified stem density, central tendency, spread and variability of diameter distributions. Spectral organization was summarized using principal component analysis (PCA), focusing on plot-level centroid position of the first PCA score and a distance metric in multivariate space between paired plots. Stem diameter distributions and spectral organization overlapped substantially between paired plots. Variation in spectral organization between paired plots was more closely related to the spread and variability of stem diameters than to average size or the dominance of large stems. Plots with greater diameter variability occupied more extreme positions in multivariate spectral space. Differences in diameter variability between paired plots tended to correspond with differences in spectral distance, explaining 22% of the variation between plots. Our results suggest that plot-level hyperspectral organization reflects demographic heterogeneity rather than mean forest structure, highlighting the value of integrating field inventories with hyperspectral remote sensing data.

Pervasive effects of plant invasions along roadsides on native vegetation across tropical forests and savannas

Juliano Zardetto

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AE10

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Edge effects and biological invasions are among the major threats in protected areas. Invasive plant species are often found alongside roads in protected areas, facilitated by local edge effects. Although structurally distinct, both forests and savannas seem to be under strong invasion along roadsides. A very efficient way to assess impacts of invasive species is through a metacommunity framework. In this study, we investigated how edge effects of roads facilitate plant invasions in protected areas of forest and savanna, and how they affect native communities and metacommunities. We conducted replicated multi-strata surveys in 180 communities and 60 metacommunities, distributed across protected areas of forest and savanna, in two treatments: edge of the road and core (50m from the road). We analyzed diversity metrics (species richness, abundance and evenness) at community and metacommunity scales, and β-diversity. We found facilitative effects of road edges for invasive plant species, in both vegetation types and at both spatial scales. Savannas, however, also have considerable invasion even in core areas. The abundance of invasive species was related to increase in native species evenness, decrease in native species abundance, and changes in relative abundances of dominant native species. We recommend prioritizing non-invaded forest and savanna edges for invasive species prevention and early detection, and keep managing invaded areas, as they still support valuable native diversity. Finally, new roads in protected areas should be avoided, or, if unavoidable, carefully planned and closely monitored.

Shifts in dry grassland vegetation depend on soil and microtopography

Horka Susanne

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CE3

Type: Oral

Subject: Ecosystem-focused topics

Session: Central-European grasslands

We assessed how microtopography, soil properties and edge proximity relate to long-term taxonomic and functional vegetation change in species-rich dry grasslands in Central Germany. We tested whether (I) taxonomic turnover is primarily associated with slope–aspect variation, (II) community-weighted functional-type metrics capture change more consistently than single leaf traits, and (III) soil–topography interactions are linked to functional reorganisation. We analysed resurvey data from rocky porphyry outcrops spanning gradients in slope, aspect, soil depth, chemistry and texture, and distance to adjacent arable fields. We modelled Bray–Curtis taxonomic turnover and Euclidean change in community-weighted means (life forms, longevity classes, Grime strategy types, LDMC, SLA and Ellenberg indicator summaries) using Boosted Regression Trees, assessed by cross-validation; interactions were explored with partial dependence plots. Taxonomic turnover was most strongly associated with slope and aspect, whereas soil properties and edge proximity had less influence. Turnover peaked on flatter, non-south-facing microsites, particularly where soils had low C/N ratios, indicating hotspots in intermediate ("mesic") positions within outcrop gradients. Functional change was captured more consistently by aggregated functional-type metrics than by single traits or Ellenberg-based change metrics. Non-additive patterns were common, most notably a pH × C/N interaction associated with overall functional change, alongside additional soil–topography combinations affecting selected functional components. Vegetation change in the porphyry hillscape is structured by microtopographic gradients, with soil properties and their interactions contributing to functional reorganisation; transitional outcrop microsites represent key hotspots of turnover.

Socio-ecological consequences of military conflicts and forest vulnerability: the indicator role of bryophytes

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IM3

Type: Oral

Subject: Special Sessions

Session: Impact of Military Conflicts on vegetation and habitats

The war in Ukraine has indirectly altered ecological conditions and social dynamics in regions beyond the active combat zone, particularly the Ukrainian Carpathians. Population relocation and the expansion of renewable energy and tourism infrastructure in mountain areas have intensified local disturbance, contributing to soil and vegetation degradation. Bryophytes are highly sensitive to microclimatic and structural habitat changes. We assessed bryophyte community structure along a disturbance gradient in Carpathian forests (Lviv and Ivano-Frankivsk regions), including protected, managed, and recreational sites. Surveys were conducted along transects with 10 plots of 1 m^2 each, where species composition, frequency, and cover were recorded. Diversity was quantified using the Shannon–Wiener index (H_3) and Simpson's dominance index (D), while differences in community composition were tested using PERMANOVA implemented in the *vegan* package of R programming language. Protected forests showed the highest species richness (up to 35 species) and diversity (H' = 2.10), with low dominance (D = 0.16), reflecting structurally complex and microclimatically stable communities. Managed forests exhibited reduced richness (mean 17 species), lower diversity (H' = 1.40), and higher dominance (D = 0.33), indicating the prevalence of disturbance-tolerant taxa. Recreational sites displayed intermediate richness (22 species) but elevated dominance (D = 0.25), associated with an increased proportion of ruderal and pioneer species. An increasing proportion of xeromesophilous low-turf mosses along the disturbance gradient indicates local xerophytisation and reflects environmental disruption. Analysis of bryophyte community dynamics enables the detection of early signs of habitat degradation before changes become visually apparent or irreversible.

Community trait composition effects on the resistance of ecosystem function to extreme climatic anomalies

Hoss Daniela [(1)], *Bruelheide Helge* [(2)], *De Patta Pillar Valério* [(3)]

[(1)] *Guest at iDiv (no employment link),* [(2)] *MLU,* [(3)] *UFRGS*

PB9

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

The intensification of climatic anomalies is a major driver of ecosystem change. Research on biodiversity and ecosystem stability has largely relied on experimental studies, often focusing on drought. Yet, climate projections indicate that both extreme dry and wet events are increasing in frequency and intensity. Here, we leverage the latest version of the sPlot database to synthesize observational data from globally distributed grassland ecosystems and test whether functional community structure moderates the impacts of extreme climatic anomalies on productivity across a 25-year time series. Preliminary findings indicate that while both extreme dry and wet events reduce productivity resistance, functional redundancy and communities dominated by acquisitive, fast-growing species buffer these effects. Our results demonstrate that response diversity reflects the maintenance of ecosystem resistance across time and space.

Variation in taxonomic and functional composition of plant communities along gradients of climate and land use in human-modified landscapes

Sandra Rojas-Botero; Nishtha Shrivas; Johannes Kollmann

Technical University of Munich

SL1

Type: Oral

Subject: Special Sessions

Session: Scaling laws in (vegetation) ecology

Climate and land use shape plant biodiversity across spatial scales, yet their relative contributions to taxonomic and functional diversity remain uncertain, particularly in modified landscapes. The extent to which biodiversity patterns are associated with climate and land use must be considered in monitoring that informs planning and management of anthropogenic landscapes. Using a space-for-time approach, we surveyed vascular plant assemblages across 60 landscapes in Bavaria, Germany, spanning five climatic zones and three widespread land-use types. To disentangle the effects of climate and land use on plant diversity across different spatial scales, we quantified alpha, beta, and gamma taxonomic and functional diversity, and related them to climatic variables and land-cover structure and diversity at different scales. Alpha taxonomic diversity increased with land-cover diversity, urban and forest cover. Similarly, alpha functional diversity increased with land-cover diversity and urban cover. Beta taxonomic diversity was positively associated with land-cover diversity, whereas other environmental predictors showed weak effects. Beta functional diversity exhibited inconsistent relationships with the predictors. At the landscape scale, gamma taxonomic diversity increased with regional temperature and forest cover, while gamma functional diversity increased with urban cover and, to a lesser extent, forest cover. These findings indicate that fine-scale habitat heterogeneity and the composition of forested and urban land shape multiple dimensions of plant biodiversity, with effects that differ across spatial scales. Our results support multi-metric monitoring to inform ecosystem management in modified landscapes, emphasizing the need to consider and interpret scale-dependent patterns.

Tree growth and phenological responses to climate in a tropical evergreen forest

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TE8

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Understanding tropical forest responses to climatic variability is critical for assessing tree sensitivity and guiding conservation under changing climate. We report analyses of two key processes of forest dynamics in a tropical wet evergreen forest of the Western Ghats biodiversity hotspot, India. Phenology was monitored monthly from April 2021 to September 2023 for 720 individuals and 95 species. Vegetative and reproductive events were analyzed using binomial generalized linear mixed models to examine associations with short-term climate parameters, without implying causation. These analyses reveal community-level responses to rainfall, temperature, and humidity variability over short timescales. Tree growth was assessed using high-resolution dendrometer data spanning 35 years across 3,000 individuals and 100 species. Growth responses to climatic extremes were modeled using a Bayesian multilevel model, enabling robust inference across individuals, species, and community levels. Because tree growth responses to climate extremes are inherently causal, a causal framework was proposed to avoid confounding, overcontrol, and collider bias common in observational data. Thus, we employed structural causal modeling (SCM) with directed acyclic graphs (DAGs) to explicitly encode assumptions about the causal structure of the system. The analyses showed wet and dry anomalies reduce tree growth, highlighting the sensitivity of Indian moist tropical forests to hydric extremes. The results provide multi-scale insights into the ecology of wet tropical ecosystems, offering a preliminary understanding of its functioning under climatic variability. These findings inform future studies integrating physiology and functional traits to better understand vegetation responses to climate extremes.

Integration of an Australia-wide consistent classification scheme at the macrogroup level with the IAVC

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BC2

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

Australia is an island continent with an area over 7,688,287 km² with clearly distinct endemic plant species. It has over 26,000 plant species across a range of diverse biogeographic zones, such as interior semi-desert, sub-tropical and temperate, often on low fertility substrates from ancient rock types. The challenge is to classify the full range of ecodiversity ranging from semi-desert woodlands and hummock grasslands, tropical savannas, dry sclerophyll, semi-mesic, and wet eucalypt forests and woodlands, rainforests, semi-arid shrublands, grasslands, and even sub-alpine and alpine vegetation in accordance with a pragmatic, consistent classification scheme (CCS). We present a CCS for the continent using earlier ones of Beadle, Specht, and Carnahan, and NVIS. Carnahan and Beadle used their comprehensive field knowledge. Specht used early rudimentary datasets and numeric classification approaches. NVIS collated and merged individual State classification datasets. We essentially review, validate, and present a CCS at the macrogroup and sub-macrogroup level across Australia by integrating these complementary approaches using vegetation plot data to split, add, or confirm existing revised groups and alliances where necessary. These macrogroups can be further split into vegetation alliances and associations at the local and regional levels within each of the seven Australian States. These preliminary macrogroups will provide a first draft CCS which can be verified and amended using further available plot-based analyses, along with expert opinion. We conclude that it is possible to integrate a consistent classification scheme with the IVC and provide a realistic number of mappable macrogroups for the Australian continent.

UV-B stress responses and functional differentiation in Antarctic vegetation communities

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University of La Rioja

CD1

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Cold terrestrial ecosystems are shaped by extreme environmental constraints that strongly influence vegetation structure and composition. In Antarctic ecosystems, enhanced UV-B radiation associated with stratospheric ozone depletion has represented an additional environmental stressor for terrestrial vegetation, yet its role has rarely been examined from a community-level perspective. Here, we present a synthesis of emerging patterns from an ongoing study exploring UV-B tolerance and post-stress recovery across dominant species representative of contrasting Antarctic vegetation types along habitats on Livingston Island. Using controlled UV-B exposure experiments combined with assessments of photosynthetic performance and UV-screening capacity, we examine how species differ in their functional responses to short-term UV-B stress. Rather than showing a uniform response, preliminary analyses indicate consistent interspecific differences, with contrasting combinations of sensitivity, tolerance and post-stress recovery. These response patterns appear to be associated with specific habitat conditions, suggesting that UV-B-related functional traits may contribute to environmental filtering processes in Antarctic vegetation. By framing UV-B responses within the context of cold ecosystem ecology and vegetation science, this study highlights how extreme radiation environments can promote functional differentiation among species and influence the assembly of Antarctic plant communities. This perspective provides a basis for integrating physiological stress responses into broader frameworks of vegetation ecology in polar and other cold-region ecosystems.

Disentangling climatic hazard, vulnerability, and exposure to assess vegetation risk under climate change in three Italian mountain areas

Francesco Maria Sabatini [(1)]; Manuele Bazzichetto [(1)]; Gianmaria Bonari [(2)]; Alessandro Chiarucci [(1)]; Michele Di Musciano [(3)]; Martina Livornese [(1)]

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PB1

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Climate change is expected to rapidly increase in importance as a driver of biodiversity loss. Its impacts on vegetation will depend both on the magnitude of climatic change experienced at a given location and on the susceptibility of plant communities to those changes. To predict climate-driven changes in vegetation patterns, we adopted a risk-science framework and separately assessed climatic hazard (the likelihood of experiencing climatic change of a given magnitude), vulnerability (community susceptibility), and exposure (the value or rarity of communities at risk). We calibrated generalised dissimilarity models using vegetation surveys and a set of climatic, edaphic, topographic and land cover predictors in three protected mountain areas in Italy. We then mapped compositional dissimilarity under current and future climate conditions to identify spatial mismatches and convergences among hazard, vulnerability, and exposure. Highly vulnerable and rare communities were not consistently located in areas expected to have the strongest climatic change. Nevertheless, across scenarios we identified recurrent hotspots of risk, where high levels of hazard, vulnerability, and exposure converged. These hotspots were often associated with dry, south-facing slopes characterized by relatively high temperatures and low precipitation. By integrating multiple dimensions of climate risk, our framework identifies areas where strong climatic change overlaps with high ecological susceptibility and limited community representation. In these areas, compositional disruption is expected to be strongest and conservation action is therefore most urgent. This approach provides a spatial basis for prioritising adaptive conservation actions in the most vulnerable, hazard-prone, and exposed mountain landscapes.

A comprehensive picture of vegetation changes in Switzerland since 2001, based on the national biodiversity monitoring program (BDM)

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ST2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Short-term vegetation dynamics

Long-term biodiversity dynamics are key to understanding ecosystem responses to global change. Here we present a synthesis of vegetation trends derived from the Swiss Biodiversity Monitoring (BDM). A total of ca. 1,600 plots of 10-m^2 on regular grid across Switzerland have been surveyed every five years between 2001 and 2025 to record vascular plant and bryophyte composition. We applied generalized linear mixed modelling in a comprehensive analysis to assess changes in plot-level vascular plant and bryophyte species richness, mean ecological indicator values, and species-level occurrence frequencies for different land-use types, biogeographic regions, and elevation bands. Generally, vascular plant and bryophyte species richness both increased with time, though with distinct spatial and ecological patterns. Vascular plant species richness rose modestly (+4.6%), mainly in the Central Plateau, high alpine areas, and extensively managed grasslands, whereas forests and settlements showed little change. Indicator values shifted toward higher temperature and drought tolerance, consistent with climate warming and reduced moisture availability. Bryophytes showed a stronger overall increase in species richness (+14.6%), with significant gains across all biogeographic regions and land-use types. Species turnover was evident in both groups, with 139 vascular plant and 62 bryophyte species increasing in frequency, whereas 82 and 5 species, respectively, decreased, indicating ongoing compositional reorganization. Collectively, these results reveal spatially heterogeneous vegetation dynamics in Switzerland, with signs of recovery of vascular plant and bryophyte richness in some regions since 2001. They emphasize the importance of context-dependent conservation approaches and the value of high-quality long-term monitoring programs.

Metapopulation spatial synchrony decreases the potential for metacommunity stability

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MS3

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Temporal stability is key to maintaining ecosystem functioning and services over time and under global change. Stability is thought to emerge from compensatory dynamics among populations, either linked to asynchronous fluctuations or arising from statistical averaging when many populations are aggregated (i.e., the averaging effect). These effects may vary across scales, with different stabilizing mechanisms within vs. across communities within a site (metacommunity) with recent studies showing that asynchrony among populations of the same species can stabilize ecosystems (species spatial compensatory effects). We analysed more than 90 plant metacommunities across multiple regions, each annually sampled for at least six years and up to 99 years, to quantify synchrony at three hierarchical scales: within communities, among communities (metacommunity scale), and among conspecific populations (metapopulation scale). Using two established metrics of synchrony and temporal stability, together with environmental and biotic predictors, we tested two hypotheses: (1) that metacommunity stability is primarily driven by asynchronous fluctuations among constituent populations, within and across species; and (2) that higher heterogeneity within metacommunities promotes asynchrony at broader spatial scales. Contrary to expectations, metacommunities and metapopulations were predominantly synchronous, and yet compensatory dynamics were evident and largely attributable to the averaging effect. Asynchrony occurred mainly at the within-community scale, consistent with local species interactions. Landscape-level biotic heterogeneity ($_3$ -diversity and functional diversity) had little influence on broad-scale asynchrony. These results demonstrate that compensatory dynamics and synchrony are not interchangeable indicators of stability, and that explicitly accounting for them is essential for interpreting synchrony and stability patterns.

Plant and soil drivers of grassland biodiversity in the Czech–Saxon border region

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CE2

Type: Oral

Subject: Ecosystem-focused topics

Session: Central-European grasslands

Semi-natural grasslands in Central Europe continue to exhibit a pronounced decline in plant species diversity, even under long-term conservation-oriented management within protected areas. The traditional focus of conservation management on aboveground vegetation responses to defoliation regimes has resulted in a limited consideration of belowground processes, which in turn constrains management effectiveness. To address this gap, both key above- and belowground drivers of biodiversity patterns were examined in grasslands of the Czech–Saxon border region. The dataset included 39 paired plots with contrasting levels of plant species diversity from semi-natural grasslands. In addition, 15 plots were sampled from intensively managed, reseeded agricultural grasslands in Saxony (Germany). Semi-natural grasslands were managed by low-intensity mowing without excessive fertilisation, whereas agriculturally managed grasslands were intensively fertilized and cut three to five times per year. Plant species richness and soil bacterial richness were analysed on all plots. Generally, plant-available Ca, Mg, and K were associated with higher species richness. In contrast, higher plant available P was associated with lower plant species richness. However, only the difference between plant-available Ca and species richness in pairs of species-rich and species-poor plots showed a significant positive relationship. Genus-level soil bacterial communities differed significantly between species-rich and species-poor plots in Czech semi-natural grasslands. On the other hand, only a few differences were found in semi-natural grassland of Saxony, but they were significantly different in comparison with intensively agriculturally managed plots. Integrating plant species richness with soil chemistry and microbial communities is essential for effective and evidence-based conservation management of grasslands.

Phylogenetic and functional distance jointly shape competitive effects and responses among co-occurring plant species in a common garden experiment

Kevin Mejia-Alarcon [1]; Pablo Ferrandis [2]; Rocío Chaves [3]; Ariane Bárcenas [4]; Laura García [3]; Cristina Hernández [3]; Arantzazu L. Luzuriaga [5]

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DD1

Type: Oral

Subject: Ecosystem-focused topics

Session: Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation

Semiarid gypsum ecosystems in central Spain are characterized by extreme edaphic and climate conditions, creating a challenging environment where competitive interactions may strongly influence plant coexistence. In these gypsum outcrops, species vary widely in functional strategies and evolutionary histories. Here, we evaluate how functional trait distance (specific leaf area, seed mass, reproductive/vegetative ratio, maximum height) and phylogenetic distance modulate the competitive effect (the ability of focal species to suppress a phytometer species) and the competitive response (the ability of the focal species to withstand, tolerate, or reduce the performance of the phytometer). We studied pairwise interactions among annual species in a common garden experiment using seeds from 10 species collected in a well-conserved gypsum steppe. We applied linear models with standardized trait and phylogenetic distances between species pairs to model competitive effect and response indices. Larger differences in phylogenetic relatedness and maximum plant height resulted in weaker competitive effects. In addition, competitive responses showed stronger dependence on phylogenetic relatedness and functional traits: larger differences in SLA, seed size, and reproductive/vegetative ratio between species pairs reduced the focal species' tolerance to the phytometer, suggesting the existence of competitive hierarchies linked to resource acquisition strategies. Conversely, greater differences in maximum height and phylogenetic relatedness increased competitive responses, suggesting some kind of niche complementarity among more distantly related neighbors. Our findings demonstrate that phylogenetic and functional distance jointly shape interaction outcomes between species pairs. This integrative perspective enhances understanding of community assembly processes in Mediterranean drylands facing increasing environmental variability.

Donor and recipient hydrological conditions interact with soil type in shaping plant communities restored by soil inoculation.

Tobias Skjærlund

University of Copenhagen

VR4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration: Recovering plant communities with native seeds

Restoring agricultural land is necessary to mitigate biodiversity loss in intensively cultivated landscapes. Plant communities in restored areas on former agricultural soil rarely equal those in natural habitats. Recently restoration measures such as soil inoculation have shown promising results, but evidence on the importance of matching the ecological conditions of donor and recipient and their interactions with soil type remains under-explored. Using a full factorial mesocosm two-year experiment, we explored how donor provenance of inoculation material (mixed soil from dry grassland or wet meadow), recipient site hydrology (dry, moist or wet) and soil type (top or mineral soil) interacted in shaping restored plant communities. Across treatments, soil inoculation significantly increased species richness and botanical value of the restored plant communities compared to seeded controls, indicating that species are introduced and/or facilitated by inoculation. We found a consistent effect of soil type, with mineral soil increasing the species richness and botanical value of the communities. Matched treatments, where conditions of inoculum donor and recipient were the same, consistently outperformed mismatched conditions. These findings confirm that inoculation as a restoration measure can increase plant biodiversity across different hydrological conditions and can outperform more consolidated measures such as seeding with a high-quality seed mix. Further, our findings suggest the importance of handling the agricultural nutrient legacy, that can promote fast growing competitive species despite inoculation and seeding, rapidly excluding more sensitive members from the community.

Evaluating large-area vegetation models using floristic data

Elgene box

University of Georgia

BC3

Type: Oral

Subject: Special Sessions

Session: Bringing the different vegetation classification approaches together

Most, if not all, global or other large-area vegetation models have not been validated or otherwise rigorously evaluated, especially geographically over the full range of their claimed areas of applicability. Such models (including DGVMs) are not floristic because there are too many species – or because they target only highly generalized land cover types. But how else can (predictive) vegetation models be evaluated except by reference to the vegetation? An intermediary between types and taxa is needed: generalized plant types (life forms) that represent groups of structurally and functionally similar taxa. What is then required for the evaluation? Models would require vegetation types that are not just opaque "blocks" but rather vegetation types that have some visible internal composition and structure (that can be compared with taxa). Evaluation requires relevés or other species lists at enough sites to do a geographically representative test of environmental (climatic) situations – and understanding the ecology of species that can represent model components in different geographic areas. This presentation concerns how to evaluate the model PFORMS and other such large-area general vegetation models, at an adequate number of geographically representative sites with adequate floristic data.

Time to switch to open data: implementing FAIR principles in the European Vegetation Archive

Irena Axmanová [(1)]; Jan Divíšek [(2)]; Klára Friesová [(1)]; Ilona Kuželová [(2)]; Marcela Řezníčková [(2)]; Martin Večeřa [(2)]; Milan Chytrý [(2)]

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VD8

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

The European Vegetation Archive (EVA) has recently become an extremely important source for large-scale vegetation and biodiversity research. EVA currently integrates more than 2 million plots from 108 providers, available upon request in a more or less restricted regime. Within the EVA-FAIR project, we aim to overcome long-standing restrictions on data openness by implementing FAIR (Findability, Accessibility, Interoperability, Reuse) principles, developing workflows and publishing open data in trusted repositories. The first project stage was a national pilot focused on the Czech Vegetation Database (CVD), one of Europe's largest vegetation-plot databases. We created its publicly accessible version (CzechVeg-Open) and a taxonomically harmonised and geographically and environmentally stratified subset optimised for research (CzechVeg-OpenStrat). Species-occurrence records from CVD were uploaded to GBIF, thereby improving global biodiversity coverage. To ensure reproducibility and future updates, we developed R scripts for taxonomic harmonisation, stratified resampling, and Darwin Core Archive export, all openly released on a newly established GitHub repository and stored at Zenodo with version control. We also provide tutorials for data handling in R. This national pilot provides a replicable model of "FAIRification" for vegetation-plot databases and is available at https://czechvegetationdatabase.github.io/ In the second stage, these tools and workflows will be scaled to the European level. Through workshops and community-building, EVA data providers will be encouraged (but not pressed) to open their datasets. We will then prepare an open, stratified version of the European Vegetation Archive. Ultimately, EVA-FAIR will unlock unprecedented access to vegetation-plot data, supporting biodiversity science, conservation, restoration, and citizen science across Europe.

Vegetation types and associated plant cover shape bacterial community structure and assembly in Mediterranean coastal wetlands

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PC5

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

Plant communities strongly influence soil microbial assemblages by modifying microhabitat conditions and resource availability, yet their role in structuring bacterial communities in Mediterranean coastal wetlands remains poorly explored. Here, we investigated how coastal wetland vegetation types and associated plant cover affect bacterial diversity, composition and community assembly processes by comparing vegetated patches and adjacent bare soil across different habitats in the Tepilora coastal wetland (Sardinia, Italy) using 16S rRNA amplicon sequencing. Bacterial alpha diversity was significantly higher in vegetated soils than in bare soils (Shannon, Simpson, Chao1 and observed ASVs; Wilcoxon tests, $p < 0.05$), indicating that plant presence enhances microbial richness and evenness. Ordination analyses revealed a clear separation in community composition between vegetated and unvegetated samples. Differential abundance analyses showed enrichment of *Actinomycetota*, *Alphaproteobacteria* and *Cyanobacteriota* in vegetated soils, whereas bare soils were dominated by halophilic and marine-associated taxa, consistent with stronger abiotic stress in unvegetated patches. Community assembly analyses further indicated a shift from predominantly stochastic processes in bare soil to stronger deterministic selection under plant cover. These results highlight plant communities as key drivers of belowground microbial organization in coastal wetlands, with implications for ecosystem functioning and resilience to climate change, particularly under increasing salinization. Moreover, the microbial information generated in this research is being leveraged to support the development of targeted active microbial inoculation strategies for wetland restoration.

Relationships between seed size, seed shape, and persistence in the Pannonian flora: contrasting relationships in different plant functional groups

Péter Török Török [1]; Viktória Törő-Szijgyártó Törő-Szijgyártó [2]; Katalin Szél-Tóth Szél-Tóth [2]; Hajnalka Málik-Roffa Málik-Roffa [2]; Luis Roberto Guallichico Suntaxi Guallichico Suntaxi [2]; Szilvia Madar Madar [2]; Gergely Kovacsics-Vári [2]; Andrea McIntosh-Buday McIntosh-Buday [2]; Patricia Elisabeth Díaz Cando Díaz Cando [2]; Judit Sonkoly Sonkoly [2]

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SR6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

Seed persistence data are vital from both theoretical and practical considerations but collecting direct persistence data for many species is unfeasible. Identifying traits associated with seed persistence could help predict the persistence of many species, but studies on the effects of seed size and shape on persistence yielded results varying across regions. We studied 392 species of the Pannonian flora (Central Europe) to assess: (I) how seed mass and shape are related to persistence, (II) whether this relationship is consistent across plant functional groups (PFGs), and (III) whether seed mass and shape are correlated in different PFGs. We collected data on seed mass and persistence and performed measurements to calculate the species' seed shape index (higher values indicating greater deviation from sphericity). We analysed the effects of seed mass and shape on persistence, as well as the relationship between these two traits, accounting for phylogenetic non-independence. Across all species, both seed mass and seed shape index were negatively related to persistence. The same relationship was observed in forbs and short-lived species, but only seed shape was related to persistence in graminoids. The relationship between seed mass and shape also varied between PFGs. In conclusion, consistent with several previous studies, both seed mass and shape were negatively related to persistence in the Pannonian flora after accounting for phylogeny. However, only seed shape was associated with persistence in graminoids, suggesting that different factors may be at play in these groups. Therefore, future studies of this relationship may need to analyse graminoids separately.

Ellenberg ecological indicators for the Spanish flora

Rosario Gloria Gavilán García

Complutense University

VD3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

The ecological indicators of Ellenberg (EIVs) for species and subspecies have been compiled for the Spanish flora. Indicator values for light (L), temperature (T), moisture (F), soil reaction (R), nutrient availability (N) and salinity (S) were assigned to aprox 7000 species using the nine-degree, or 12-degree for moisture and 10-degree for salinity, using the ordinal scales proposed by Heinz Ellenberg for the flora of Germany. We have used the original Ellenberg indicators as a baseline, together with datasets from other reference floras from close countries: Jiménez-Alfaro et al. from the Cantabrian Range; Julve et al. from France; Pignatti et al. and Guarino et al. from Italy; Böhling et al. for the South of Greece and Landolt et al. for Switzerland. We used the reciprocal averaging method to fill values of the EIVs for the species of different vegetation datasets obtained from SIVIM (Font et al. 2012). We have revised all vegetation types existing in Spain: therophytic vegetation, high-mountain and alpine vegetation, *Quercus pyrenaica* forest, other forest vegetation, ruderal vegetation, pastures s.l., coastal and saline vegetation and shrublands and scrublands. The total number of plots was approximately 75000. that were analyzed with Juice v.7.1 and the R package FD, functcom. The final list has been checked by a committee of experts in flora and environmental relationships. The results showed a final list of more than 7000 species and subspecies, each with a value for those EIVs.

Economic spectrum of rhizomes

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HH5

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Plant economic spectrum is very popular concept of trait-based ecology that was examined not only for acquisitive traits of leaves and fine roots, but also on stems connecting them and bearing the weight of branches and leaves. Nevertheless, plant economic theory was never applied to organs of herbs that are belowground and serve for connection of roots and shoots, storage, protection against seasonal adversities, for regeneration after injury and clonal multiplication. We assembled a set of chemical, anatomical and morphological traits and examined how they describe economy of belowground perennating organs of herbs (BO). We found numerous combinations of traits without any dominant adaptation axes, and we believe that this pattern reflects multifunctionality of those organs. When considering longevity of BO as an important measure of its economy, it was correlated with dry matter content and relative area of phloem on the cross-section. While correlation with dry matter content is in accordance with trend found in long-lived leaves and fine roots, the area of the phloem points out the importance of transporting function. The large phloem enables strong support of the belowground long-lived organ by photosynthates transported from leaves to the storage organ in favorable season and back at the end of unfavorable season (e.g. winter rest) to support seasonal regrowth. Our analysis is but the first step in understanding economy of storage belowground organs of herbs and opens new perspectives to whole plant function.

Improving monitoring for the EU Habitats Directive with quantitative assessment of vegetation plots: Nardus grasslands as an example

Stephan Kambach [1]; Jandt Ute [1]; Alicia Teresa Rosario Acosta [2]; Jose Manuel Álvarez-Martínez [3]; Manuele Bazzichetto [4]; Marta Carboni [2]; Milan Chytrý [5]; Gabriella Damasceno [6]; Franz Essl [7]; Klára Friesová [5]; Michael Glaser [7]; Georg J. A. Hähn [8]; Florian Jansen [9]; Borja Jiménez-Alfaro [10]; Ilona Knollová [5]; Roger Norum [11]; Francesco Maria Sabatini [8]; Alicia Valdés [10]; Helge Bruelheide [12]; MOTIVATE consortium (Stefan Dullinger, Tracy Hruska, Bernd Lenzner) [13]

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BC7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

Precise tracking of spatiotemporal trends in threatened habitats is crucial for understanding and alleviating the current biodiversity crisis. Therefore, the effective monitoring of threatened priority habitats is a key element of the EU Habitats Directive (HD). However, quantitative monitoring of habitat quality is often complicated by country-specific assessment criteria and data gaps. Here, we used species-rich *Nardus* grasslands, a highly diverse priority habitat that has been suppor-

ted by millennia of extensive land use, to show how collaborative scientific vegetation databases can support the quantitative monitoring of priority habitat types. After compiling the specific habitat indicator species from all national habitat interpretation manuals, we first constructed an algorithm to identify *Nardus* grassland plots from the European Vegetation Archive (euroveg.org/eva-database) and the ReSurveyEurope database for vegetation-plot time series (euroveg.org/resurvey). Then, we synthesized the information on species composition, relative cover, and species-specific traits to estimate the spatial and temporal trends in habitat quality, diversity, and functional composition. Aiming at a generalizable pipeline to leverage official monitoring with vegetation databases, we highlight the advantages, challenges, and limitations towards a more robust and quantitative monitoring of biodiversity change across Europe.

Arctic seed germination in a warming climate

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CD9

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Arctic ecosystems are warming nearly four times faster than the global average, with projected continued acceleration. The regeneration niche is highly sensitive to environmental variability, and germination success and timing are strongly influenced by temperature and precipitation to ensure establishment during favorable conditions. The rapid environmental shift threatens Arctic biodiversity and ecosystem functioning with cascading effects across trophic levels and feedback to the global climate. Understanding the germination niche across temperature and moisture gradients is therefore essential for understanding Arctic vegetation responses to climate change. More than 70 species were collected across multiple environments within the Arctic Circle. We tested germination responses under controlled gradients of temperature (5 to 25 °C) and water potential (0 to -0.6 MPa), representing conditions characteristic of both current and future Arctic climate. Experiments included freshly collected seeds and cold-stratified seeds for five months to simulate Arctic winter conditions. Germination of fresh and cold stratified seeds was compared, and results showed a widening of the thermal niche. Cold stratification significantly improved germination success of Arctic species, and while seeds generally preferred warm and humid conditions, the germination niche of Arctic species was highly variable, suggesting that some species may struggle to germinate in future Arctic climates. Our study provides critical insights into the germination niches of various Arctic species, highlighting potential challenges of vegetation regeneration in a warmer and drier Arctic. These findings are vital for assessing the risks to future Arctic plant diversity and conservation efforts in a rapidly changing environment.

Climbing invaders: effects of non-native lianas on riparian forest communities

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AE13

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Invasive climbing plants, particularly lianas, can strongly alter forest structure and composition by competing with native vegetation, although their effects across different forest layers have rarely been investigated. Using 122 paired plots (invaded vs. non-invaded), we investigated how four non-native liana taxa (*Humulus scandens*, *Parthenocissus quinquefolia* group, *Sicyos angulatus*, *Vitis riparia* group) affect the taxonomic diversity (species richness and Simpson diversity) functional diversity (FD), and functional composition (community-weighted mean, CWM) of plant height and specific leaf area in riparian forests along the second longest river in Italy (410 km, northeastern Italy). We found that different taxa tend to invade distinct vegetation layers. Simpson diversity was higher in invaded plots than in non-invaded plots when all layers were considered, whereas both Simpson diversity and species richness were higher in invaded plots only in the tree layer. Across layers, invaded plots showed lower FD and CWM for plant height and higher FD and CWM for specific leaf area compared to non-invaded plots. However, these responses depended on the vegetation layer considered, with the tree layer in invaded plots showing higher FD and CWM for all traits except CWM for plant height, which was lower. Similar patterns were observed in the shrub layer, although FD for plant height was lower in invaded plots. In the herb layer, only plant height CWM was lower in invaded plots compared to non-invaded plots. Overall, our results demonstrate that invasive lianas can alter community structure and functional composition differently across forest layers in riparian ecosystems.

An integrated genomic and restoration framework for the conservation of the Algerian oak (*Quercus canariensis* Willd.) in Portugal

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VR6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration: Recovering plant communities with native seeds

The Algerian oak (*Quercus canariensis*), classified as Critically Endangered (CR) in mainland Portugal, is threatened by habitat fragmentation and hybridization with *Q. faginea*. To strengthen conservation actions, we implemented an integrated framework combining population genomics, common garden trials, and multi-scale ecological modelling. Whole-genome resequencing enabled the identification of genetically pure maternal trees within core populations. From these, 12 offspring per site derived from genotyped pure mothers were established in a network of common gardens distributed across Portugal, including multiple properties in the southwestern region, a biogeographically critical area for the species. These trials enable long-term monitoring of survival, growth performance, phenotypic variability and adaptive responses under contrasting environmental conditions. To inform restoration planning, we developed micro-scale habitat suitability models focused on southwestern Portugal, integrating high-resolution environmental data and field-based vegetation assessments. These were combined with national-scale predictive modelling to identify priority zones for reinforcement, assisted regeneration, and the establishment of genetically validated conservation orchards.By integrating genomic validation, experimental

field trials and spatial modelling, this project refines restoration strategies for *Q. canariensis*. The approach links in situ reinforcement with ex situ propagation from genetically confirmed material and evidence-based spatial planning, providing a transferable framework for the conservation of relict Mediterranean forest trees under accelerating environmental change.

Biodiversity regeneration in Mediterranean shrublands: ecological losses associated with shortened fire return intervals

María de la Encarnación Coca García

University of Valladolid

FP4

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

The assembly of biodiversity is a dynamic process emerging from the interplay between deterministic and stochastic mechanisms and widely studied in local plant communities. Among deterministic processes, environmental filtering acts through trait–environment matching, whereby abiotic constraints and biotic pressures determine which species can establish and persist eventually. In fire-prone ecosystems, environmental filtering is strongly influenced by recurrent disturbances such as wildfires, whose frequency and intensity are expected to increase under ongoing climate change. Nevertheless, the relative roles of abiotic and biotic filters in shaping taxonomic, functional, and phylogenetic diversity across spatial gradients and along secondary succession remain poorly understood. We analysed seven Mediterranean shrubland localities along an altitudinal gradient (400–1400 m a.s.l.), covering a wide range of ages since the last disturbance. Using Structural Equation Models, we evaluated how taxonomic, functional, and phylogenetic diversity respond to climatic, edaphic, and successional age variables. Diversity patterns were quantified using standard indices of diversity and dispersion across the three biodiversity dimensions. Our results show that taxonomic, functional, and phylogenetic diversity increase along secondary succession and toward warmer, drier conditions. However, the limited expansion of phylogenetic diversity suggests that newly incorporated species belong primarily to already represented, closely related lineages, indicating persistent abiotic filtering. Overall, our findings suggest that recurrent disturbances such as wildfires may truncate successional trajectories, limiting the full recovery of taxonomic, functional, and phylogenetic complexity. Under projected climate change scenarios, increasing wildfire frequency is therefore likely to have significant consequences for plant biodiversity recovery in Mediterranean landscapes.

Organization of the plant body: morphology, construction, and aboveground-belowground relationships

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HH4

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Plants, due to their sessile nature, must build their bodies to reach all the essential elements for their life, namely water, nutrients and light. This is best served by large bodies, but terrestrial environments sets a number of functional and biomechanical requirements on how the plant body must be built. The overall size of the body must be matched by the diameter of the connecting organs (stems, thick roots), both because of construction stability and because of matter transport through them. The plant body, however, is built iteratively by adding metameres at the growing tip. The apical growth follows the rules of cell division and tissue differentiation, which do not necessarily fully match the structural requirements placed on them in later age. Plant developmental morphology thus dictates a set of non-biomechanical constraints on how the plant body looks like, which can be traced to construction of individual plant metameres, apical meristem size, and ultimately, seedling and seed (embryo) parameters. After making the key distinction between woody species (which thicken secondarily) and herbs (which do not), we concentrate on herbs, and explore how these relationships constrain how the plant shoot looks like, which correlative rules govern its construction, and how this can be traced to cell growth processes at the apical meristem level. We show how these constraints affect the key plant traits associated with growth and competition (mainly for light), response to disturbance, and how they are linked to sizes of belowground organs.

Subarctic cold spot Faroe Islands shows decreasing floristic diversity and no thermophilization in summit vegetation over the past two decades.

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CD11

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

The Faroe Islands represent a subarctic, mountainous, 'cold spot'. However, it is currently difficult to predict whether the archipelago's climate is warming or cooling as a result of global warming (due to a possible weakening of the North-Atlantic-Current). Here, we present novel data on plant community dynamics from floristic summit monitoring over two decades on weathered basalt volcanic bedrock – as part of the Global Observation Research Initiative on Alpine Environments (GLORIA). Richness and abundance of angiosperm and cryptogam species were recorded across an altitudinal gradient from 372 m to 752 m a.s.l. The loristic pattern was resurveyed between 2005 and 2025. Here, we present plant community dynamics along with novel metrics for analyzing "winner" and "loser" species. The total summit vegetation species pool of Faroe Islands consists of 80 plant species (50 forbs, 24 graminoids, 6 dwarf shrubs, 20 mosses, 9 lichens). Bryophytes dominate vegetation cover on higher summits, graminoids on lower summits. However, although the rate of richness change across continental European mountain summits is generally increasing, which has been correlated with rising temperatures, our data from the Faroe Islands suggest that more species have disappeared than newly appeared. Thus, we present evidence of local species loss. Remarkably, species redistribution dynamics at Faroe Islands over the last two decades result in a lower "Thermophilization Indicator" D = -0.023 (S2025 – S2005) than the European average D = 0.054. Such a decrease in thermophilization of mountain summit vegetation has rarely been presented elsewhere so far.

Rocking across scales: assessing spatial resolution and ecological information in remote sensing surveys of mountain vegetation

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EO9

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

High heterogeneity is symptomatic to natural ecosystems. This variability can be approached using remote sensing capable to provide high spatial resolution and covering inter-annual phenological changes. However, the crucial question remains: What is the optimal spatial/temporal resolution of the survey, and how does the changing scale influence the captured information? We hypothesize that increasing spatial detail does not necessarily increase ecologically meaningful information. The noise, position inaccuracies and very fine-grained vegetation mosaic can complicate generalization.

To address this issue, we studied mountain habitats above the treeline in Krkonoše Mts, Czech Republic, consisting of a fine grain mosaic of short herbs, grasses, mosses, chamaephytes, shrubs and bare soil and scree, often covered by lichens. Whereas such ecosystem can be considered rather homogeneous temporally, changing slowly under extreme mountain conditions, it is very heterogeneous spatially. We assess the effect of changing scales on the amount of revealed variability. Drone and satellite data were acquired regularly over the season, resampled to 10, 20 and 50 cm spatial resolution, and vegetation classified using both pixel and object-based methods. Results were compared to the detailed ground survey and expert onscreen interpretation.

Our results indicate that increasing spatial resolution does not necessarily enhance the ability to classify vegetation into phytosociologically meaningful units. Conversely, the immense structural variability captured at this scale can obscure community-level patterns and reduce the potential for comprehensive classification. Still, it enables precise detection of dominant species or life forms, particularly relevant for studying fine-scale ecological changes in high mountain environments.

Using stable isotope ratios as plant traits in vegetation ecology

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HUN-REN Centre for Ecological Netwirk

CA2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

In trait-based studies, usually easily measurable, so-called soft traits are used. The disadvantage of these is that their relationship with the processes is indirect and often unclear. Measuring so-called hard traits, which are more closely related to the function, is more complicated, but may give more usable results. In the presentation, I would like to present the application of a special group of hard traits, stable isotope ratios, partly based on literature data, partly based on my own studies, with the latter also addressing practical questions (sample size, laboratories in Hungary, cost). Different isotopes of an element do not differ from a chemical point of view, but due to their different atomic masses, they participate in physical processes at different speeds. Therefore, their ratio in plants may differ from the value typical in nature, and the degree of the difference may be characteristic of species. The two most important isotopes in plant ecology are 13C and 15N. CO_2 containing the 13C isotope is more difficult to cross membranes than the 12C isotope, so its proportion in plants is lower than in the air. The difference depends on the path of photosynthesis (C3 and C4 plants differ markedly) and on the openness of the stomata. Because of the latter, the 13C ratio is a proxy for water use efficiency (WUE) in C3 plants. The 15N ratio is determined by the depth from which and in what form the plant takes up nitrogen

Linking LiDAR-derived forest structure to functional plant diversity along secondary succession

Lorenzo Orzan [1]; Antonio Tomao [2]; Luca Cadez [3]; Valentino Casolo [2]; Paolo Cingano [1]; Giacomo Trotta [4]; Kamil Král [5]; Martin Krůček [5]; Filip Kratoš [5]; Miha Živec [5]; Giorgio Alberti [2]

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EO3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Forests harbor a large share of terrestrial biodiversity, which underpins key ecosystem functions and services. Forest structure is a major driver of biodiversity at local scales, as it regulates microclimatic conditions and resource availability. However, its role in shaping diversity patterns among communities, particularly from a functional perspective, remains insufficiently explored. In Europe, widespread land-use abandonment has promoted secondary forest expansion, providing an opportunity to investigate how forest structure develops during succession and how it influences understory plant diversity. Using a space-for-time substitution approach, we examined relationships between LiDAR-derived forest structural attributes and functional plant diversity along secondary successional gradients in north-eastern Italy (Friuli Venezia Giulia). Historical orthophotos were used to identify four successional stages following meadow abandonment. Four independent chronosequences were analysed, resulting in 16 forest plots (531 m² each). Understory vegetation was surveyed in three 5 × 5 m subplots per plot, recording species cover. Functional diversity indices based on literature-derived traits were calculated. High-density Unmanned Laser Scanning (ULS) acquired during leaf-off conditions enabled detailed characterization of forest architecture. Structural metrics describing height heterogeneity, canopy gaps, and vertical complexity were extracted from processed point clouds. Functional alpha-diversity showed weak and inconsistent relationships with forest structure attributes. In contrast, distance-based redundancy analysis (dbRDA) indicated that LiDAR-derived structural metrics explained a substantial proportion of functional beta-diversity. These results suggest that, in this context, forest structure plays a limited role in shaping local functional diversity but is a key driver of functional differentiation across forest communities.

Similar and synchronous?

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MS2

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

The temporal stability of plant communities is of paramount importance for maintaining multiple ecosystem functions over time. The urgent need to understand the underlying stabilizing mechanisms of plant communities is nowadays reinforced by predictions of increased extreme climatic events under climate change, which have been shown to negatively impact ecosystem stability. Asynchronous fluctuations of coexisting species can stabilize communities. Functional dissimilarity, i.e., how species differ in their functional traits, is a mechanism proposed to regulate the degree of asynchrony and, consequently, community stability. We propose to identify the internal community dynamics of coexisting species by identifying pairs and clusters of synchronous and asynchronous species within communities in a dryland biodiversity hotspot in Israel. We test whether synchronous and asynchronous dynamics are associated with functional dissimilarity in species' drought resistance and reproductive traits using a Mantel test to relate the trait dissimilarity matrix to the temporal correlation matrix within each community. To examine the generality of this relationship, we analyze communities across a gradient from Mediterranean to arid climates, varying in mean annual rainfall, interannual variability, and rainfall unpredictability. Understanding the functional mechanisms underlying asynchronous fluctuations should clarify how communities remain stable over time and improve our ability to predict their potential to resist future extreme perturbations.

Keywords: community stability, asynchrony, functional dissimilarity, drylands

Extreme fire severity interacts with seed traits to determine plant community assembly

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FP1

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Fire is an important ecological process in ecosystems around the world and shapes the evolution of traits that allow plant species to persist, and even thrive, in fire-prone communities. Fire regimes, made up of fire frequency, severity and seasonality, act as a selective force on traits and as a filter on community assembly. The study of fire-driven filtering of community composition has often focused on fire frequency and two alternate persistence mechanisms, resprouters and obligate seeders. However, other components of the fire regime, including severity, and other persistence traits, are less well studied. Furthermore, fire regimes are shifting due to climate change and other anthropogenic factors, leading to an urgency to understand the impacts this will have on plant communities. We investigated how seed size, seed dormancy and seed bank type contribute to community composition across a fire severity gradient. Larger-seeded species tended to dominate after extreme fire severity whereas smaller-seeded species declined, with dormancy type determining patterns of response across the severity gradient. For serotinous species that retain a canopy seed bank, extreme fire severity caused a decline in recruitment for those species with thinner cone walls and therefore less protection. Evidence points to future fire regimes that include more extreme severity fire over large extents. Our results highlight that effects may be particularly pronounced in species with small seeds as safe sites with lower temperature soil heating become less available, potentially leading to compositional shifts toward plant communities that are dominated by larger-seeded species.

Global patterns of plant diversity on nature trails

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Estonian University of Life Sciences

AE14

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Natural terrestrial ecosystems are shrinking globally, while nature tourism and ecotourism are growing, increasing pressure on protected areas where nature trails are typically located. These trails are mostly located in the last remaining pristine and intact nature areas, especially in the developed countries. Understanding the long-term ecological effects of visitor load on nature trails and the ecosystems surrounding them remains challenging due to very limited number of large-scale, standardized studies. We developed a macroecological framework to assess the impacts of tourism on biodiversity and ecosystem sustainability on a global scale that is based on plot-based surveys in different habitat types in nature trails. In addition, we gathered data about various social and infrastructural aspects of these trails. We analyzed the various effects of visitors on plant diversity in different types of trails, habitats and cultural spaces in more than 100 nature trails from 15 countries from several continents. Additionally, we identify key natural and anthropogenic factors influencing visitor distribution, providing suggestions for sustainable management of nature tourism. Our results indicate that nature tourism has a long-term negative effect on the vegetation of nature trails and their surroundings, but this depends on habitat types.

Historical and current drivers of plant biodiversity in floodplain forest quality. Lessons from a regulated pre-alpine river

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FW4

Type: Oral

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Temperate floodplain forests are biodiversity hotspots in Central Europe. Pre-alpine rivers, such as the Isar in southern Germany, support distinctive floodplain forests shaped by extensive sediment transport and dynamic hydrological regimes. However, river regulation has profoundly altered these environmental conditions, and due to the high density of human settlements full restoration of a free-flowing unregulated state is unfeasible. This raises some questions about the trajectories of biodiversity in floodplain forests, depending on either continued degradation or adaptive forest conservation. The study used a stratified sample of 120 sites along a 60-km section at the Isar river between Munich and Landshut. It analysed gradients of floodplain integrity based on hydrological conditions, naturalness of tree species composition, historical maps and successional legacies, and assessed the extent to which they are reflected by floodplain vegetation. Using this approach, we identified characteristic plant species and functional traits that indicate near-intact floodplain forest structure and dynamics. We evaluated how the gradients contribute to present-day community structure in both former and remaining inundated areas approximately 100 years after channelization of the river. Our results provide insights into the persistence of floodplain forest characteristics under long-term river regulation and offer valuable arguments for realistic conservation strategies in regulated Alpine rivers. They demonstrate that the legacy of historical river dynamics is progressively diminishing due to the absence of early successional stages, and that current vegetation patterns have become increasingly adapted to the altered hydrological regime, as reflected by indicator species associated with different hydrological dynamic types.

Validation of plot locations in vegetation databases using remote sensing

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EO14

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Vegetation plot databases are essential data sources for biodiversity assessment. However, their applicability for large-scale ecosystem mapping and monitoring is limited by the spatial uncertainty of plot locations, which constrains their integration into methodological frameworks based on remote sensing (RS). When available, plot-location information ranges from textual descriptions to coordinates with errors of a few meters to tens of kilometers. Here, we present a framework to validate vegetation-plot locations focused on a) metrics related to three RS-derived Essential Biodiversity Variables (EBVs): ecosystem productivity, phenology, and structure, obtained from Landsat, Sentinel-2 and GEDI data; and b) Google Satellite Embeddings, representing ecosystem spatial and structural patterns beyond raw spectral information. Using the ReSurveyEurope database as a case study, we selected observations with the most accurate coordinates (i.e. those located with GPS) and extracted RS data to train machine learning models that classified all observations into major habitat types (forests, shrublands, grasslands, wetlands). We found that 63% of the observations and 57% of the plots in ReSurveyEurope were validated positively (i.e., the habitat predicted by the model matched the habitat assigned in the database). Habitat classification based on Google Satellite Embeddings was slightly more accurate than EBV-related metrics derived from Landsat or Sentinel-2 and GEDI. This framework enables filtering the spatial resolution of vegetation databases for using validated plots in RS-based biodiversity monitoring. In this sense, we advocate for the implementation of vegetation-plot time series and remote-sensing indicators in future habitat monitoring schemes.

Detecting vegetation changes in Cantabrian mires using remote sensing and field resurveys

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FW6

Type: Oral

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Mires are key ecosystems providing carbon storage, water regulation and biodiversity conservation, yet they are increasingly vulnerable to global change. This vulnerability is particularly pronounced at the southern edge of their European distribution, where even moderate shifts in temperature or precipitation can rapidly lower the water table and accelerate drying processes. In addition, grazing pressure may influence vegetation structure through nutrient inputs and trampling, potentially amplifying ecological changes. To better understand these dynamics, it is essential to integrate long-term remote sensing analyses with field monitoring, combining large-scale temporal trends with field-based validation. Our main aim was to investigate trends in mire habitats by combining satellite data and vegetation resurvey in the Cantabrian Mountains. We focused on three EUNIS level 2 habitat types: Q1 (raised and blanket bogs), Q2 (valley mires, poor fens and transition mires) and Q4 (base-rich fens and calcareous spring mires). Remote sensing analyses were conducted on thousands of polygons mapped in the study region, using Landsat time series to assess temporal trends in productivity- and moisture-related indices. For the resurvey, we selected 10 sites across habitat types, corresponding to 67 historical plots revisited in 2024. Across habitats, significant changes emerged. We found a general rise in satellite-derived productivity indices, coupled with increasing species richness in the three habitat types. Moisture-related trends and shifts in ecological indicator values were also detected. Meanwhile, some mire specialists associated with deeper water conditions declined, suggesting early signs of terrestrialization. Overall, the combined approach reveals rapid vegetation change across southern European mires.

Vegetation responses to livestock exclusion: a five-year study in Pyrenean fens

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University of Barcelona

FW2

Type: Oral

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Alpine fens are key habitats that provide essential ecosystem services. In the central Pyrenees, most fens occur within extensively grazed pastures. In recent decades, cattle numbers have increased, and herds often spend prolonged periods on fens and other flat subalpine depressions, leading to overgrazing. To address this issue, land managers aim to restore the ecological value of degraded fens in protected areas. However, the capacity and rate of recovery following grazing reduction or cessation remain unclear and likely depend on degradation level, local species pool, elevation, climate, and other ecological factors. Furthermore, secondary succession may drive vegetation toward communities distinct from pristine fens. To assess recovery, portions of six subalpine fens (1630–2000 m a.s.l.) were fenced in 2018 and 120 permanent plots (50 × 50 cm) established. Vegetation changes were evaluated over the short (1 year) and medium term (5 years) under livestock exclusion and under continued overgrazing. Vegetation rapidly recolonized pugged areas, more slowly in colder, acidic fens. Colonizers derived from the local species pool and comprised fen pioneers and generalists, spreading mainly through clonal growth; seed germination was secondary, except for *Juncus articulatus*. After five years, competitive species such as *Carex paniculata* became dominant in some sites but did not exclude others, although bryophytes declined. Plant communities in fenced plots diverged from those in overgrazed plots but still have signs of ruderalization. These results provide critical evidence for regulating extensive grazing and for designing restoration and protection strategies in overgrazed alpine fens.

When fungal friends turn foes: ectomycorrhizal networks spread carbon limitation and impair plant water relations in the field

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PC1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Plant community interactions: Relationships with symbiotic and mutualistic organisms

How plants allocate carbon determines their productivity, responses to stress, and interactions with other organisms. A substantial amount of plant carbon is stored as non-structural carbohydrates (NSCs), which sustain turgor via osmoregulation and fuel metabolism when carbon is limited. NSC stores also support root-colonizing ectomycorrhizal fungi, which can receive ~15% of net primary productivity in exchange for nutrients and other benefits. Quantifying the factors that shift carbon allocation to ectomycorrhizal fungi is important because this carbon drives ecosystem processes. We hypothesized that under carbon-limiting conditions such as drought, ectomycorrhizal carbon demand can reduce NSC reserves needed to maintain turgor, resulting in a trade-off between feeding ectomycorrhizal fungi and tolerating drought. We manipulated carbon allocation to ectomycorrhizal (EcM) networks putatively connecting wild ponderosa pine (Pinus ponderosa) trees by girdling a tree within an EcM network and assessed responses in neighboring connected and disconnected trees under drought and ambient conditions. In droughted plots, EcM networks drained 33% of stored NSCs and reduced turgor 10% relative to ungirdled neighbor, despite girdling-induced reduced competition for water. This pattern was not observed in non-droughted plots or when trees were disconnected from the EcM network by trenching. This suggests an increase in carbon demand by the EcM network in response to girdling, and an allocation trade-off under carbon-limiting conditions. Our findings highlight that stress can spread from plant to plant via shared ectomycorrhizal networks. Given the expected shifts in climate, carbon pathways from plants to ectomycorrhizal fungi and their relationship might change under future droughts.

Ecological Indicator Values for Europe (EIVE) 1.5: now including bryophytes, lichens and macroalgae

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VD7

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

We reached a new milestone in our efforts to create a comprehensive database of Ecological Indicator Values for all plants in Europe with version 1.5 of EIVE. In addition to the vascular plants included in EIVE 1.0, this version covers a substantially higher number of vascular plants, but also bryophytes, lichens and macroalgae from Europe and neighbouring regions. We considered all EIV systems that included at least one of the following indicators: moisture, nitrogen or nutrients, reaction, light or temperature. Nomenclature has been standardised to Euro+Med, with extensions documented for taxa not included therein, such as lichens, macroalgae, hybrids, neophytes and aggregates. In total, 56 systems met our criteria, comprising over 125,000 assessments. The EIVE 1.5 database provides niche position and niche width for over 22,000 accepted taxa (from varieties to species aggregates). We carefully set the gradient ranges of the respective source systems and averaged optima as well as minimum and maximum niche values for an initial EIVEini list. The initial country lists were then corrected once with a linear regression to this EIVEini before averaging and normalising the final European EIVE mean for every taxon. We will discuss the methods applied and some of their alternatives as well as the next steps to go. The database "Ecological Indicator Values for Europe (EIVE) 1.5" and all harmonised source systems will be made available in an open-access repository. We will publish the R code of the workflow and provide an interactive online dashboard for exploring the data.

Peri-Carpathian forest-steppe: a relict non-equilibrium ecosystem shaped by long-term disturbance

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LT3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

At the IAVS 2008 conference in Stellenbosch we presented a hypothesis proposing a deep historical link between pine-birch forests of West Siberia and their Central European analogues, suggesting that both represent relics of Early Holocene vegetation. This lecture synthesizes more than 15 years of follow-up research in the fields of vegetation ecology and paleoecology, resulting in the concept of the peri-Carpathian forest-steppe. It is a non-equilibrium ecosystem persisting in a non-forest state despite a climate suitable for closed forests due to recurrent disturbances such as grazing, burning, haymaking, and other human activities. At the same time, it represents a relict ecosystem in which light-demanding species have survived for millennia, in some regions likely since the Late Pleistocene. Many of these species probably originate from Late Glacial and Early Holocene hemiboreal forests, whose historically accumulated species pool contributes to the exceptional biodiversity of present-day forest-steppe grasslands. These characteristics place the peri-Carpathian forest-steppe (associated with the Carpathian Mountains) among a distinct group of disturbance-dependent semi-open ecosystems worldwide, where long-term continuity of non-forest habitats sustains high species richness. The system also shows links to collapsed Pleistocene ecosystems, whose openness was maintained by large herbivore grazing and fire, highlighting alternative pathways for the long-term persistence of open habitats outside arid regions.

Widespread thermophilization but weak link to climate warming in Europe's mountaintop vegetation

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CD2

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Over the past decades, considerable changes in alpine vegetation have been observed and often attributed to climate warming. This attribution is particularly intuitive in the case of plant community composition shifting towards more warmth-demanding species, a process referred to as thermophilization. However, the causal link between thermophilization and warming has rarely been explicitly tested. Here we combined local long-term microclimatic temperature data with vegetation surveys in 724 permanent plots across 53 European mountain summits monitored over 21 years to evaluate a possible thermophilization trend and relate it to rates of change in ten macro- and microclimatic temperature metrics. We found both significant thermophilization of plant communities and increases in temperatures across the entire continent, but relationships between the magnitudes of thermophilization and temperature change were weak to non-existent, especially at the scale of local communities. Instead, substrate conditions, and particularly the availability of thermophilic colonizers in the surrounding vegetation had a strong impact on observed thermophilization rates. We conclude that the response of plant communities to climate change strongly depends on the abiotic and biotic context and can hence be difficult to detect without accounting for these confounding factors. Factoring in this complexity will require still intensified monitoring efforts.

Trait syndromes of plant winners and losers in European agroecosystems under long-term agricultural intensification

Greta La Bella [1]; Marie-Charlotte Bopp [2]; Jana Bürger [3]; Alejandro Juarez [4]; Nina Leclef [5]; Karim Barkaou [6]; Gaëlle Bernadas [7]; Jocelyne Cambecèdes [7]; Stephane Cordeau [8]; Romain Frelat [1]; Léa Genty [9]; Brice Giffard [8]; Laure Martin-Lefevre [10]; Aurélie Metay [11]; Helen Metcakfe [12]; Alice Michelot-Antalik [13]; Benoit Ricci [8]; Silvia Winter [14]; Guillaume Fried [9]; Elena Kazakou [15]

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LT10

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Agricultural intensification poses a major challenge to spontaneous plants in agroecosystems, leading to widespread species loss. Despite overall negative trends, some species have nevertheless persisted or even benefited from this intensification. However, the functional characteristics that determine species' decline or success remain unclear. Using resurvey data collected at 703 sites from the 1940s to the present, we modelled temporal changes in occurrence and cover of 688 plant species to identify species that have consistently increased (winners) or declined (losers) over time across a North-South European gradient of agroecosystems, comparing intensively managed annual crop rotations with typically less intensive perennial cropping systems. We identified the functional trait syndrome associated with winners and losers by testing the effects of key response traits, such as specific leaf area (SLA), plant height, and seed mass, on species' temporal responses. Overall, we found a markedly higher number of losers than winners in both agroecosystems, with losses being particularly pronounced in annual crops. Preliminary trait-based analyses suggest that, across both systems, loser species are characterised by traits associated with low tolerance to disturbance and nutrient enrichment, such as lower SLA, shorter stature, and heavier seeds. In contrast, winner species tend to exhibit traits linked to rapid resource acquisition, faster growth, and effective dispersal, including higher SLA, taller stature, and lighter seeds. Our results indicate that species trajectories can be partly explained by consistent trait-based responses across agroecosystems, highlighting the potential of functional traits to anticipate biodiversity changes under future agricultural scenarios.

Anthropocene shifts within global plant functional trait space

Jan Pergl [1]; Sophie Wolf [2]; Daria Svidzinska [2]; David Schellenberger Costa [3]; Miguel D. Mahecha [2]; Lirong Cai [4]; Julia Joswig [3]; Karin Mora [3]; Guido Kraemer [2]; Kolja Nenoff [2]; Marten Winter [2]; Christian Wirth [5]; Helge Bruelheide [6]; Mark van Kleunen [7]; Holger Kreft [8]; Petr Pysek [1]; Patrick Weigelt [9]; Teja Kattenborn [10]

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AE6

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Since the onset of European colonial expansion, humans have reshaped global plant biogeography by accelerating intercontinental species migration. These introductions, together with land-use and climate change, have reorganized plant communities worldwide. Yet we lack a macroecological assessment of how this redistribution has altered the global structure of plant functional trait space.

Plant ecological strategies organize along major axes of variation, including a size spectrum and the leaf economics spectrum. We hypothesize that human-mediated species movements since the Anthropocene (~1610) have driven systematic regional shifts within this global trait space, resulting in directional changes in assemblage-level functional composition. We integrate global plant occurrence records with functional trait data and information on native and introduced ranges to reconstruct historical (native-only) and contemporary assemblages. Using dimension reduction, we identify major axes of biogeographical trait variation and quantify how introductions have shifted regional plant communities (grid-cell averages) within this multidimensional space. We recover three global axes of trait variation: a size axis, a leaf economics axis, and a third reflecting carbon–nitrogen allocation. Across most regions, contemporary assemblages shift toward the smaller, faster, nitrogen-rich end of this three-dimensional strategy space. However, the magnitude and dominant direction of change vary regionally, indicating that human-driven species exchange has differentially shifted regional floras along distinct functional dimensions. Using introduced species as an integrative lens on colonization, land-use transformation, and other anthropogenic pressures, we provide the first global estimate of centuries-scale, directional shifts within plant community trait space.

Competition drives pronounced extinction debt in mountain plants

Norbert Helm

University of Vienna

CD14

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

While the number of vascular plants species on European mountain summits has increased rapidly in recent decades, local species extinctions have remained surprisingly rare despite pronounced climatic warming. This discrepancy is often attributed to lag times, but the presumed extinction debt is difficult to demonstrate with empirical data. We followed a novel approach by using four years of vital rates measurements from plant individuals to compute environment-dependent population growth rates of 44 frequent species at 853 plots across a typical alpine landscape in the European Alps. We find negative population growth rates, i.e. declining populations, under current environmental conditions for 31% of local populations. Our results suggest that this extinction debt is not primarily driven by direct temperature effects, but rather indirectly via intensified competition from neighbouring plants. Accordingly, our models predict species with low competitive abilities, which are often those adapted to coldest environments and longest snow cover, to be the fastest to go extinct. Although the estimated times to extinction for many local populations span decades to even centuries, and therefore provide a time window for species to adapt or change their distributions, ongoing climate change is rapidly narrowing this window.

Effects of nutrient enrichment on plant community stability and its components

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MS8

Type: Oral

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Understanding how nutrient enrichment affects the temporal stability of grassland productivity is essential for predicting ecosystem responses to anthropogenic pressures. Previous global syntheses have shown that eutrophication generally destabilizes herbaceous communities, yet the mechanisms underlying this pattern remain insufficiently resolved. Traditional approaches often rely on indirect analyses, which can obscure the distinct ecological processes that jointly shape community stability. As a result, the respective roles of dominant species, compensatory dynamics among species, and the stabilizing influence of diversity through averaging effects have been difficult to quantify within a unified framework. To address these limitations, we applied a recently developed partitioning framework to long-term data from the globally distributed experimental network coordinated by the Nutrient Network (NutNet). This framework quantifies, in addition to mean population stability, three mechanistic contributors to community-level temporal stability: dominance, species asynchrony, and averaging effects. This approach allows a direct assessment of how fertilization modifies the processes that stabilize—or destabilize—productivity in grassland communities. By linking nutrient enrichment to explicit stability mechanisms, this work provides a clearer understanding of how and why fertilization alters ecosystem dynamics. Identifying the pathways through which stability is affected—whether through changes in the influence of dominant species, shifts in compensatory interactions, or altered stabilization by species diversity—is essential for understanding grassland responses to ongoing environmental change. This mechanistic perspective offers a robust basis for interpreting global eutrophication patterns and for informing management strategies aimed at sustaining ecosystem functioning.

Seed addition experiments reveal seed removal is more important than post-fire habitat and termite nests to control seedling recruitment in Brazilian Cerrado

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Universidade Federal de São Carlos

SR4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

Fire and termites are important determinants of savanna vegetation. Termite nests often change surrounding soil conditions and are spots of seed deposition by frugivores, such as seeds defecated by territorial Maned-wolf (*Chrysocyon brachyurus*, Canidae) in Brazilian savannas (Cerrado). In spite fire usually stimulates flowering and fruiting in these ecosystems, plant recruitment by seed after fire seems rare. Therefore, suitable microhabitat conditions for germination and seedling survival may be more important to plant recruitment than seed availability. We tested these ideas using seed addition experiments with the shrubs *Solanum lycocarpum* (Solanaceae), *Psidium grandifolium* and *Campomanesia adamantium* (both Myrtaceae) in southeastern Brazil. We added 30 seeds of each species to each of four treatments disposed in 20 blocks in a factorial design: burned and unburned spots close or away from termite nests (2400 seeds per species). In a month, ca. 80%-90% of seeds left without exclosures for animals were removed (mainly by granivorous ants). Inside animal exclosures we observed mean 0.2%-15.5% of seed germination and 75%-99% seedling mortality up to four months, irrespective of fire or termite treatments. Widespread granivory limits seed availability, overcoming the isolated effects of fire and termite nests and decreasing the likelihood of plant recruitment. However, low seed germination (in special for *Campomanesia*) and widespread seedling mortality increase further bottlenecks for early recruitment. Therefore, fire and termite presence or absence do not seem to be determinants of the early recruitment of these species, highlighting the role of animals and abiotic conditions in controlling early regeneration.

Understanding long-term plant diversity changes in Europe

Ute Jandt [1]; Stephan Kambach [2]; Marta Carboni [3]; Milan Chytrý [4]; Franz Essl [5]; Florian Jansen [6]; Borja Jiménez-Alfaro [7]; Roger Norum [8]; Francesco Maria Sabatini [9]; Helge Bruelheide [10]; consortium MOTIVATE [11]

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VD1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

The MOTIVATE project (motivate-biodiversity.eu) brings together approaches from vegetation science, biodiversity modelling, remote sensing, and anthropogeography to complement the monitoring of European plant diversity. The project will support standardized, policy-relevant reporting for habitat conservation, using and promoting time series data on vegetation resurveys of the ReSurveyEurope database. As a part of this framework, we present our recent analysis of 55,975 vegetation plots that were resurveyed over the past century across all major European habitat types. Besides the high degree of specificity, with regard to the identity and changes in habitat types, we showed that local species richness and phylogenetic diversity frequently increased, especially in dynamic systems such as disturbed wetlands and forests undergoing succession, and declined in habitat types characterized by specialists. Functional evenness decreased across most habitat types, indicating biotic homogenization. Red List species showed mixed trajectories, with

gains in early-successional stages and losses in stable grasslands and forests. Habitat-specific species pools remained mostly stable and only increased in grasslands that were neither affected by succession or perturbation and sparsely vegetated habitat types undergoing succession. These insights and the methods that produced them provide a pathway to i) harmonize reports under the EU Habitat Directive, ii) develop habitat-specific management options to counteract succession or perturbation and, iii) identify data gaps in space and habitat types in Europe for future monitoring efforts in Europe.

Using taxonomy, functional ecology, and distribution to rediscover under-recorded plants

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TE1

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Rare plant species are often overlooked in vegetation science, despite performing critical ecological functions that support ecosystem stability and preserve unique genetic lineages. Developing a structured framework that integrates herbarium studies, ecological analyses, and targeted field surveys can improve our ability to locate and protect these species. The grasslands of the Brazilian Pampa provide an ideal system for studying patterns of species (re)discovery, particularly for taxa that have been under-recorded. Here, we compiled a list of under-recorded vascular plant species and assessed whether they are taxonomically clustered, share similar traits, and show preferential distributions across vegetation types and environmental conditions. A total of 240 species met the criteria of occurring in fewer than three known wild locations or not having been observed in the wild for ≥30 years. These species exhibited clear taxonomic clustering, with under-recorded taxa disproportionately represented in species-rich families such as Asteraceae, Cactaceae, Fabaceae, Bromeliaceae, Iridaceae, and Poaceae, and within genera including *Parodia*, *Mimosa*, and *Dyckia*. We identified vegetation and soil hotspots associated with gently sloping landscapes and deep, low-fertility soils. Spatial analyses revealed that these hotspots overlap with regions experiencing intense land-use conversion and substantial losses of natural vegetation. Most species occurred in open vegetation types, particularly grasslands and rocky outcrops. They are predominantly lignified forbs of low stature (< 70 cm) and typically flower and fructify during spring and summer. Together, these taxonomic, ecological, and functional patterns improve our understanding of rarity types, enhance knowledge of species biology, and provide guidance for targeted rediscovery efforts.

From Copernicus services to biodiversity patterns: AI-driven habitat mapping and monitoring across European protected areas

Jose Manuel Alvarez Martinez [1]; Javier Becerra [2]; Adrián Cost [2]; Francisco de Borja Jiménez-Alfaro [1]; Alicia Valdes [1]; Gonzalo Hernandez-Romero [1]; Jorge González le Barbier [1]; Justine Huge [3]; Carlos Dewasseige [3]; Chris Poray [4]; Dimitri Papadakis [4]; Ana Maria Ribeiro de Sousa [5]

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EO12

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Accurate ecosystem monitoring is essential to address biodiversity loss and global change impacts. Protected areas (PAs) are key conservation instruments that require up-to-date, operational land use and land cover (LULC) information to support evidence-based decision-making. Although the Copernicus Land Monitoring Service (CLMS) provides valuable datasets, translating these products into European Nature Information System (EUNIS) habitat types aligned with Annex I of the Habitats Directive remains a major challenge for end-users. This study presents an integrated framework to enhance the uptake of Copernicus services for conservation planning under the Habitats Directive. By leveraging CLMS PA datasets and Sentinel-2 time-series imagery, we apply Artificial Intelligence (AI) and super-resolution techniques to generate high-resolution habitat maps across hierarchical EUNIS levels (L1–L4) throughout the Natura 2000 network. Structured across biogeographical regions, the approach improves efficiency in data collection, reduces bias, and enhances the usability of remote sensing products. The framework incorporates feedback from conservation practitioners, land managers, and policymakers to ensure alignment with operational workflows and reporting needs. Preliminary results indicate classification accuracies exceeding 90% for Level 1 EUNIS categories, with strong potential for refining higher-level habitat discrimination and deriving indicators of ecosystem extent and condition. By embedding Copernicus-derived products within scalable AI-driven workflows, this framework supports Article 17 reporting under the Habitats Directive, contributing to the EU Biodiversity Strategy and the European Green Deal. The study highlights the importance of user-centred Earth Observation

approaches to bridge Copernicus services and biodiversity conservation policy.

Inferring dispersal limitation in alpine plant communities

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PB5

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Understanding whether alpine plant communities are limited by dispersal at regional scales remains a central question in metacommunity ecology. We evaluated dispersal limitation in a well-sampled relict alpine system by integrating taxonomic, functional and geographic completeness approaches across plant assemblages of acidic alpine grasslands in the Cantabrian Mountains. We compiled 245 vegetation plots of Luzulion caespitosae grasslands distributed across 14 alpine massifs. We first compared the differences between specialist and generalist species richness using GAMs and RDAs. We then analysed specialist compositional and functional turnover with generalized dissimilarity models and distance-based RDAs, using as predictors the spatial context, environmental variables, and generalist-community composition. We quantified geographic specialist species completeness by fitting Species Distribution Models and calculating the proportion of occupied vs. climatically suitable massifs. Finally, we estimated specialist community completeness across increasing spatial species pools defined by progressively adding nearby massifs and modelled its drivers using linear mixed-effects models. Specialist richness showed a strong elevational response and clear spatial structure, whereas generalists displayed weaker environmental responses and broader geographic gradients. In specialists, spatial predictors explained more compositional variation than climate and topography, and generalist-community dissimilarity improved model performance. Species-level completeness varied widely, indicating that several specialists do not fully occupy suitable areas. Community completeness declined consistently as the geographic extent of the species pool increased, with alpine area emerging as the main predictor. Overall, our results support a key role for spatial processes in structuring alpine specialist communities, consistent with dispersal limitation constraining both species distributions and local community assembly.

Diversity and Distribution of Native Pinus sylvestris Forests in the Iberian Peninsula

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PB3

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Temperate deciduous and mixed forests of the Northern Hemisphere are primarily characterized by the dominance of deciduous broadleaved trees, yet remarkable variation exists in their functional composition. Across the temperate biome, ecoregions range from mixed forests of deciduous broadleaves and conifers to forests partially or fully dominated by evergreen broadleaved species. This variability is likely shaped by the interaction between current climate, postglacial recolonization history, and regional ecological constraints.

Using vegetation plot data from the global sPlot database, we assessed patterns of tree species richness and the dominance of major functional types (deciduous broadleaved, evergreen broadleaved, and coniferous) across the temperate biome in the Northern Hemisphere. We tested if the dominance of each functional type is associated with climatic gradients, and other factors such as biogeographic region, soil properties, past climate, or human disturbances.

At the community level, we quantified the variation in the relative dominance of different functional types of trees using numerical indices derived from plot-level species abundances. These indices were used to (I) map the distribution of different functional types of forests, (II) characterize their position within the climatic space of global biomes,, and (III) assess their relationships with environmental drivers. Our results aim to provide a biome-wide functional perspective on the structure and composition of forests in the Norther Hemisphere and to clarify the ecological and historical processes promoting functional convergence and divergence across ecorregions and continents.

Vegetation complexity shapes microbial recovery in restored dryland soils: a decade perspective

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VR2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration: Recovering plant communities with native seeds

The recovery of soil microbial communities is a critical yet often overlooked component of the long-term success of ecological restoration in degraded drylands. However, the relative roles of vegetation and soil substrate in shaping microbial recovery remain poorly understood. Here, we use post-mining restoration in semi-arid Western Australia as a model system to investigate how soil substrate and vegetation complexity influence bacterial and fungal community dynamics five years after rehabilitation. Experimental plots combined three soil substrates- topsoil, mine waste, and a 1:1 mixture- with increasing native vegetation complexity, from native grass monocultures (*Triodia wiseana*) to multispecies assemblages of grasses, shrubs, and forbs (*Acacia ancistrocarpa*, *Grevillea wickhamii*, and *Ptilotus exaltatus*). Microbial diversity and composition were assessed by 16S rRNA and ITS amplicon sequencing. Restoration significantly enhanced microbial alpha diversity in degraded mine waste substrates, where biological legacies were minimal, while effects were weaker in topsoil with already high diversity. Beta diversity analyses showed soil substrate was the primary driver of microbial community structure ($p = 0.001$), with more moderate vegetation effects ($p = 0.091$). NMDS ordination revealed clear separation of bacterial communities by substrate, with partial overlap among vegetation treatments. Bacterial communities were dominated by *Actinomycetota*, *Pseudomonadota*, and *Gemmatimonadota*, while fungal communities were dominated by *Ascomycota* and *Basidiomycota*. Overall, substrate constrained microbial recovery, while vegetation complexity modulated community composition, particularly in severely degraded soils. A second sampling campaign conducted 10 years after trial establishment has been sequenced and is undergoing bioinformatic analysis to evaluate long-term microbial recovery trajectories.

Understanding community assemblage using species and functional diversity across elevational gradients from the tropics to the Arctic

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IT8

Type: Oral

Subject: Special Sessions

Session: Integrating intraspecific trait variability into vegetation science for improved ecological predictions

Species and functional diversity are different metrics describing biodiversity and ecosystem function and they are affected by both abiotic and biotic filtering as well as the regional species pool. Species richness and functional diversity are expected to decrease towards high elevation and the Arctic, due to stronger environmental filtering and fewer species in the species pool. These metrics can be used to understand how plant communities respond to different filters and how communities assemble along broad environmental gradients. We assessed plant species diversity and functional diversity including intraspecific trait variation along six elevational gradients from the Arctic in Svalbard, temperate mountains in Norway and Colorado to (sub)tropical mountains in China, Peru, and South Africa. We ask does plant functional diversity respond to environmental drivers along elevational and latitudinal gradients?. We find that richness relative to the regional species pool varied with elevation but increased with latitude. Plant communities from warmer regions showed more resource-acquisitive traits compared to plant communities from colder regions. This was largely reflected within and across regions. Together, these results show that species and functional diversity vary differently across these environmental gradients, suggesting that other factors than environmental filtering are important for community assemblage across these gradients.

Our results provide important insights into the responses of plant species and communities and their function to climate change. Understanding species and functional diversity across elevational gradients can help predict the potential of plant species to shift to higher elevation with climate change and invade alpine environments.

Taxonomic and functional diversity along a deglaciation gradient: disentangling the effects of primary succession and grazing pressure

Luana Bertolotti [1]; Paolo Mazzetto [1]; Valeria Fochi [1]; Alessandra Pollo [1]; Gianalberto Losapio [2]; Consolata Siniscalco [1]; Ludovica Oddi [1]

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CD13

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Glacier retreat is rapidly exposing new substrates, creating extensive areas undergoing primary succession. In mountain systems, land use may interact with these dynamics, influencing biodiversity trajectories. We investigated taxonomic and functional diversity along deglaciation gradients in three alpine valleys in Switzerland (Arolla, Mont Miné, Zinal), characterized by cattle grazing, sheep grazing, and no domestic grazing. In each valley, four successional stages were identified, from pioneer debris communities to larch-dominated forests. For each stage, five 3×3 m plots were surveyed (20 plots per valley). Floristic relevés were conducted, recording species presence and abundance. Taxonomic diversity along the gradient was assessed using species richness and the Shannon index. Functional diversity was analyzed through community-weighted means (CWM) of eight functional traits representative of life and reproductive strategies, and dispersal modes. Functional alpha diversity was calculated to describe within-community trait diversity. Grazing influenced successional trajectories. The ungrazed valley showed stronger forest expansion, with late-stage forest cover approximately three times higher than in grazed valleys. Taxonomic diversity peaked at intermediate stages in the ungrazed and sheep-grazed valleys, while the cattle-grazed valley displayed a more homogeneous pattern across succession, suggesting a stronger and more persistent disturbance effect of cattle grazing. Functional diversity increased in late stages under grazing, whereas it remained relatively stable in the ungrazed valley, indicating that grazing can contribute to the maintenance of functional heterogeneity during succession. Overall, grazing modulates both structural and functional components of primary succession and may represent a management tool for conserving biodiversity in newly deglaciated landscapes.

Multimodal plant diversity patterns mediated by community structure across successional-environmental gradients

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CA6

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Community assembly: Theory and methods in vegetation science

Although successional stage and environmental conditions have each been shown to produce unimodal patterns of diversity, their joint effects on plant diversity can be considerably more complex, due to increasing ecological specialization and deterministic dynamics along successional trajectories. Moreover, macroecological studies indicate that diversity patterns are usually driven more strongly by common than by rare species. Hill numbers therefore provide a suitable framework because they allow contributions of species across the abundance spectrum to be differentiated. In the Czech Republic, high-quality ecological indicator values are available describing species' preferences for both successional stages and environmental conditions. Here, we analyzed plant diversity, expressed as Hill numbers, along gradients of succession, soil moisture, and soil reaction. Plot-level indicator values were estimated using hierarchical Bayesian models, which control for potential artefactual correlations between diversity and community-weighted means and allow uncertainty in the estimation to be propagated into subsequent analyses. We then modeled the main effects and interactions of the indicator values and of diversity using generalized additive models. Succession and soil reaction showed consistent unimodal relationships with diversity, whereas soil moisture exhibited a non-linear negative effect. Interaction surfaces revealed patterns more complex than the simple overlap of unimodal responses: although the central region of the succession-environment space generally supported high diversity, peak diversity also occurred in late-successional, dry habitats and mid-late successional, alkaline habitats. Contrary to expectations, Hill numbers focusing on rare species were the ones best predicted by the gradients.

The role of functional diversity and grazing disturbance in mire plant community assembly and functioning

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University of Barcelona

FW3

Type: Oral

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Understanding how functional diversity interacts with disturbance contributes to predicting vegetation dynamics in mires. Pyrenean mires are threatened by overgrazing, and we aimed to evaluate the joint effects of functional diversity and disturbance intensity on plant community assembly and productivity. We exposed artificial communities comprising monocultures and polycultures spanning three levels of functional diversity to a gradient of simulated livestock disturbance (clipping, soil-compaction, and soil pugging) under controlled conditions. We quantified plant cover and multiple biomass compartments, including aboveground, root, and clonal belowground organs. Disturbance intensity strongly reduced plant cover, total biomass, and aboveground production, with undisturbed communities consistently showing the highest productivity. Functional diversity enhanced aboveground biomass and production in polycultures compared to monocultures, but differences among polyculture diversity levels were negligible. Notably, positive effects of functional diversity on total and root biomass were restricted to undisturbed conditions and disappeared under disturbance. When grazing and trampling were introduced, these effects disappeared, indicating that the relationship between plant functional diversity and productivity is contingent upon environmental conditions. Our results suggest that, in mires, niche complementarity operates primarily in the absence of livestock pressure, while recurrent disturbance suppresses diversity effects on both above- and belowground plant biomass, and thereby constrains community functioning. In southern mountain mires, limiting livestock pressure appears critical for maintaining productivity, whereas ensuring a minimum level of functional diversity may enhance ecosystem performance when disturbance is absent. These findings contribute experimental evidence on the interaction between disturbance regimes and trait-based diversity in mire ecology.

War and vegetation in Syria: changes in forest and plant conservation

Sandra Saura-Mas; Angham Daiyoub

CREAF-UAB

IM4

Type: Oral

Subject: Special Sessions

Session: Impact of Military Conflicts on vegetation and habitats

How the armed conflict in Syria has reshaped the vegetation dynamics is the main question of this research. Concretely, how it has affected both forest cover and use by rural communities and the survival of narrowly endemic plants. Our results explain that 19.3% of forest cover was lost from 2010 to 2019, directly tied to the armed conflict in Syria. Moreover, in coastal villages (with different levels of violence), wartime hardship led to a marked intensification of forest logging, with weekly logging days rising from 1.5 to 4 and increasing numbers of residents relying on wood extraction for heating, cooking, and income. Additionally, before the war, women engaged in logging significantly more frequently than men. And the amount of wood logged per month varied with socioeconomic factors like gender and age: women logged less wood than men, and younger people logged more than older ones. At the same time, the endemic plant *Iris nusairiensis*, restricted to high-elevation habitats in western Syria, faces severe conservation threats exacerbated by war. Surveys identified a single fragmented population of 13,651 individuals— 306 of them mature—distributed across rocky *Juniperus*-dominated peaks. Based on our field data and IUCN criteria, we classify *I. nusairiensis* as Critically Endangered mainly due to anthropogenic pressures, especially intensive grazing and war-related habitat destruction, such as soil removal and disturbances by military activities. Armed conflicts increase human dependence on vegetation while accelerating ecological degradation, highlighting the need for coordinated post-conflict restoration and protection of vulnerable plant habitats.

The first high-resolution EUNIS map of habitat types in Vojvodina (Serbia)

Bojana Bokić [1]; Boris Radak [1]; Maja Knežević [2]; Andrijana Andrić [2]; Mirjana Radulović [2]; Lori Giagnacovo [3]; Marcel Buchhorn [4]; Eline Vanuytrecht [3]; Sanja Brdar [2]; Predrag Lugonja [2]; Branko Brkljač [5]; Jose Manuel Alvarez-Martinez [6]; Borja Jimenez-Alfaro [7]; Ranko Perić [8]; Tijana Nikolić Lugonja [2]

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EO2

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Biodiversity is under increasing pressure in Europe because of global change effects including climate change, urban expansion and agricultural intensification. Governance responses often lack spatially explicit and operational ecological information for developing locally-tailored conservation and restoration planning. Serbia is considered moderately vulnerable to climate change, with medium adaptive capacity, and habitats in its northern part (Vojvodina) have been heavily transformed and fragmented by long-term land-use practices. Despite this, remnants of natural and semi-natural habitats persist, supporting biodiversity and providing important ecosystem services. Although vegetation mapping initiatives have been conducted since 1970s, no harmonized, publicly available, high-resolution EUNIS habitat map currently exists for Vojvodina. This highlights the need for up-to-date habitat maps aligned with European standards. To address this gap, we developed a scalable and reproducible habitat

mapping workflow based on the EUNIS habitat classification, focusing on hierarchical level 3 to balance thematic resolution with European comparability and policy relevance. The workflow integrates targeted field surveys with high-resolution Sentinel-2 imagery and biophysical and topographic GIS-derived predictors. Pixel-level habitat classification was implemented using a CatBoost decision tree algorithm, producing discrete habitat classes at 10-m spatial resolution, together with per-pixel class probabilities to support uncertainty assessment and post-processing refinement. The resulting EUNIS habitat map of Vojvodina was validated through spatial cross-validation and independent datasets from experts, Geoportal of Vojvodinašume Public Enterprise and Forest Management Plans. The final product represents an operational tool for biodiversity assessments and monitoring, conservation and restoration planning, informed decision-making, sustainable land management, and NbS allocation.

Human-induced extinction, and extinction debt of vascular flora: the size of hidden extinction

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LT1

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Long-term vegetation dynamics: Insights into the past

We studied the extinction patterns of vascular flora at the Hungarian Great Plain (Central Europe) using historical data. In this agriculture-driven landscape a huge loss of natural habitats occurred in the last century. As a spatial replicate we studied two separate regions of the Hungarian Great Plain. The estimated loss of natural habitats was about 90% based on the First (1782-1785) and Second (1819-1869) Military Survey of Hungary (ancient military maps). For steppic loess grasslands, the area lost was around 98-99% in the Great Plain. We used species-area relationships to estimate the potential extent of undocumented magnitude of species extinction in this region based on the habitat loss and the documented extinction. Based on species-area relationships 90% loss of the natural habitats cause 30% extinction of the plant species. Compared to the documented loss of species our findings suggest that the magnitude of species extinction is highly overestimated by the species-area relationship based on the loss of natural habitats. We conclude that the undocumented (hidden) extinction on steppic loess grasslands could not have been large, certainly not a magnitude larger than the documented extinction. Our findings also demonstrate that there is a significant extinction debt for steppic loess grasslands, suggesting that large number of species is at risk.

Assessing vegetation resilience in National Parks

Rut Sánchez de Dios; Miguel Berdugo; Felipe Domínguez Lozano

University Complutense of Madrid

EO4

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Monitoring vegetation dynamics is critical for the conservation of threatened ecosystems. In the context of global change, predicting regime shifts can become a useful tool for protected area management. In this work, we used a 40-year global satellite-derived temporal assessment of the Normalized Difference Vegetation Index (NDVI) across Natural Vegetation Systems (NVS) in Spanish National Parks to calculate both their resilience and changes in that resilience. Using climatic data, we related the NVS to different dynamic syndromes and their drivers. Finally, we explored the relationship between these dynamic syndromes and NVS resilience, identifying systems that might be experiencing critical slowing down and, therefore, approaching collapse. Our results show differences in dynamic syndromes within the same vegetation type, highlighting the importance of ecological subtypes in conservation and management. We were able to identify two distinct critical dynamic scenarios in the vegetation of Spanish National Parks: a) Negative slope: As the ecosystem's fragility increases, the velocity of degradation tends to decelerate. b) Positive slope: A low resilience value correlates with an increasing rate of change, implying that the system is not only approaching a tipping point but is accelerating toward it. The integration of vegetation resilience analysis provides a robust early-warning system for National Park management.

Introducing TESSERA: a geospatial foundation model based on Sentinel-1 and Sentinel-2 data that enables high-resolution monitoring of habitat change

David Coomes [1]; Zhengpeng Feng [1]; Clement Atzberger [2]; Sadiq Jaffer [1]; Anil Madhavapeddy [1]; Srinivasan Keshav [1]; Amandine Debus [1]; Aland Chan [1]; Jovana Knezevic [1]; James Ball [1]

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EO8

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Recent advances in foundation modelling are redefining how remote sensing data can be used to understand ecological processes at scale. TESSERA is a geospatial foundation model trained exclusively on multi-year global archives of Sentinel-1 synthetic aperture radar and Sentinel-2 multispectral imagery. Using a multimodal self-supervised architecture, Tessera learns joint spectral–temporal representations that capture vegetation properties across seasons. These representations can then be fine-tuned to predict ecological variables with minimal task-specific training data, overcoming longstanding barriers of data scarcity, sensor inconsistency, and limited transferability.

By embedding radar and optical signals within a unified feature space, TESSERA provides spatially explicit descriptors of vegetation structure, composition, and temporal dynamics globally at 10 m resolution. This enables consistent measurement of habitat condition and change from local to global scales, opening up new possibilities for vegetation mapping, functional trait inference, and biodiversity assessment using only freely available ESA Copernicus inputs. We will present examples illustrating TESSERA's capacity to detect fine-scale habitat change and monitor restoration outcomes. These include analyses from a large-scale restoration project in the Scottish Highlands, where TESSERA-derived indicators reveal patterns of vegetation recovery, structural heterogeneity, and land-use transition following sustained reductions in herbivore pressure. Collectively, these applications demonstrate how foundation models trained on harmonised radar–optical data can provide a powerful and scalable basis for continuous vegetation monitoring and ecological understanding in a rapidly changing world.

The response of *Carex nigra* to disturbance by herbivory and trampling

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HH7

Type: Oral

Subject: Special Sessions

Session: The Hidden Half: emerging questions in belowground functional ecology

Fens are permanently waterlogged ecosystems with restricted gas exchange, generating hypoxic conditions that act as a strong abiotic filter on plants. These conditions favour clonal growth forms, among which rhizomatous plants are particularly prevalent. Such belowground organs govern resource storage, physiological integration, and disturbance tolerance through compensatory growth. Despite their importance, they remain poorly understood components of plant functional ecology.

Here, we assessed how livestock disturbance, a prominent threat in alpine fens, affects the performance of *Carex nigra*, a rhizomatous cyperaceae ubiquitous in these ecosystems. We disentangled the components of overgrazing, herbivory and trampling, and examined their effects on compensatory responses mediated by biomass allocation and clonal reproduction. We combined a four-month factorial experiment under controlled conditions, simulating herbivory (clipping) and trampling (soil-compaction and soil-pugging), comparing grazed and grazing-exclusion conditions.

In both exeriments, overgrazing limited compensatory growth and biomass accumulation across plant compartments. However, herbivory drove the response of the processes involved in compensatory growth, while trampling promoted the response only through clonal reproduction. Herbivory strongly reduced belowground biomass while promoting compact, phalanx-like growth with higher ramet density per node. Soil-compaction reduced rhizome biomass without altering ramet or rhizome number, suggesting maintenance of clonal reproduction at the expense of stored reserves. Soil-pugging had the strongest negative effects, decreasing both biomass accumulation and clonal reproduction, likely due to rhizome damage and bud bank exposure. Overall, plant responses to grazing were mediated by belowground functioning, highlighting the central role of rhizomes in compensatory growth and resilience in alpine fens.

Plant functional traits reveal effects of warming and competition on Range expanding plant species

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CD4

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

What will happen when novel plant communities arise in alpine ecosystems, and how can a functional traits lens help us to understand this process? Project RangeX aims to understand the ecological effects of lowland plant species invading into alpine ecosystems as they get warmer due to climate warming. We accelerated this process by experimentally transplanting ten different lowland species upslope in grasslands beyond their current range limit, combined with a warming (Open Top Chamber) treatment. This allows us to disentangle the direct (abiotic, warming) and indirect (biotic, novel plant interactions) drivers of warming in alpine grasslands. We expect that lowland species are more resource-acquisitive and therefore stronger competitors for light compared to the more resource-conservative alpine plant community. Here, I will present how plant functional traits (plant height, leaf thickness, -area, and -mass) of both the extant community and the novel invaders, vary between treatments four years after the experiment was started in Norway. How well are the novel species able to survive beyond their current range, and what traits mediate their success? And, do we observe changes in community traits of the extant community as a result of them having new neighbors?

Effects of interacting disturbances on wetland vegetation recovery trajectories in the Everglades, Florida, USA

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FP8

Type: Oral

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

In an ecosystem, interacting multiple disturbances often alter post-disturbance vegetation recovery, resulting in changes in plant community attributes that differ from the independent effects of each disturbance. In wetlands where fire-prone vegetation is common, fire and flooding are two key ecological processes shaping plant community structure and composition. In this study, we investigated how varying levels of post-fire flooding occurring at different intervals after fire, influence vegetation recovery trajectories in wetlands of the Everglades, Florida. We collected vegetation composition data before and from two to nineteen years after fire at sites burned between 2005 and 2020. Vegetation composition data were analyzed using non-metric multidimensional scaling (NMDS) ordination, and differences in composition between pre-burn and each post-burn survey year were tested statistically. We also examined vegetation trajectories at individual sites through trajectory analysis and by calculating changes in normalized vegetation difference index (NDVI). Recovery at the burned sites was hindered when mean post-fire water depth reached 20 cm or more for one to three months after fire, and when maximum water level exceeded 30 cm during the same period. Sites subjected to rapid flooding shortly after fire exhibited greater compositional dissimilarity between pre- and post-fire vegetation than sites where water level rose gradually. Although the interval between fire and subsequent hydrologic events is important in shaping the vegetation responses to the combined effects of these two stressors, our findings suggest that magnitude and duration of post-fire flooding ultimately determine the direction and pace of vegetation recovery trajectories in wetlands.

Canopy-scale effects of shrub encroachment on soil properties and their microbial communities in alpine mountains

Alba Anadon-Rosell [1]; Núria Roca [1]; Laura Escarmena [1]; Enrique Navarro [2]; Rebecca Boden [3]; Frederik Märker [4]; Estela Illa [1]

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CD3

Type: Oral

Subject: Ecosystem-focused topics

Session: Cold-driven ecosystems: Alpine, arctic, and mountain vegetation

Shrub encroachment is occurring in high-elevation and high-latitude ecosystems worldwide as a consequence of global change. While previous studies have addressed its impacts at community and ecosystem scales, less is known about the effects of individual shrubs and how soil properties and microbial communities vary beneath shrub canopies. We aimed to determine how individuals of two widespread circumpolar dwarf shrub species, *Dryas octopetala* (DO) and *Empetrum nigrum* subsp. *hermaphroditum* (EH), influence the properties and microbial communities of the soils they colonize. In the alpine mountains of Finse, Norway, we selected four individuals per species and collected soil cores from internal, peripheral, and external canopy positions. We analyzed soil physicochemical characteristics and microbial carbon substrate utilization, and measured functional traits from leaves, branches, and rhizomes along the canopy gradient. We observed a decrease in soil C:N ratios from the interior to the exterior, whereas soil pH, moisture, and nutrient availability showed no consistent spatial patterns. Although dissolved organic carbon and dissolved nitrogen did not differ significantly among positions, shrub leaf traits significantly influenced these variables. We found clear differences in leaf functional traits along the canopy for both species, with more conservative trait values at the periphery than in the interior. Microbial communities exhibited position-dependent differences in carbon substrate utilization. Overall, individual shrubs generated small-scale spatial heterogeneity in soil properties and microbial functioning. These individual-level effects mirror patterns previously reported at broader scales, indicating that shrub establishment can modify soil environments and microbial communities from early stages of encroachment.

Vegetation dynamics on small islands: successional dynamics or equilibrium theory

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PB2

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

The Theory of Island Biogeography (TIB) proposes that the number of species on an island is determined by a dynamic equilibrium between the rates of immigration and extinction, with a balance influenced by the island's size and its distance from the mainland. This theory has been tested across insular systems and taxa. Here we focus on using a resurvey approach to test the TIB for plant communities across small Mediterranean islands (0.01-1 km2) with vegetation plot data recorded at least 10 years ago. With this contribution, we aimed to get the first insights on how small Mediterranean islands are responding to ongoing global phenomena (e.g., human-driven land use change, alien species spread) and our hypothesis predicted a reduction of species richness because of an increase in the extinction rate and a stability of the immigration rate. We resurveyed 47 small islands across five countries (Croatia, France, Greece, Italy, and Spain) and obtained a dataset of 183 historic and resurveyed plots. We investigated patterns of change at species, plot, and island scales, focusing on positive or negative shifts in plot species richness and in cover abundance of single species. We found a significant reduction in island species diversity, coupled with an increase in cover of shrub species. The observed pattern suggests a confirmation of our hypothesis based on the combination of TIB with ongoing changes, but also an ongoing secondary succession on the islands.

A view on vegetation from large herbivores' eyes

Pablo Manzano

BC3 Basque Centre for Climate Change

EO15

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Vegetation restoration and management

Some decades after the consolidation of the alternative states of ecosystems and the advanced understanding of Open Ecosystems, the role of herbivores as disturbance agents is clear for the community of vegetation scientists. To further advance the knowledge on how they shape ecosystems, the distinction between different functional types of large herbivores and thereby their differential effects on vegetation is a must. Ecophysiological classifications of herbivores, mainly following the grazer-browser gradient, are being useful for starting the study of the subject. Current literature, however, is largely based on digestive or food-processing perspectives and lacks a vision from the vegetation side. An important element to be accounted for is the role that large tree-whacking fauna, notably proboscideans, can have in the balance between woody vegetation destruction and growth. A further important element that may have been ignored is the possible role of grazing monogastric megafauna in consuming large amounts of biomass from nutrient-poor forage, due to the capacity to filter out nitrogen. A final important element that may have been left out is the natural proportion of migratory grazers in grazing ecosystems that are obliged to follow maturing grass, versus static browsers that are able to survive unproductive spells by feeding on standing leafy biomass of woody plants. By considering such elements, a better understanding of the disturbance and regeneration balances in the vegetation may drive to a more significant interpretation of global vegetation patterns, with ample consequences for sustainability science.

Towards a synthesis of island Floras – new insights and resources for island biogeography

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PB7

Type: Oral

Subject: Special Sessions

Session: Plant biogeography and macroecology in a changing world

Islands contribute disproportionately to global plant biodiversity and are hotspots of both historical and ongoing species extinctions. At the same time, they serve as classic model systems for studying the biogeographical processes underlying the assembly of floras. However, global-scale analyses of island floras have long been constrained by the fragmented nature of island systems and limited data availability across the thousands of islands worldwide. In this talk, I present how the Global Inventory of Floras and Traits (GIFT; https://gift.uni-goettingen.de/) has enabled island biogeography research at an unprecedented scale and resolution. Recent studies using GIFT reveal that 31% of all vascular plant species are native to islands, and 21% of global plant diversity is endemic to islands. These analyses provide new insights into the nature of endemism—particularly the distinction between neo- and paleoendemism—and illuminate patterns of taxonomic and phylogenetic turnover between island and continental floras. Despite these advances, major knowledge gaps remain—especially at the community level and in the availability of plant functional trait data and highly resolved phylogenies. To address this, I will introduce BioMonI-Plot, a new community-driven initiative aimed at mobilizing and sharing local vegetation data. This effort has the potential to significantly advance basic research, biodiversity monitoring, and ecosystem restoration in island environments.

Riverbank works as a substitute for natural disturbances? Conclusions from a study on pioneer vegetation and seedbanks along the middle reaches of the Loire River (France)

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SR3

Type: Oral

Subject: Cross-cutting topics accross ecosystems

Session: Seed regeneration of plant communities

Natural river dynamics create sediment deposits which are the starting point for ecological successions that lead from scarce pioneer vegetation to dense floodplain hardwood forest. While the different vegetation stages, especially pioneer softwood stages, have a recognized biodiversity value, they may locally increase the flood risk for human settlements. Woody pioneer vegetation at the middle reaches of the Loire River is therefore subject to riverbed works that may include clearing of vegetation and scarifying of sediments. This study asks whether mechanical management of softwood vegetation in floodplains has a significant impact on the floristic composition of standing vegetation and seed banks. I therefore compare both components from two types of sandy-gravely sediment bars along the middle reaches of the Loire River: (I) bars that result from mechanical clearing of softwood vegetation and (II) bars that result from natural river dynamics. To do this, standing vegetation and seedbanks from 76 sites presenting pioneer habitats and situated along the entire middle reaches of the Loire River have been sampled. Half of them had undergone some riverbed works between 1998 and 2015 and the others had not. The results of the study allow to characterize seed bank properties such as densities, functional and taxonomic composition, etc., as well as analogues characteristics in standing vegetation. They moreover allow to quantify a possible impact of river works on seedbank and vegetation characteristics and show whether riverbed works are neutral or detrimental to the conservation values of those pioneer habitats.

Spatial distribution of alien plant species impacts on biodiversity across Europe

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AE9

Type: Oral

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Biological invasions by alien plants are a major driver of biodiversity loss in Europe. Efficient conservation efforts require knowing where negative impacts on biodiversity and ecosystem functioning are likely to occur. The Environmental Impact Classification for Alien Taxa (EICAT) is a well-known standardized system adopted by IUCN to score and compare these impacts and can be potentially used to predict the spatial distribution of threats to biodiversity. Here we selected 100 terrestrial alien plant species known for their high potential to cause impacts in Europe. For each of them, we (I) assessed the EICAT impact score using available literature, and (II) by fitting ensemble Species Distribution Models, we (III) projected its potential distribution in Europe under current conditions and future scenarios. We matched impact scores and geographical distributions across species to obtain maps of potential impact intensity across Europe. Results showed that chemical impact on ecosystems, competition with native species in invaded communities, and indirect impact on other species were the most common mechanisms and contributed most to the spatial distribution of impacts by alien plants. Most species have a potential for moderate impacts (i.e., reducing populations in the habitats they invade). However, several species with major impacts, inducing local extinctions of native species, have the potential to spread widely throughout Europe.

30 years of grassland responses to ecological trends and events

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CE1

Type: Oral

Subject: Ecosystem-focused topics

Session: Central-European grasslands

Grassland experiments contributed substantially to a better understanding of biodiversity – ecosystem functioning relationships. They also advanced ecological theory. Short-term establishment, large extent, economic importance and the contribution to regional species diversity were main arguments for these experiments. Furthermore, their experimental approach enabled us to test fundamental hypotheses on the ecological role of biodiversity. Standardized design was implemented in coordinated experiments to identify generality in patterns and processes. The classic BIODEPTH Experiment (1996-1999) stimulated the scientific debate with several sites spanning across the European continent. However, flaws in initial experimental settings, artificial species composition, and short duration were criticized, resulting in improved experimental approaches and analyses. This study is now a long-term legacy of the 64 grassland plots of the BIODEPTH experiment with continuous sampling from 1996 until 2025. Since 1999, species richness and composition is no longer manipulated. The traditional management of hay meadows (mowing twice a year in June and September, no fertilization) with continuous extraction of biomass is continued until today. Hay meadows, which are a characteristic landscape unit all over Europe, allow the continuous extraction of species-specific biomass, and the acquisition of quantitative data. The long duration of the study allows us to identify the increasing influence of climatic variability such as periods of drought or heavy rain before biomass harvest and the role of their seasonal timing. We find trends in total biomass, alpha-, beta-, and gamma-diversity, and species-specific responses over 30 years. After an initial homogenization of alpha-diversity, resulting from enrichment (niche filling) of initially species-poor plots, plant communities stabilized until extreme climatic conditions increased the beta-diversity and compositional heterogeneity within the experiment. Nutrient depletion resulted in a shift towards plant species that are of high nature conservation value. In recent years, stronger climatic fluctuations enhanced gamma-diversity and the total species pool of the experiment. These findings illustrate the value of precise monitoring in long-term studies reaching beyond snapshots in most time-limited experiments.

POSTERS

The power of few: Small representative samples capture global plant diversity patterns across scales

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P145

Type: *Poster*

Subject: *Special Sessions*

Session: *Scaling laws in (vegetation) ecology*

Global knowledge of plant diversity remains incomplete, and large-scale analyses of diversity patterns rely on subsets of species shaped by spatially and taxonomically biased collecting. Recent advances in global taxonomic databases provide robust baselines for diversity patterns at coarse scales. However, methods for translating these patterns to finer spatial scales remain largely untested. Here, we investigate how global vascular plant diversity patterns scale with sample size. Using the World Checklist of Vascular Plants (WCVP) as a reference, we identify the number of species required to create representative diversity maps that closely match known global plant diversity patterns. We show that relatively small samples with less than ~1% of all described species are sufficient to capture global species richness patterns at coarse scales. To investigate how results vary with spatial resolution, we use a genetic algorithm to maximise the geographic and compositional representativeness of species subsets from openly available data relative to established coarse-scale diversity patterns. We then employ species distribution modelling to infer species richness at a fine spatial resolution (10 km²). By comparing multiple independent samples across sample sizes (2,000, 4,000, and 6,000 spp.), we quantify the stability of the predicted richness patterns. We find that samples of approximately 2,000 species already yield highly stable spatial patterns, with correlations exceeding 0.9 across independent samples, indicating diminishing returns from including additional species. These findings demonstrate that small representative species samples can efficiently capture global species richness patterns, offering a practical pathway for diversity mapping in data-poor regions.

Remote sensing-based assessment of land use and land cover dynamics in mangrove vegetation, Akwa Ibom state, Nigeria (1986-2024)

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(1) University of Uyo; (2) Igbinedion University, Okada, Nigeria

P170

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

This study was poised to determine the spatial extent and trends of changes in Mangrove Vegetation in Akwa Ibom State, in the Niger Delta region of Nigeria, for about forty years. Remotely sensed Landsat satellite images were obtained for 1986, 2004, 2014, and 2024 from the United States Geological Survey, Earth Explorer. The study identified, classified, and analysed the various land uses replacing Mangrove Vegetation in Akwa Ibom State using the supervised algorithm in ERDAS Imagine. The result showed that the Mangrove Forest declined by about 70% from 1986 to 2024. The decline in the spatial extent of the Mangrove Forest was influenced by several anthropogenic factors, especially in coastal areas. Notably, there was a steady increase in built-up and farmland uses through these years. This study suggests the need to monitor Mangrove vegetation exploitation. Furthermore, it recommends the need for an urgent Mangrove restoration programme in the area, given the ecological benefits of the Mangrove Vegetation to the Ecosystem.

Placing understory plant communities back into their microenvironments: using forest composition for accurate microclimate predictions

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Type: Poster

Subject: Cross-cutting topics across ecosystems

Session: Vegetation databases: Expanding the utility of plot-based surveys

Predicting the responses of forest biodiversity to climate change requires linking understory plant communities to the microclimatic conditions they experience in their habitats. Commonly used macroclimatic datasets (e.g., WorldClim) provide synoptic conditions that fail to capture the (micro)climate conditions experienced by understory plants in forest ecosystems. This is particularly critical in vertically complex forest stands where canopy structure strongly buffers understory conditions. Mechanistic models, such as the R-based microclimf, simulate forest microclimates by relying on input data describing vegetation properties (e.g., leaf area index, tree height), which are normally derived from remote sensing products. Yet, satellite-borne remote sensing products often fall short at capturing site-level vegetation structure, owing to differences in spatial resolution, geolocation uncertainties, and temporal mismatches with field-based vegetation records. Here, we present a framework to mechanistically model forest understory temperature by relying on tree functional types and canopy species composition from field-based surveys, which has the advantage of leveraging existing global vegetation databases. The model is validated against in situ temperature observations from widely distributed forest habitats, demonstrating strong performance across multiple temperature indices capturing the monthly, seasonal and annual understory temperature means, variability and extremes. Our results show that hourly predictions of understory temperatures can be made with the microclimf package while incorporating simplified estimates of forest thermal buffering from field-based vegetation surveys. Overall, our framework enables robust, mechanistic prediction of below-canopy temperature dynamics, overcoming the limitations of macroclimate datasets and accurately capturing interannual variability.

Trade-offs between forage use and biodiversity: when grasslands are pressured to be productive

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P1

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: Human-disturbed habitats, invasions, and novel communities*

In semi-natural ecosystems such as temperate subalpine grasslands used for livestock grazing, management intensification strongly influences biodiversity and ecosystem services, essential for local livelihoods, particularly forage provision. By altering plant species composition and their sensitivity to environmental conditions, management practices also shape ecosystem responses to global change. While the effects of management intensity on forage quantity are relatively well documented, its consequences for forage quality and the role of species abundance in driving these outcomes remain less understood. This study draws on a two-year dataset from 60 subalpine grasslands in southern Bavaria (Germany), managed along a gradient ranging from extensive to highly intensive practices. Forage quantity and quality were assessed using biomass production, plant functional traits (leaf nitrogen content and specific leaf area), and plant diversity metrics based on species abundances. Biomass production was significantly higher only at intermediate management intensities, where forage quality showed only a modest improvement. However, these intermediate intensities were also associated with reduced plant diversity and an increased dominance of a few graminoid species. While these species supported higher yields, they displaced other functional groups, leading to shifts in community composition and declines in overall species richness. Overall, the results indicate that productivity-oriented management can erode key ecological functions that sustain plant diversity without delivering substantial gains in forage quality. At the same time, the findings suggest that certain management practices may help reconcile productivity with conservation, emphasizing the importance of biodiversity for maintaining ecosystem functions, long-term resilience, and the sustainability of human-managed grasslands.

Establishment of cultivation and multiplication of *Drosera rotundifolia L.* in vitro conditions

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P91

Type: *Poster*

Subject: Ecosystem-focused topics

Session: Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies

Drosera rotundifolia L. belongs to the Droseraceae family. *Drosera rotundifoli*a is a widespread species throughout the territory of America and Europe (Wolf et al., 2006). In Ukraine, there are two species of *Drosera*: *D. anglica* Huds., *D. intermedia* Haune. They have the status of "Vulnerable" and are listed in the Red Data Book of Ukraine. In previous years, there were mentioned 37 locations of *D. rotundifolia* in Ukraine. Now *D. rotundifolia* was proposed to be included into Red Data Book of Ukraine into the category of "vulnerable" on the territory of Ukraine (Rak et al., 2022). One of the promising ways to preserve rare and endangered plants is to grow and multiply them *in vitro* conditions and then transfer them to the places of their natural growth. Our aim was establish effective culture medium for the regeneration of *D. rotundifolia* for further micropropagation and obtaining of adult plants from regenerants *in vitro* conditions. The biotechnological methods were used in the work. After conducting a series of experiments, effective media for the cultivation and regeneration of *D. rotundifolia* were established. The most effective medium for shoot regeneration from leaf explants was 1/4 MS (Murashige & Skoog, 1962) + 0.1 mg/L NAA (1-Naphthaleneacetic acid) + 0.3 mg/L BAP (6-Benzylaminopurine). The obtained regenerants were separated from the explants and were transfered on the medium 1/4 MS with 0.1 mg/L BAP for elongation. After two months of cultivation on medium 1/4 MS or 1/2 MS, adult plants were successfully obtained.

Floristic and LiDAR-based structural differentiation of extrazonal Mediterranean-type *Cupressus sempervirens* woodlands in northern Iran

Rezgar Darvand

Tarbiat Modares University

P65

Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

Extrazonal Mediterranean-type woodlands embedded within temperate forest regions pose persistent challenges for vegetation classification and ecological interpretation, particularly when floristic differentiation occurs alongside strong structural heterogeneity. This study examines the internal organisation of natural *Cupressus sempervirens* woodlands in northern Iran and explores how integrating canopy structural information and non-linear ordination can extend the interpretation of a floristically based classification.Vegetation was sampled in 226 plots across natural *C. sempervirens* stands. Plant communities were classified using TWINSPAN, fidelity analysis, and expert-system reassignment. Floristic units were related to bioclimatic gradients and 3D canopy structure from Global Ecosystem Dynamics Investigation (GEDI) via principal component analysis, while Uniform Manifold Approximation and Projection (UMAP) explored species-space relationships.The floristic classification identified six associations grouped into two alliances within a single order of Mediterranean-type Cypress woodlands. These were organized along two main gradients: west–east humidity and thermal continentality. Associations showed consistent differences in canopy architecture, including plant area index, foliage-height diversity, and vertical structural complexity. UMAP ordination revealed compact, stable clusters matching the phytosociological units and their transitional relationships.Natural *C. sempervirens* woodlands in northern Iran form a distinct but internally structured extrazonal forest system. While community delimitation remains floristically based, the combined use of LiDAR-derived canopy metrics and non-linear ordination provides an extended interpretative framework that links classical syntaxonomy with three-dimensional forest structure and facilitates the integration of satellite-based information into vegetation science.

Keywords: Extrazonal vegetation; *Cupressus sempervirens*; vegetation classification; canopy structure; spaceborne LiDAR; non-linear ordination

Testing the roles of microbiome history and nutrients in grassland plant community assembly

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Abiotic and biotic factors shaping plant communities and the soil microbiome can feed back to influence subsequent plant communities, creating legacy effects when these influences persist. While research has examined how filters impact composition and structure of soil microbiomes, few studies link whole-community microbial changes to functional outcomes in plant communities. As a result, functional soil microbiome legacy effects on subsequent plant communities remain poorly understood.We asked whether legacy effects of past resources and plant community composition influence current grassland plant communities via soil microbiome function, and whether these effects depend on current nutrient availability. We conducted a mesocosm experiment where six grassland plant species were grown in sterile soil or sterile soil inoculated with field soil that had its resources manipulated experimentally. Nutrient availability was manipulated by either adding fertilizer or leaving pots unfertilized. Using previously collected field data, we assessed how field plant community composition influenced mesocosm plant communities.Soil microbiomes shaped by past resources and plant communities produced no detectable legacy effects on plant community composition. However, the presence of soil microbiome inoculation and current nutrient addition affected mesocosm community composition. Soil microbiome effects were independent of nutrient treatment. These results demonstrate that functional legacy effects of past plants and resources on the soil microbiome are limited in this grassland system. More broadly, these findings suggest that microbial compositional differences do not necessarily translate into functional legacy effects, highlighting the need to link changes in soil microbial composition to plant community outcomes when evaluating soil legacies.

Stand age affects the C:N:P stoichiometry and nutrient cycling in three subtropical plantations

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P171

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Ecological stoichiometry serves as a key indicator of biogeochemical cycling and nutrient limitations in terrestrial ecosystems. However, how plantation types and stand ages influence carbon (C), nitrogen (N), and phosphorus (P) stoichiometric traits of leaf, litter, and soil remains poorly understood. Using a space-for-time substitution approach, we collected 135 samples and examined the C, N, and P concentrations and stoichiometric ratios of leaf, litter, and soil across five stand ages (young, medium, near-mature, mature, and over-mature) in *Eucalyptus robusta* (*E. robusta*), *Pinus massoniana* (*P. massoniana*), and *Cunninghamia lanceolata* (*C. lanceolata*) plantations from 15 sites in subtropical China. The results found that stand age exerted a strong but species-specific influence on C, N, and P stoichiometry in leaf, litter and soil. Nutrient limitation patterns differed by plantation types. *E. robusta* was co-limited by N and P, characterized by preferentially allocating nutrients to leaf. *P. massoniana* was primarily P-limited with maintaining relatively stable nutrient cycling. *C. lanceolata* experienced N-limited through shifting from rapid external nutrient uptake to more efficient internal recycling as it developed. Stand age affects C:N:P stoichiometric patterns of the three plantation types in the subtropical region. Nutrient limitation patterns differed by plantation types. These findings provide important insights into nutrient cycling that guide fertilization strategies and optimize structure in subtropical plantations.

Comparing species diversity and community assembly processes between different regions of montane cloud forests in Taiwan

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Montane cloud forests (MCFs) are rare and fragile ecosystems distributed across Taiwan's mountainous areas. Situated at the junction of tropical and subtropical zones and tectonic plate boundaries, Taiwan features diverse climatic zones. Vegetation is influenced by typhoons, monsoons, and high fog frequency. This study compares species diversity and community assembly processes among MCFs in different regions in Taiwan.Using 1751 plots from the National Vegetation Dataset, we categorized Taiwan into four climatic regions (north, south, east, west). Alpha diversity was calculated via iNEXT. To quantify assembly processes, we analyzed variance partitioning between environmental (deterministic) and spatial (stochastic, MEM-derived) variables using 100 plot subsets with 50 replications. The "rdacca.hp" package determined the relative importance of deterministic factors.Results indicate southern Taiwan exhibits the highest diversity, while the west shows the lowest. Deterministic processes were significantly higher in the west, whereas stochastic processes showed no regional differences. Mean annual temperature was the most critical deterministic factor across all regions. Strong environmental selection, driven by temperature, limits vegetation to adapted species. Stochastic processes explained spatial variation but did not vary regionally, likely because MCFs occupy a narrow elevational belt despite broad distribution.We speculate that similar assembly patterns exist in comparable island ecosystems. This study offers new ecological interpretations of temperature and fog gradients, providing valuable insights for conserving island MCFs.

Keywords: community assembly processes, island ecosystem, species diversity

Drought effects on Radiation Use Efficiency in grasslands across temporal scales: a flux–remote sensing approach

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Radiation use efficiency (RUE) reflects the conversion of absorbed photosynthetically active radiation (APAR) into carbon and is estimated from the relationship between gross primary productivity (GPP) and APAR. Although RUE is an input for remotely sensed GPP estimates, drought effects on RUE across temporal scales remain poorly understood. This study assesses drought impacts on RUE from short-term to annual scales across grasslands along an aridity gradient. We hypothesize that background aridity constrains RUE and modulates its drought sensitivity. We expected drought to reduce RUE at short temporal scales, dominated by rapid eco-physiological processes, whereas at longer temporal scales, ecosystem integration leads to stable RUE. We combined eddy-covariance data from FLUXNET and AmeriFlux grassland sites with MODIS Enhanced Vegetation Index (EVI). Drought intensity was quantified using the Standardized Precipitation Index (SPI) and the Standardized Precipitation–Evapotranspiration Index (SPEI). GPP, APAR, RUE, SPI and SPEI were calculated at multiple temporal scales (16days to 1year) and related to drought intensity. We found that RUE was strongly constrained by aridity, particularly at the annual scale, ranging from 1.16 $gC.MJ_3^{\ 1}$ in the wettest site to 0.49 $gC.MJ_3^{\ 1}$ in the driest site. At short temporal scales, RUE showed high variability (0–4.2 $gC.MJ_3^{\ 1}$) and moderate positive relationships with drought indices (r≈0.39–0.52, p<0.001). At the annual scale, drought effects were weaker, with a negative tendency only in the driest site (r=–0.42, p=0.08). In conclusion, temporal scale and climatic context are key factors when assessing drought impacts on ecosystem productivity.

Leaf functional traits reveal adaptive nitrogen strategies of legume shrubs along an aridity gradient on the Tibetan Plateau

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Leguminous shrubs dominate dryland ecosystems and often increase in cover and biomass with increasing aridity. However, the physiological mechanisms underlying their success under dry conditions remain poorly understood. Here, we investigated how leaf functional traits and nitrogen acquisition strategies of two dominant legume shrubs, *Sophora moorcroftiana* and *Caragana versicolor*, respond to increasing aridity across the Tibetan Plateau. Our results show that *S. moorcroftiana* shifts its nitrogen acquisition strategy from soil nitrogen uptake to symbiotic nitrogen fixation with increasing aridity. This shift is associated with higher leaf nitrogen content and enhanced intrinsic water use efficiency, indicating improved physiological performance under water limited conditions. In contrast, *C. versicolor* exhibits a non-linear response, with an aridity threshold around 0.35. Beyond this threshold, the species shifts from increasing leaf nitrogen investment to modifying leaf structure by reducing SLA, reflecting an optimal balance between water use efficiency and phosphorus demand. Furthermore, changes in leaf functional traits were closely linked to shrub biomass accumulation in both species, suggesting that trait-biomass linkages provide a mechanistic explanation for shrubland dynamics along aridity gradients.

Temporal changes in riparian forest vegetation: unexpected responses to streamflow alteration under climate change

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Riparian forests are highly dynamic and species-rich ecosystems, although they face multiple pressures. Recent vegetation$_3$ resurvey studies revealed mixed effects of river regulation on riparian forests, but the impacts of increased minimum flows remain understudied. We resurveyed historical plots to assess the ecological impact of a dam on the Irati River in northern Spain, located in a temperate-Mediterranean ecotone. This dam regulated the Irati River by altering flow peaks, reducing winter flow and increasing summer average discharge. We investigated how flow alteration and climate change affected riparian vegetation composition between Old (1997-2003) and New (2022-2023) plots, with a particular focus on moisture-demanding, alien and ruderal species. The plots were divided into three sections: (1) the temperate control, (2) the Mediterranean control, and (3) the Mediterranean dam-affected. A shift in species composition was observed in the studied forests, each section displaying a distinct pattern of change. We associated the changes in plant species composition to climate change and river regulation. Both control sections exhibited increases in thermophilous species and a decline in moisture-demanding riparian species. Conversely, the dam appears to support riparian species by maintaining summer flows, mitigating climate-induced drought impacts. Additionally, ruderal species increased in both Mediterranean sections, suggesting that their spread was more likely facilitated by industrial and agricultural development rather than by the dam. We conclude that dam-induced summer flows may partially buffer climate change effects on riparian forests, providing guidance for flow management prescriptions and highlighting the need for long-term, multifactorial assessments of river regulation.

Gains and losses driven by woody plant encroachment: a focus on phylogenetic diversity

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

The global increase of woody plant encroachment (WPE) has been shown to affect multiple ecosystem properties, including plant diversity. While most studies have focused on taxonomic diversity (TD), often yielding inconsistent results, far less is known about the responses of functional (FD) and phylogenetic diversity (PD) to WPE. This study aimed to: (I) analyse changes in PD along a gradient of woody encroachment; (II) explore relationships among different diversity facets; (III) assess the degree of decoupling between PD and FD across encroachment levels; and (IV) characterise diversity patterns in relation to WPE. The study was conducted at four sites in northern Iberia, where plots were established along a gradient of woody plant cover. Shrublands showed phylogenetic overdispersion driven by the presence of older lineages such as pteridophytes and gymnosperms. When analyses were limited to angiosperms, phylogenetic clustering emerged at low woody cover, suggesting strong environmental filtering. TD was negatively related to both FD and PD, indicating ecological redundancy, whereas FD and PD were positively related, reflecting trait conservatism, although this relationship weakened when only angiosperms were considered. Patterns of PD-FD decoupling varied with encroachment intensity and taxonomic scope: shrublands showed PD-driven decoupling linked to non-angiosperm lineages, while grasslands exhibited FD-driven decoupling associated with adaptive divergence among closely related species. Overall, FD and PD increased with woody cover, whereas TD peaked at intermediate levels (5-30%) before declining. These results demonstrate that plant diversity facets respond differently to shrub encroachment, highlighting the need for a multifaceted approach to understand WPE.

Vegetation as fire–climate infrastructure: A methodological framework for reducing wildfire risk at peatland edges

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Independent researcher / Landscape architect

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

This study examines how vegetation-based strategies can function as fire–climate infrastructure at peatland edges under warming climate conditions, reducing ignition likelihood and associated carbon emission risks. Focusing on peatland margins affected by the 2025 wildfire in North York Moors National Park, UK, the research investigates how planting composition, ground treatment, and vegetation structure influence moisture retention, fuel continuity, and post-fire stability in vulnerable edge zones. Rather than intervening in intact peatland cores, the study concentrates on high-risk peripheral areas where altered hydrology and surface drying increase susceptibility to wildfire re-ignition. Native peatland-adapted species tolerant of fluctuating wet and dry conditions are prioritised, alongside non-combustible ground treatments that disrupt fuel continuity while supporting soil stability. Lightweight, low-impact vegetation structures are favoured to minimise subsidence risks commonly associated with post-fire peat soils. By framing vegetation as fire–climate infrastructure, this study advances a methodological approach for addressing wildfire risk and carbon emission potential at peatland edges through minimal, vegetation-led intervention. Rather than treating planting as post-fire restoration alone, the framework emphasises vegetation structure, fuel characteristics, and ground treatment as spatial tools for mediating moisture extremes and ignition likelihood. The approach offers a transferable method for assessing and deploying vegetation-based fire–climate strategies in peatland landscapes facing increasing wildfire pressure under future climate scenarios.

Managing mesic grasslands sustainably: lessons from herbaceous forbs

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

High plant diversity maintains ecosystem functioning and delivery of services in response to disturbance through the insurance of functional redundancy. Forbs (herbaceous dicots and non-graminoid monocots) rather than grasses, comprise most of the species in South African mesic grasslands, which receive 600 mm of annual rainfall. Research in South Africa's mesic grasslands sheds light on the critical role of forbs, in maintaining ecosystem health. Grazing significantly impacts forbs, with overgrazing drastically reducing diversity and replacing native species with hardy, often exotic ones. Certain forb species serve as indicators of grazing intensity, with their presence or absence informing a forb condition score for monitoring and adjusting grazing practices accordingly. High-density, short-duration grazing (HDG) may not immediately affect forb diversity but can damage individual plants, promote unpalatable grasses, and alter forb composition, potentially harming soil health. Forbs exhibit individualistic responses to grazing and competition, highlighting the need for nuanced management strategies. Although forbs regrow after defoliation, their underground storage organs are depleted, affecting future growth and potentially reducing diversity in the long run, emphasizing the importance of lenient management practices. While HDG can increase litter accumulation, it might not effectively replace fire's role in stimulating growth and reducing competition, underlining the significance of fire in maintaining forb diversity. Beyond grazing, certain forbs provide valuable food for herbivores, support pollinator communities, and offer essential resources for human livelihoods. Managing for forb diversity involves maintaining forb-rich habitats through responsible fire and grazing management practices to sustain biodiversity and the various services these grasslands provide.

Mapping global change threats to groundwater-dependent vegetation across drought-driven ecosystems

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P128

Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Groundwater-dependent vegetation (GDV) forms critical ecological refuges in arid and semi-arid regions, functioning as 'green, cool and wet islands' within otherwise drought-prone landscapes. These ecosystems sustain regional biodiversity and provide essential ecosystem services, yet are increasingly threatened by declining groundwater tables, intensified land use and climate change. Despite their importance, global assessments of GDV vulnerability remain scarce. Building on recent global baseline maps of GDV in Mediterranean and dryland regions, we develop a spatially explicit risk assessment framework to identify threatened GDV and the drivers of degradation. GDV at risk is quantified at 1-km resolution using a composite variable that integrates both the proportion of browning and the mean rate of decline in vegetation vitality. We relate this response to climatic (precipitation, temperature and drought), hydrological (groundwater abstraction and depletion), and land-use (changes in human modification) trend indicators to quantify key drivers of change. Using Mann-Kendall trend analysis on MODIS NDVI time series, we found that 16% of GDV areas had undergone significant browning over the past 25 years. Meanwhile, 48% remained stable and 36% exhibited greening. However, these trends vary across biomes: one quarter of GDV in deserts and xeric shrublands shows browning relative to largely stable non-GDV, whereas Mediterranean GDV is dominated by greening despite higher browning in non-GDV. By directly linking vegetation condition trends with global change drivers, this framework provides a novel and scalable baseline for identifying and prioritising areas for GDV conservation and restoration, and for understanding where and why these refugia are declining.

The burning question: how quickly do forb communities respond to fire suppression?

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P79

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Fire suppression is a major driver of change in savanna ecosystems, altering community structure and composition. Forbs are particularly sensitive to fire exclusion and may be progressively lost as suppression persists. Although long-term fire exclusion is known to affect forb communities above- and belowground, the timing at which forb communities begin to shift remains unclear. We tracked forb communities in the Cerrado over 10 years of fire exclusion and compared them with frequently burned plots. We quantified species cover, richness, and temporal turnover. Across the first years, forb cover and species richness did not show consistently large differences between fire-excluded and frequently burned areas. However, forb cover declined through time under fire exclusion, while species richness remained relatively stable. In contrast, frequently burned plots maintained forb community cover and showed an increase in species richness over time. Temporal turnover declined with year, indicating directional compositional change over the decade, but there were no differences in turnover between. This decoupling between abundance and richness suggests that early responses to fire exclusion are expressed primarily as shifts in species abundances rather than immediate species loss. Overall, our results highlight that changes can emerge within a decade of fire exclusion and reinforce the role of recurrent fire in maintaining forb communities diversity in the Cerrado.

Contrasting community structure and environmental drivers between biological soil crust and vascular plant assemblages in grasslands

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P43

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

Grasslands support biodiversity by providing essential ecosystem functions, including forage production, nutrient cycling, and carbon storage. For grasslands to occur, they rely on disturbances, such as grazing, to limit woody encroachment. Within grasslands, two contrasting vegetative groups exist: vascular plants (VPs) and low-stature, slow-growing biological soil crusts (BSCs), which are dominated by lichen. While both VPs and BSCs require disturbance, they have asymmetric responses to varying disturbance intensities, which are not fully understood in Northern grassland systems. To begin resolving the effects of disturbance on VP and BSC community assemblages, we first need to know how environmental variables drive community structure. We investigated whether patterns of community structure differ between VP and BSC communities, and if they exhibit similar responses to environmental variation. To measure these effects, we collected data on vegetative community composition and soil characteristics across 396 sites. Sites were located in two distinct ecoregions, the relatively mesic aspen parkland with higher topographic variation (n=180), and the relatively drier and topographically flatter dry-mixed grass ecoregion (n=216). Results reveal a higher abundance of VPs and higher spatial heterogeneity across BSC communities. Environmental drivers were ecoregion-dependent; moisture gradients shaped communities in aspen parkland sites, whereas in dry-mixed grass sites, nutrients drove VPs, and soil texture drove BSCs. These findings establish a critical baseline for Northern grassland vegetative communities and also support a larger grazing experiment aimed at predicting the effects of grazing management on community dynamics.

Phylogeographic patterns are strongly associated with biogeographic patterns in the Irano-Anatolian global biodiversity hotspot

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P28

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Biogeographic breaks, i.e., shifts in overall species composition, are expected to be associated with phylogeographic breaks because of shared ecological or evolutionary factors operating at both the interspecific and intraspecific level. Here, we test the hypothesis that biogeographic and phylogeographic boundaries are congruent using mountain species of the Iranian Plateau as our model system. To this end, we analysed the genetic structure from RAD-sequencing data of four montane (i.e., mid-elevation) and five alpine plant species endemic to yet widely distributed in the Iranian mountains. Phylogeographic boundaries were inferred via the Monmonier maximum difference algorithm and compared to biogeographic breaks identified previously based on floristic data. Correspondence of phylogeographic groups (separated by phylogeographic breaks) with areas of endemism (separated by biogeographic breaks) was moderate, because areas of endemism often contained more than one phylogroup or phylogroups were shared between areas of endemism. Major phylogeographic break zones, supported by several montane and alpine species, were identified between Alborz and Zagros as well as between the Azerbaijan Plateau and Zagros (each of those areas corresponding to an area of endemism), thus supporting the biogeography and phylogeography concordance hypothesis. Moreover, the genetic structure is stronger in alpine than in montane species, which can at least partly be attributed to the stronger isolation of high-elevation habitats acting as sky islands.

Distribution of aquatic macrophytes along environmental gradients in agricultural ditches

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P92

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

Freshwater ecosystems are among the most threatened vegetation types worldwide and are impacted by several interacting stressors, including eutrophication, land-use intensification, biological invasions and climate change. Although drainage ditches are anthropogenic, they provide important habitats and refugia for aquatic biodiversity. Despite this, they remain poorly studied compared to most terrestrial habitats. In this study we surveyed aquatic macrophyte vegetation in 135 drainage ditch sections across protected and conventional agricultural landscapes in the area of Bremen, north-western Germany. We analyzed the effects of land use, ditch morphology, turbidity, and nutrient availability on macrophyte composition at the community level, across morphological growth forms, and for selected species. Ditch morphology (depth and width) and turbidity were the strongest predictors of macrophyte community composition. Submerged macrophytes, including *Potamogeton acutifolius*, *Potamogeton friesii*, and *Myriophyllum spicatum*, dominated clear, low-nutrient ditches and indicate more stable ecological conditions. In contrast, floating plants such as *Lemna minor*, *Lemna gibba*, and *Spirodela polyrhiza* dominated nutrient-rich, turbid ditches. The keystone species *Stratiotes aloides* was strongly associated with surrounding land use and was underrepresented in conventionally managed agricultural landscapes, indicating management-driven negative effects on this species. Overall, drainage ditches can sustain distinct and predictable macrophyte communities based on their environmental conditions and represent an impactful opportunity for freshwater biodiversity conservation in agricultural landscapes.

From *Diploicia to Usnea* – Changes in epiphytic lichen composition along a European gradient

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P2

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Lichens have long been used as bioindicators for air pollution, and current research has shown that they are suitable to track climate change much faster than vascular plants. In this study we aimed to examine the occurrence of epiphytic lichens in relation to various environmental drivers and to quantify the distribution of the lichens considered as "climate change indicator species" along a climatic gradient from Western Central to Northeast Europe. We recorded the abundance of lichen species in relation to various tree characteristics in the cities of Amiens (France), Ghent (Belgium), Bremen, Potsdam (Germany), Lund, Linköping and Stockholm (Sweden). Trees of the genera *Tilia* and *Quercus* in different parts of the cities were sampled by the same observer based on German VDI-guidelines. Lichen species with higher temperature and precipitation preferences, among them climate change indicators, increased towards the SW, whereas lichen species with low nitrogen preference increased towards the NE. However, the close correlation between climatic variables and pollution levels made it difficult to disentangle the main drivers. Overall, each city had a distinct lichen community composition. Total species number was significantly influenced by tree habitat and mean temperature. The tree characteristics 'tree species' and 'circumference' had significant effects on the epiphytic lichen vegetation. A historical comparison between surveys for Bremen showed significant changes in lichen species composition, in line with the results for the spatial comparison. Our study emphasizes the importance of environmental variables and tree characteristics for epiphytic lichens and their contemporary changes in the geographic gradient.

Short-term understory vegetation changes in Lalashan forest dynamics plot, northern Taiwan

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P156

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

The montane cloud forest is one of the most endangered forest ecosystems, providing vital services, including freshwater and carbon storage. Compared to long-lived overstory species, understory vegetation has higher sensitivity to microclimatic variations due to the shorter life cycles. However, previous studies on how cloud forest understory species interact with environmental changes remain limited and inconclusive. To investigate these drivers, we conducted a resurvey of understory vegetation in 1-ha Lalashan Forest Dynamics Plot in northern Taiwan. We analyzed changes in species composition and richness between 2020 and 2025, further related them to shifts in environmental conditions (canopy openness, moisture, temperature, soil pH, substrate types) and changes in overstory species composition during the same period. We observed that species richness and evenness declined during these five years, with a directional change in species composition. Quadrats became more compositionally heterogeneous, with no significant differences within each vegetation types. These changes were driven by the reduced cover of dominant fern species. Linking species composition shifts to changes in environmental variables showed that moisture, temperature, and canopy openness are having influence, with temperature identified as the main factor leading the direction. Furthermore, by regressing changes in light availability against the community weighted mean of fern shade-tolerance traits, increased shading intensity resulted in a turnover favoring species with higher shade tolerance. These findings highlight that understory communities are highly sensitive to short-term microclimatic fluctuations. Variation in water availability is shaping understory species composition, which may potentially influence the long-term changes in cloud forest vegetation.

Landscape functional connectivity of Cerrado forest ecosystems within silvicultural matrices

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P3

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

The Cerrado biome, the second largest in Brazil and high in biodiversity and endemism, has undergone various anthropogenic modifications that affects its ecosystem dynamics. This study evaluated the influences of the *Eucalyptus* spp. silviculture matrix on the landscape functional connectivity of a Cerrado forest ecosystem (cerradão). In three silviculture-dominated landscapes, two transects were drawn, starting from the largest Cerrado fragment in the landscape, crossing the silviculture matrix, towards two other fragments. Data from individuals of woody plant species were collected along each transect at five distances from the main fragment (10, 30, 60, 110, and 200 m), and inside it, 60 m from its edge. To assess the existence and variation among landscapes of relationships between distance and diversity and structural variables of woody flora, different linear models were tested using General Linear Mixed Models. Diversity variables - individual abundance and species richness - drastically decreased with the distance, and revealed a threshold between 110 and 200 m. Structural variables - mean height, circumference, and volume - increased with distance, and revealed a threshold between 10 and 30 m. Sørensen Index showed strong dissimilarities between matrix communities and the cerradão fragments communities, and between the communities at 200 m and those closer to the fragment. These results indicate that the silvicultural matrix filters Cerrado woody species, not contributing to the landscape functional connectivity. Therefore, maintaining fragment proximity and enhancing propagule fluxes are key strategies for conservation and restoration of the Cerrado.

Distribution of the *Rubo caesii-Amorphion fruticosae* Shevchyk et V. Solomakha in Shevchyk et al. 1996 alliance in Ukraine

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P4

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Amorpha fruticosa is a North American species, introduced to Europe in 1724, and first appeared in Ukraine in 1809 in Kharkiv. Although this species is actively spreading in all regions of Ukraine, currently it is most common along the Dnipro. The exact date of its appearance in this region is unknown, but the first mention of *Amorpha* in the floodplain of the Middle Dnipro was made in 1969-70. Over the past 30 years, this species has completely naturalized in this region and became a strong competitor, especially in riparian habitats. The alliance *Rubo caesii-Amorphion fruticosae* was first described in 1996 in the Kaniv Nature Reserve. The most spread association *Euphorbio virgultosae-Amorphetum fruticosae* was chosen as the nomenclatural type of this alliance. It unites riparian shrubs on temporarily flooded clay soils covered by water during flooding. The aim of our study was to investigate the distribution of communities that belong to this alliance in Ukraine. Our research based on personal geobotanical releves sampled across floodplains of Ukraine. Totally 138 releves (coverage of *Amorpha* 30-100%) have been sampled during field seasons since 2014. It was discovered that communities of this alliance have a broader distribution in Ukraine. Along the Dnipro they spread north to the border with Belarus. They are also spread along the Dunaj and Desna and rarely occur along the Pivdennyj Buh. With lover coverage *Amorpha* is also spread on the rivers of the Middle Dnipro basin but still isn't presented in floodplains of Western Ukraine (except Zakarpattia).

Fine-scale spatial heterogeneity drives plant species composition in the arid Trans-Himalayas

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P55

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Cold, arid ecosystems of the Trans-Himalayas are characterised by harsh climatic conditions, low precipitation, poor soil nutrient availability, and low primary productivity. These ecosystems are highly vulnerable to climate change and harbour unique diversity of flora that also forms the resource base for local pastoral communities. Traditional approaches to modelling social ecological systems for climate change provide a matrix of regional-level impacts, but fail to account for subregional ecological phenomena that are critical in shaping local climate change outcomes and responses. It is critical to establish empirical relationships that drive vegetation composition to effectively understand the intertwined impacts of climate change and local pastoral practices. This study aims to understand ecological processes that drive the plant species composition in Tso Kar Basin, Southern Ladakh. The vegetation data was collected using a stratified, systematic sampling method along with soil samples that were subsequently subjected to analysis of nutrient and elemental composition. Our results indicate that in four of the eight habitat types, rank-abundance patterns follow log-normal distributions, whereas the others follow Pre-emption distributions, characteristic of stressed ecosystems. Results indicate that patterns in species turnover across habitat types are significantly correlated with fine-scale variations in physicochemical parameters of soils and topography. Further, these relationships vary across habitat types and for the overall basin, indicating the influence of multiple factors in determining the community composition. The empirical relationships observed can enable us to refine climate models to sub-landscape level impacts, which can benefit wildlife conservation programmes and sustainable pastoral practices in the basin.

Functional strategies of ferns in fire-affected ecosystems

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P80

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Fire occurs naturally in many ecosystems, but shifts in fire regimes are affecting both ecosystems that depend on fire and those that are sensitive to it. Vegetation provides the primary fuel for wildfires, placing plants at the center of how we understand fire on the landscape. Although ferns are often abundant in early successional communities following a disturbance, they are more commonly associated with shady, mesic ecosystems not typically considered fire-prone. As a result, "ferns and fire" remains a topic with little research. Across existing studies, fire-adapted ferns are generally described as persisting in one of three ways: 1) via subterranean rhizomes and/or clonal organs, 2) by insulation of the apical meristem via a root mantle or persistent leaf bases, and 3) by spores, which may survive in the soil or quickly colonize an area. However, there is still a significant gap in understanding how these strategies relate to functional traits, how they vary across fire characteristics (e.g., intensity and time since fire), and how they shape fern community assembly in post-fire landscapes. This project will explore functional strategies of ferns in fire-associated ecosystems through a series of case studies, the first of which will take place in March 2026 in the Central Highlands of Vietnam, a tropical montane region with a history of recurrent fire in Khasi pine forests. This Poster will introduce the study framework, present a functional trait protocol for studying fire-affected ferns, and briefly share field insights from the Vietnam case study.

PlotDEM: an open and reproducible relocation tool for quasi-permanent vegetation plots in mountain areas

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P44

Type: Poster

Subject: Cross-cutting topics across ecosystems

Session: Community assembly: Theory and methods in vegetation science

This study presents a novel methodology and an implemented R tool for the relocation of quasi-permanent vegetation plots during resurveys in topographically complex environments, such as mountain regions. This standardized workflow integrates historical plot site data and descriptions, digital elevation models (DEMs), and in-field expert knowledge to identify the most suitable sites for plot relocation, even when precise geographical coordinates are unavailable. The methodology is fully reproducible, thanks to the application of an entirely open-source workflow. The effectiveness of the relocation method was evaluated in terms of both precision and reproducibility among operators during the pre-fieldwork steps, and reliability during field sampling. The latter was assessed by quantifying pseudoturnover through comparison among four independent plot replicas and with historical data from alpine grasslands. The proposed method proved to be an effective support tool for plot relocation, showing good reproducibility among operators. Moreover, it resulted in levels of pseudoturnover comparable to those reported as acceptable in previous resurvey studies, while substantially reducing the effort required for plot relocation in the field. This method has the potential to facilitate the execution of large resurvey campaigns by enabling the sampling of single plot replicas rather than multiple ones, as previously recommended. Nevertheless, we recommend identifying a subset of plots for conducting replicate surveys within the identified suitable area, in order to empirically estimate spatial pseudoturnover and further enhance the robustness of resurvey-based studies.

Legacy effects of white-tailed deer (*Odocoileus virginianus*) browse on soil seed banks in the forests of the northeastern United States

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P148

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

Declines in seedling abundance across the northeastern United States have become a major concern. Yet, an often-overlooked component of seedling recruitment occurs below ground in the soil. Soil seed banks serve as reservoirs of viable seeds that allow ecosystems to recover from disturbance and are a vital part of plant community regeneration. As disturbances such as over-browsing become more frequent and widespread, they can severely strain a seed bank's capacity to regenerate seedlings. Concurrently, increasing populations of white-tailed deer in the United States can have substantial effects on seedling recruitment and forest regeneration. This study aims to determine the long-term effects of white-tailed deer browse on forest regeneration by examining changes in soil seed banks over time. We sampled soil seed banks from 49 pre-existing deer exclosures across Ohio, Pennsylvania, and West Virginia (U.S.A.), conducting seedling emergence trials on samples collected from both inside and outside each exclosure. We hypothesized that seed banks inside exclosures would exhibit higher plant abundance and diversity, with both increasing as exclosure age increased. During emergence trials, we germinated and identified 1,764 seedlings representing 60 species, with *Juncus tenuis*, *Vitis* spp., and *Rubus* spp. being the most common. Contrary to our expectations, abundance and diversity did not differ significantly between samples collected inside and outside exclosures, decreased with exclosure size, and were not correlated with exclosure age. Overall, this research improves our understanding of the legacy effects of white-tailed deer browse on plant regeneration and evaluates whether browse exclusion can help replenish forest seed banks.

Temporal dynamics of plant diversity in response to productivity change

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P195

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Understanding the causes of global biodiversity variability is essential in light of the rapid environmental change we are experiencing today. We are witnessing a global decline in biodiversity, which we attribute to human activity such as habitat loss, homogenisation, or land use. However, it has now been found that at least at the local scale, plant species richness is not declining consistently. Losses and gains of species appear roughly balanced, yet the drivers of these inconsistencies remain unknown. My PhD project will attempt to link these changes to the changes in productivity, as a proxy for available resources in the environment. The research's primary hypothesis is that local-scale human-induced productivity increases affect assemblage diversity, with the direction of change depending on initial productivity levels: (A) In low-productivity sites, increases in productivity (e.g., through nitrogen deposition or land abandonment) are expected to lead to increases in species richness and abundance over time. (B) In high-productivity sites, further productivity increases may paradoxically lead to reduced richness and abundance as individuals increase in size and larger species become dominant. The PhD project addresses this problem by utilizing a two-scale approach. First, by conducting a local resampling study, comparing contemporary data on species richness and productivity with records collected from the same sites fifteen years ago. Second, by integrating global databases to provide a long-term context. I would like to present my methodology progress and expected outcomes.

Environmental drivers of whole-plant functional diversity across European ecosystems

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P45

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

Plant functional diversity links vegetation composition to ecosystem functioning and resilience, yet above- and belowground trait dimensions are rarely integrated at large spatial scales, limiting our understanding of whole-plant responses to environmental heterogeneity and global change. Here, we combine newly measured and existing trait data with high-coverage plant community and environmental datasets to assess how climate, soils, topography, and human footprint shape above- and belowground functional diversity across European ecosystems. Using a trait-probability-density framework, we quantified multidimensional functional diversity for 3,013 species across 32,596 plots spanning forests and open habitats. We applied spatially explicit generalized additive models and hierarchical partitioning to identify dominant environmental drivers while accounting for spatial structure. Functional diversity in both compartments peaked in Central and Southern Europe, but environmental controls differed in magnitude and direction. Climate emerged as the dominant driver above- and belowground, whereas soil properties, topography, and human pressure were relatively more influential belowground. Environmental effects were habitat-dependent and stronger in forests than in open habitats, where belowground responses were weak. Aboveground functional diversity increased with higher temperature, climate change intensity, and human footprint in open habitats, but declined under similar conditions in forests. In contrast, belowground functional diversity decreased with increasing temperature and showed contrasting habitat-specific responses to precipitation stability, soil fertility, and topographic heterogeneity. Our results demonstrate that environmental drivers shape plant functional diversity in compartment- and habitat-specific ways, highlighting the need to integrate belowground traits into large-scale biodiversity assessments and vegetation models to improve forecasts of ecosystem responses to global change.

A new aspect of seed dispersal: Human-dispersed diaspores can survive and disperse after the laundry washing

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P5

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: Human-disturbed habitats, invasions, and novel communities*

The number of diaspores (seeds and fruits) dispersed through HVD (human-vectored dispersal) can be extremely high: a single person can disperse thousands of diaspores on their clothing in just one day. These diaspores often adhere to clothing so strongly that they do not fall off even after the laundry, therefore, they can spread further long distances. In a full-factorial experiment we tested 18 plant species, which have already been registered as being able to spread on human clothing. We tested the effects of 21 washing treatments: seven types of detergents (water, soap nut and five types of synthetic detergents: D1- liquid laundry detergent, D2 – washing pod, D3 – washing powder, D4 – detergent with bleach and D5 – detergent with extra bleach (30%)) at three washing temperatures (30, 40 and 60 0C) compared to an untreated control. Our results showed that washing temperature was the most significant factor affecting germination; while, the seven types of detergents had no significant effects on the germination potential. We showed that during human-vectored seed dispersal (HVD) people are not purely transporting diaspores from one location to another, but via the laundry cycle, we can also influence the fate of the transported diaspores by affecting germination capacity. These results have new implications for understanding the early stages of biological invasions and suggests the necessity of improved biosecurity measures in protected areas facing increasing pressures from tourism.

After fire, plants bloom: fire season effects on reproductive phenology in the Cerrado

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P81

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

In savannas, fire is widely recognized as a trigger that stimulates and synchronizes the reproduction of several species. In the Cerrado, changes in fire regimes have shifted the timing of burns, potentially altering species' reproductive responses. Therefore, this study aimed to evaluate whether different fire seasons affect the reproductive phenology of plants in the ground layer of the Cerrado. Surveys were conducted in plots subjected to burns at early, mid and late-dry season. Reproductive phenology was recorded in thirty 1×1m subplots for each fire season. Results showed that burned areas exhibited a higher percentage of reproductive species than unburned areas and that fire season differently affected Cerrado species. Responses varied with fire season and post-fire time, especially during the first year, at both community and growth form levels. Early-dry season fires showed higher percentages of reproductive species three months post-fire, whereas mid- and late-dry season fires peaked after nine months. The percentage of reproductive stems and growth form responses also varied with fire season, with forbs and graminoids reaching higher reproductive peaks during the first post-fire year. In contrast, shrub species showed no differences between fire seasons. Understanding the effects of fire season on reproductive phenology is essential for elucidating the role of fire in fire-prone ecosystems such as the Cerrado and for developing management and conservation strategies that promote species regeneration, pyrodiversity, and the maintenance of ecological interactions.

Understanding soil carbon and nitrogen dynamics through vegetation in global grasslands

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P161

Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Plant communities regulate soil carbon (C) and nitrogen (N) cycling, yet how plant cover and species richness control soil organic matter (SOM) and its fractions remains unclear. SOM is the largest terrestrial C reservoir and plays a central role in ecosystem functioning, especially in grasslands where substantial C and N is stored in soils. We quantified C mineralization and ammonium accumulation in bulk soil (BS), particulate organic matter (POM) and mineral-associated organic matter (MAOM) during 150-day incubations of soils from six grasslands spanning contrasting climatic and edaphic conditions, relating mineralization rates to plant cover and species richness using linear mixed-effects models. C mineralization increased with plant cover, with the strongest response in BS ($_3$ = 874.6, $p < 0.001$). Species richness was the main predictor of C mineralization (R^2 = 0.50 in POM; 0.57 in MAOM), indicating that plant diversity enhances residue decomposition even in MAOM pools. N showed a similar pattern, with cover and richness explaining most variation in BS ($_3$ = 0.133, $p = 0.052$). Responses in fractions were increasingly influenced by edaphic conditions, particularly in clay-rich grasslands. Overall, vegetation helped explain soil C and N dynamics: plant cover regulated rapid fluxes in BS, while plant diversity and edaphic context shaped C turnover within fractions. MAOM supported substantial mineralization and responded to species richness, indicating a biologically active pool rather than uniform recalcitrance. Results suggest that losses of plant diversity may reduce C processing even within MAOM, with implications for long-term soil C storage in grasslands.

The effect of local- and landscape factors on rare weed communities in out of production sites

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Type: Poster

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

Rare weeds (RW) are disturbance-tolerant plant species that contribute to agrobiodiversity and associated ecosystem services without reducing agricultural yields. Ongoing agricultural intensification across Europe, however, has led to strong declines in RW communities, highlighting the need for conservation strategies that consider their specific ecological filters. In this study, we assessed the role of out-of-production sites as potential habitats for the assembly and persistence of RW communities characteristic of arable fields, old-fields, and grasslands. We conducted an intensive field survey across 216 sites in Hungary, including spontaneously recovering grasslands and reference grasslands. We examined how site- and landscape-level assembly drivers (such as geographic location, landscape transformation, habitat area, environmental heterogeneity, soil properties, vegetation age, and structural vegetation attributes) affect RW occurrence and species richness. A total of 38 RW species were recorded, including 15 red-listed and two protected species. RWs were present at 50.9% of the sites, demonstrating that out-of-production sites can function as refugia for RWs typical of croplands, old-fields, and grasslands. Environmental heterogeneity emerged as the strongest driver of RW occurrence, particularly for grassland-associated species. Poisson models indicated lower overall RW richness in northern sites. Arable RW richness increased with higher soil $CaCO_3$ content, whereas elevated soil phosphorus reduced grassland RW richness. Vegetation diversity promoted the assembly of old-field and grassland RWs. Our results suggest that land sparing through the retention of out-of-production sites, together with the maintenance of environmental heterogeneity and regeneration gaps, supports RW communities in agricultural landscapes.

High variability of nutrient resorption efficiency in *Quercus ilex* is a consequence of changes in environmental factors and water availability

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

Plants in nutrient-limited environments have developed strategies to maximize nutrient efficiency; for instance, by avoiding losses through nutrient resorption from senescent leaves. Since there seems to be no relationship between resorption efficiency and nutrient availability in soils, other factors should control the process. Indeed, reported experimental manipulations and reviews point towards temperature and rainfall as controlling factors of nutrient resorption efficiency (NRE). Here, we addressed the effects of climate and soil variables along a latitudinal gradient on NRE in holm oak (*Quercus ilex* L.), an evergreen tree species dominant in wide areas of the western Mediterranean Basin. We measured C, N, P, K, Ca, Mg, Na, Fe, and Zn content in green leaves and, over one year later, on freshly fallen litter in six localities along a latitudinal gradient from France to Spain to Morocco, and estimated NRE for each nutrient at each location. Our results show that NRE differed across sites and the nutrient considered, irrespective of soil nutrient availability. The resorption efficiency of each nutrient correlated positively with all others, except for Na. Mean annual temperature negatively affected NRE for most nutrients, while mean annual precipitation had a positive effect. NRE correlated positively with nutrient content in the green leaf for all nutrients. Our data suggest that NRE is not an adaptive strategy in *Q. ilex*, and differences between sites may result from stochastic environmental factors, mostly related to water availability, during leaf senescence.

Flowering and fruiting conditions under the canopy of conifer plantations for two evergreen tree species of the Lauraceae in warm-temperate Japan

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Type: Poster

Subject: Ecosystem-focused topics

Session: Anthropogenic ecosystems: from invasions to novel communities

In warm-temperate regions, the conversion of conifer plantations into broad-leaved forests and the restoration of broad-leaved tree populations are strongly influenced by flowering and fruiting under the canopy formed by planted trees, as these processes affect seed invasion and regeneration in the understory of plantations. *Neolitsea sericea* and *Cinnamomum yabunikkei*, both constituent species of the subcanopy layer of lucidophyllous forests, show different occurrence patterns in conifer plantations and natural evergreen broad-leaved forests. *N. sericea* has frequently been reported to invade and establish on the forest floor of plantations, whereas *C. yabunikkei* tends to occur preferentially in natural forests and, even within these forests, is more commonly found in canopy gaps with relatively favorable light conditions. In this study, we focused on flowering and fruiting traits as one factor explaining why *N. sericea* occurs more readily in plantations than *C. yabunikkei*, and investigated the flowering and fruiting status of individuals of different sizes growing under different understory light conditions. The results showed that *N. sericea* begins flowering and fruiting at a larger size than *C. yabunikkei* and has lower light requirements for flowering and fruiting. These traits suggest that *N. sericea* is better adapted to expanding its distribution within plantations, where understory light conditions are generally poor. Such differences are considered to be one of the factors governing the contrasting occurrence patterns of the two species within forests.

Do pasture matrices limit Cerrado regeneration? Insights from a controlled soil propagule experiment

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

This study investigated how pasture matrices influence the soil propagule bank and regeneration potential of Cerrado woody species, testing whether propagation potential decreases with increasing distance from native habitats due to soil compaction and dispersal strategies. The research was conducted in pasture-dominated landscapes of southwestern São Paulo state, Brazil. A controlled greenhouse experiment was carried out using soils collected from native habitats and at increasing distances into the pasture matrix. The viable soil propagule bank was assessed based on the establishment of woody species through germination or resprouting under optimal growth conditions. Regeneration from the soil propagule bank did not show a consistent decline with increasing distance from native habitats, and no significant differences were detected between soils from native habitats and those from the pasture matrix under controlled conditions. These results suggest that pasture matrices may retain a soil propagule bank comparable to that of native habitats when limiting factors such as exotic grass competition and soil compaction are minimized. Therefore, pasture landscapes may contribute to Cerrado regeneration and functional connectivity if sustainable management practices, including rotational grazing and reduced dominance of exotic grasses, are implemented, supporting conservation and restoration efforts in human-modified Cerrado landscapes.

Areas of endemism and bioregions of the alpine flora of the Andes

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

The Andes, with their extensive elevational and latitudinal gradients coupled with climatic and topographic complexity, have generated highly heterogeneous habitats and host an exceptional diversity of flora and fauna. The alpine habitats of this mountain range are particularly diverse, with a high number of endemic plant species. In this study, we aim to identify the bioregions and areas of endemism of the Andean alpine flora using two quantitative approaches: Network Clustering and Endemicity Analysis. Using Network Clustering, we identified five major bioregions extending from the Venezuelan Andes to Patagonia, generally encompassing large distribution ranges, whereas the Endemicity Analysis revealed nine areas of endemism ranging from the Colombian Páramo to the Chilean Matorral, with some overlaps among them. Although the two approaches show certain similarities, notable differences also exist. The major drivers shaping these biogeographical units appear to be tectonic uplifts, glaciation events, climatic factors, and topographic complexity.

Microenvironmental heterogeneity influences fine-scale community assembly in a montane grassland

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

Understanding how communities assemble can reveal which resources or environmental factors are limiting to species. We investigated how communities were assembled at fine-scales along a 1000 m elevational gradient in the Maloti-Drakensberg, South Africa. The dataset comprised three sites between 2000 m a.s.l. and 3000 m a.s.l., each containing seven sampling grids consisting of 160 contiguous 1 m^2 cells. Vascular plant composition, plant height and specific leaf area (SLA) were measured in each cell. We used a null model approach to test whether the functional diversity of traits in communities were greater (indicative of limiting similarity) or smaller (indicative of environmental filtering) than expected under random assembly. All traits at all elevations showed significantly greater trait convergence than expected under the null model. However, there was great heterogeneity in the community assembly signature of cells within each grid. To test whether microenvironmental differences drive fine-scale differences in community assembly, we performed k-means clustering on all cells based on percentage rock cover, vascular plant cover, soil moisture and soil depth of each cell and tested whether community assembly differed between the clusters. Environmental filtering was the dominant assembly mechanism in all four clusters. Plant height was most strongly filtered in the first cluster (with shallow soil and high soil moisture), selecting for short plants. Environmental filtering for SLA was strongest in the third cluster (with deep, moist soils and high vascular cover), selecting for conservative resource-use strategies. Thus, microenvironmental heterogeneity creates unique assembly signatures at fine scales.

Go to depression or die? How some karst dolines mitigate wildfire impacts and serve as refugia

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Type: Poster

Subject: Cross-cutting topics across ecosystems

Session: Earth Observation of vegetation: Linking in-situ data with remote sensing

In the context of increasingly frequent wildfires and a warming climate, the survival of organisms in karst landscapes may depend on whether they occur on exposed plateaus or within dolines, and on the type of doline they inhabit. Dolines, enclosed karst depressions, are small-scale geomorphological features that create pronounced environmental gradients and can serve as potential microrefugia. Following the extensive wildfires in the northern Dinaric Karst region (SW Slovenia) in the summer of 2022, some dolines remained partially or completely unburned, while the surrounding plateau - and some dolines - were severely affected. This study aims to compare the bottoms, slopes and surroundings of selected burned and unburned dolines (20 dolines) to characterize differences in environmental conditions (including vegetation and microclimate) and geomorphology between burned and unburned dolines and their surroundings, and to assess post-fire recovery patterns four years after the event. To achieve this, we use a combination of remote sensing techniques to assess fire severity and reconstruct pre-fire vegetation using Sentinel-2 imagery, and to quantify geomorphological complexity using LiDAR data. These data are integrated with continuous microclimate measurements and field surveys of vegetation and land snails. Preliminary results indicate that unburned or less severely burned dolines tend to be deeper, more geomorphologically complex, and characterized by distinct microclimatic conditions and vegetation structure compared to burned dolines and the surrounding plateau. The results will provide valuable insights into how karst systems modulate wildfire impacts and support biodiversity under a changing climate.

Long-term alpine vegetation dynamics under unstable snow conditions

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Mountain grasslands in the alpine belt are widely recognized as important biodiversity hotspots, characterized by a complex mosaic of highly specialized communities rich in endemic and rare species. However, they are increasingly threatened by global processes such as biodiversity loss, rising temperatures, and changes in grazing pressure. According to the IV Habitat Report, these ecosystems show a declining trend in their conservation status, calling for effective monitoring and conservation strategies. Here, we revisited 32 historical vegetation relevés to assess temporal changes in EUNIS E4.4 Alpine and subalpine calcareous grasslands of the Gran Sasso National Park (central Apennines, Italy) between 1987 and 2025. Vegetation data were then combined with remote-sensing data to investigate the drivers of change. In particular, we used Landsat time-series data to generate pixel composites of Normalized Difference Snow Index and Normalized Difference Vegetation Index, and extract spectral bands. Mann-Kendall tests and General Linear Models (GLMs) were applied to identify temporal trends and compare productivity and snow cover with vegetation changes. Preliminary results suggest changes in snow cover stability, potentially linked to an increasing frequency of extreme climatic events. These changes appear to drive significant shifts in species composition and community structure, including declines in the abundance of characteristic alpine grassland species. Such patterns are consistent with ongoing thermophilization and the progressive impoverishment of alpine communities observed across multiple European mountain summits. These findings highlight the potential of incorporating additional environmental variables, and future analyses will aim to improve our understanding of long-term changes in alpine vegetation.

Effectiveness of capsaicin and denatonium benzoate as acorn predation deterrents

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration: Recovering plant communities with native seeds*

Direct seeding is a revegetation method that may offer considerable advantages for scaling up forest restoration compared to the planting of nursery-grown seedlings. However, high seed predation rates remain a major limitation to its application. Repellent substances such as capsaicin and denatonium benzoate have been proposed as a main strategy to protect seeds, showing inconclusive results across literature. In this study, we evaluated their effectiveness in reducing Holm oak (*Quercus ilex* L.) acorn predation by the wood mouse, a widespread predator across Europe. Repellents were incorporated into a coating based on coconut fiber and clay at higher concentrations than those previously reported, and a field experiment was conducted in Sierra Nevada National Park (Spain) combining in situ monitoring with video recording. Additionally, we tested the effects of coatings on acorn germination, emergence, and early growth under growth-chamber and nursery conditions. Coating did not affect germination, emergence and early growth. However, the repellents were ineffective against rodent activity, with acorn removal rates reaching an overall value of 97.4%. The physical coatings delayed the time elapsed between acorn encounter and removal compared to a control treatment, but this was not influenced by the deterrent substances. Moreover, video recordings suggest that mice were insensitive to the repellents. Acorn burial was the only action that reduced removal; at the end of the experiment (day 55) all superficially placed acorns were removed, whereas 5.28% of buried acorns remained on site. Neither capsaicin nor denatonium benzoate are therefore useful for deterring acorn predation by mice.

Disturbance-dependent communities in wet meadows: the role of traditional management for the rare *Marsilea quadrifolia*

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

Wet meadows are biodiversity-rich habitats in Europe, central to the Natura 2000 network, hosting specialised plant communities and several threatened species. *Marsilea quadrifolia* L., an aquatic pteridophyte of conservation concern, is a disturbance-dependent pioneer species of open semi-natural wetlands, threatened by changing agricultural practices. We assessed the effects of traditional management - seasonal grazing and annual mowing - implemented by an organic farm on *M. quadrifolia* and plant community composition in a wet Nature Reserve in Lombardy Region (N Italy), hosting the largest known extant wet meadow population in the country. Managed and unmanaged (exclusion) areas were compared through vegetation surveys over four years (2021-2024), assessing species cover, diversity indices, Grime's functional strategies, Ellenberg indicator values, water table fluctuations and *M. quadrifolia* chlorophyll content as a stress indicator. Managed areas showed significantly higher abundance of *M. quadrifolia*, while overall plant diversity did not differ among treatments. However, unmanaged areas exhibited clear shifts in vegetation structure and functional composition, with a higher proportion of stress-tolerant and competitive strategies, a marked reduction in ruderal species, and lower community light demand. Interannual hydrological variability also influenced species performance, with drought limiting M. quadrifolia in 2022 and wetter conditions promoting its expansion in 2024. Chlorophyll measurements indicated no ecophysiological stress associated with exclusion. Low-intensity grazing combined with mowing maintains open patches, reduces competition, and supports threatened species such as *M. quadrifolia*. Traditional management within Natura 2000 sites remains essential for integrating conservation and agricultural use under changing water availability driven by climate change.

Tree structure instead of microclimatic zones determines differences in vascular epiphyte assemblages between forest and pasture

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Type: Poster

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Land cover change threatens biodiversity by reducing species richness and favoring generalists. While pasture creation promotes the loss of original species, scattered trees can mitigate this by maintaining structural similarity to forests and retaining regional epiphyte diversity. We investigated factors driving similarity between forest and pasture epiphyte assemblages, hypothesizing that pasture assemblages are species-poor, dominated by xerotolerant generalists, and nested within forest communities. We also tested two drivers: "structural dependence" (zoning-specific species) and "microclimatic dependence". Results showed lower richness and more generalists in pastures, yet significant overlap indicated pasture assemblages were nested within forest ones. Shared species were linked more to tree zones (crown and trunk) than to light exposure. Thus, similarity is driven by structural factors where certain epiphytes prefer specific tree zones regardless of microclimate or habitat. Considering these findings, we recommend maintaining and planting scattered trees in pastures to enhance structural complexity (e.g., longer trunks and multiple crown branching), which can foster a proportion of the vascular species from forested areas, thus maintaining the similarity in vascular epiphyte assemblages between habitats.

When scale matters: functional–phylogenetic diversity decoupling along a sub-Mediterranean grassland–shrubland gradient

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Type: *Poster*

Subject: *Special Sessions*

Session: *Scaling laws in (vegetation) ecology*

Understanding scaling laws in ecology is fundamental to interpreting the processes that shape plant communities. Likewise, functional and phylogenetic diversity have been comparatively understudied, yet a multifaceted approach to biodiversity is essential for a complete understanding of ecological systems. Previous research has shown that the relationship between phylogenetic diversity (PD) and functional diversity (FD) can exhibit a decoupling pattern in European grasslands. In this study, we aim to: i) assess whether differences exist in the PD-FD relationship across spatial scales, and ii) to explore whether patterns of PD-FD decoupling vary with shrub cover at different scales. We conducted field nested sampling at four sites across a calcicolous sub-Mediterranean grassland-shrubland gradient in Northern Iberian Peninsula, with different shrub cover, using six spatial scales (0.0001, 0.001, 0.01, 0.1, 1 and 10 m^2). A total of 144 plots were established. For the second objective, shrub cover was recorded at 1 m^2 and 10 m^2 to explore the gradient and compare the PD-FD relationship at both scales. Diversity metrics were calculated for the complete species dataset and for angiosperms only. Preliminary results indicate that PD-FD decoupling can occur at any spatial scale. Considering all species, greater shrub cover is associated with a decoupling of PD at both 1 m^2 and 10 m^2. When gymnosperms and pteridophytes are excluded, FD decoupling instead appears in plots without shrub cover. This work emphasises the importance of evaluating multiple spatial scales and contributes to our understanding of how different dimensions of biodiversity interact.

Vegetation patterns across forest edges in Canada: preliminary results from a synthesis of CanFERN (Canadian Forest Edge Research Network)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation databases: Expanding the utility of plot-based surveys*

To investigate impacts of edges on adjacent forests, we analyzed a database on forest edges across Canada. We asked: how does vegetation at forest edges (compared to interiors) vary among different types of edges and forests? We focused separately on plant growth forms, specifically cover estimates of groups such as lichens, bryophytes, forbs, graminoids and shrubs at different distances from the forest edge. Preliminary results suggest patterns depend on the type of vegetation and edge. Barrens-forest edges had quite different patterns than other edge types with decreasing lichen and shrub cover, and increasing herb and fern cover with distance from edge. Bryophyte cover showed different trends for different types of edges, with greater bryophyte cover compared to interior forest at barrens and wetland edges and lower bryophyte cover at fire and lakeshore edges. Shrub cover decreased with distance from edge at barrens, fire and lakeshore forest edges. Graminoids were more abundant at fire and wetland edges compared to the interior. Such syntheses are complex and challenging but important to edge theory and pertinent to forest conservation, assessing the actual footprint of various disturbances in forest ecosystems. An International Forest Edge Research Network or IFERN database will greatly facilitate global syntheses and meta-analyses of edge studies and contribute to edge theory, which is applicable and pertinent to global efforts of forest conservation.

Disentangling beta diversity partitioning and richness in urban plant communities: implications for biotic homogenization

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Urban plant communities*

Urban vegetation, as heavily managed entities, are critical models for studying urban biotic homogenization (UBH), the increasing similarity of species across space and time. However, global evidence remains inconsistent, with studies reporting both homogenization and increased heterogeneity, indicating strong context-dependency and regional knowledge gaps. Beta diversity, which measures compositional variation between sites, is the standard metric for assessing UBH and it can be partitioned into turnover (species replacement) and nestedness (differences in richness), which reflect distinct ecological processes. Yet, most studies rely on broad-sense indices (e.g., Bray-Curtis) that confound these components. Here, we conduct a preliminary systematic review to assess how partitioning and richness components have been addressed in studies of UBH, with a focus on urban forests. Our synthesis reveals a predominant reliance on broad-sense dissimilarity indices, with only 38% of studies employing some controlling method for species richness, and a mere 1% of studies partitioning beta diversity into turnover and nestedness components. More importantly, we found that when richness-controlled or partitioned metrics are applied, evidence for biotic homogenization is substantially weakened. Therefore, the prevalence of UBH as a universal urban pattern may be overstated. We argue that adopting partitioned beta diversity or richness-controlled methods is essential to accurately diagnose the mechanistic drivers behind UBH. In the next steps of our research, we will explicitly disentangle other moderators' effect (e.g., invasion) to clarify and quantify the drivers of UBH, thereby providing a more nuanced assessment and robust foundation to understand the biodiversity change process of plant communities in cities.

Host-parasite relations of *Thonningia sanguinea* in two different forests ecosystem in Ghana

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Thonningia sanguinea is a holoparasitic plant with ecological, medicinal, and cultural importance. It is endemic to African tropical forests where it is used traditionally to treat skin infections, bronchial asthma, and serves as a food source for Maxwell's duikers. Despite its significance, knowledge of its host-parasite interactions remains limited, hindering effective ecological management and conservation. This study investigated the host-parasite relationships of *T. sanguinea* in two forest ecosystems in Ghana: Owabi Wildlife Sanctuary (moist semi-deciduous) and Bia National Park (moist evergreen). Data were collected from twenty 20 m × 20 m plots per forest, where all trees with DBH ≥1 cm within each plot were identified and recorded. The presence of *T. sanguinea* on host trees and canopy openness were measured. Results showed that mean host species diversity, richness, and basal area were higher in Bia than Owabi, but host density was comparable. Abundance and prevalence of *T. sanguinea* were also higher in Bia, but parasite intensity was greater in Owabi. Host-parasite network analysis indicated a connectance value of 0.34, suggesting that *T. sanguinea* is neither host-specialized nor fully generalist. Trees with smooth bark, no buttress, and small DBH were more likely to host the parasite. Habitat suitability modeling identified host availability as the most important factor for *T. sanguinea* distribution. Parasitism patterns varied between forests and were influenced by ecosystem characteristics, host availability, canopy openness, and host traits. It highlights the ecological flexibility of *T. sanguinea*, which enables it to adapt to different forest environments through host utilization strategies.

Pine forest canopy modulates shrub–oak seedling interactions depending on shrub functional identity

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Some shrub species are known to facilitate oak recruitment in Mediterranean climates; however, much less is known whether different shrub species facilitate ecologically distinct oaks, and whether these interactions shift beneath forest canopies. We examined the effect of two shrub species on seedling survival of two ecologically distinct oaks (*Quercus faginea* and *Quercus ilex*), the underlying mechanisms of these interactions, and how they change under a forest canopy. We planted seedlings of both oaks across three microsites (*Rosa canina*, *Cistus ladanifer*, and gaps) in an open area and in the understory of a *Pinus pinaster* forest, and quantified shrub functional differences using specific leaf area (SLA). Post-summer survival was higher in the pine forest understory than in the open area, consistent with milder microclimatic conditions in the forest. *Q. ilex* exhibited higher survival than *Q. faginea*, regardless of microsite or environment (open and pine forest). In the open area, survival was higher beneath both shrubs than in gaps, particularly beneath *C. ladanifer*. In contrast, in the pine forest, the lowest survival was observed beneath *C. ladanifer*, whereas survival beneath *R. canina* was higher. Shrub facilitation was associated with the mitigation of extreme summer conditions, as microclimatic temperatures under *R. canina* canopies were lower than those under *C. ladanifer*. Shrub SLA was unrelated to facilitative or competitive capacity. This study supports the use of nurse shrubs to enhance the establishment of new oak seedlings in open spaces, with implications for their integration into forest restoration planning and implementation.

Impact of water table decline and afforestation on seed bank formation and vegetation dynamics of fen meadows in inland dune slacks

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

Inland sand-dune ecosystems across Europe are threatened by groundwater decline and stabilisation through afforestation, which particularly affect groundwater-dependent dune-slack fen meadows and lead to their degradation. Although soil seed banks may support vegetation recovery, their persistence and species composition under these stressors remain poorly understood. We examined whether soil seed banks of inland dune slacks exposed to various stressors can contribute to vegetation recovery by studying seed banks along a large vertical gradient (0–70 cm) and aboveground vegetation in wet, dried and afforested dune slacks in Central Hungary. We compared seed density, species richness and composition among habitat types, examined the relationship between plant traits and seed vertical distribution, and evaluated the correspondence between seed banks and standing vegetation. Viable seeds occurred throughout the soil profile in all habitat types. Seed densities were highest in dried dune slacks, whereas species richness was greatest in wet dune slacks, which contained several wetland species typical of early successional wet habitats, and dune slacks in good conservation status. Environmental factors typical of identical habitat types influenced the vertical stratification of the soil seed banks by filtering for certain seed characteristics and plant traits. The species composition of the seed bank and the aboveground vegetation differed significantly both among and within habitat types. Our findings suggest that soil seed banks alone cannot restore degraded dune slacks; however, deep and persistent seed reserves – especially in wet dune slacks – may support recovery when combined with hydrological rewetting and active management.

Phytosociological study of isolated *Betula davurica-Quercus* crispula forests in the Japanese Archipelago

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P25

Type: *Poster*

Subject: *Special Sessions*

Session: *Bringing the different vegetation classification approaches together*

Betula davurica-deciduous *Quercus* forests are among the principal forest types in Northeast Asia. They are distributed in continental Northeast Asia. Interestingly, *B. davurica–Q. crispula* forests are also found in isolated mountainous areas throughout the Japanese archipelago. The Japanase *B. davurica–Q. crispula* forests are significant for understanding the phytogeography of Japan and Northeast Asia. We compared the species composition of the Japanese *B. davurica–Q. crispula* forests, with those of *Q. crispula* dominant forests and *B. davurica–Q. mongolica* forests using phytosociological methods. The results suggested that the Japanese *B. davurica–Q. crispula* forests had a significant number of species common to the order *Lespedezo bicoloris–Quercetalia mongolicae* and the class *Querco mongolicae–Betuletea davuricae* in continental Northeast Asia than in other associations in Japan. We consider that the similarity the associations between Japan and the continental Northeast Aisa have been caused by the environmental similarities, the histories of taxa, and the changes in vegetation distribution.

Legacies of *Pinus contorta* invasion persist for at least 16 years following control

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Invasions by *Pinus* species are a major driver of ecosystem change globally, particularly across the Southern Hemisphere. They are also expanding beyond their native ranges in the Northern Hemisphere. These invasions can fundamentally alter community structure and ecosystem processes, yet the persistence of such effects after invader removal remains poorly understood. Understanding these legacies is critical for predicting post-control community trajectories and recovery. We quantified the magnitude and duration of ecological legacies associated with the globally invasive conifer *Pinus contorta* using a chronosequence spanning up to 16 years since control in a New Zealand tussock grassland ecosystem. We assessed how time since control, historical invasion stage, and environmental context influenced soil conditions and plant community composition. Pine invasion generated persistent soil and vegetation legacies that were strongly linked to historical invader abundance. Elevated soil phosphorus availability and moisture persisted following control and were associated with simplified plant communities. Sites with greater historical pine density exhibited reduced native species richness and cover, alongside increased dominance of a small number of non-native grass species. As a result, pine invasion was associated not only with native species loss but also with sustained secondary invasions that persisted long after control. These findings demonstrate that a single invasive tree species can leave long-lasting legacies that restructure plant communities and facilitate additional non-native species. By showing that invasion history strongly constrains post-control community dynamics, our results highlight the importance of invasion stage for understanding vegetation recovery and the persistence of altered community states across invaded ecosystems.

Spatial covariation of carbon stock and vascular plant alpha diversity in global forests

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Forests act as major global carbon sinks and biodiversity refugia, but the intertwined crises of climate change and biodiversity loss are threatening these functions. Therefore, it is essential to analyze the spatial congruence between aboveground biomass carbon and plant alpha diversity in forest ecosystems, to better align climate and conservation strategies. Existing evidence of global congruence between carbon stocks and biodiversity often relies on vertebrate richness, derived from coarse habitat models, poorly reflecting plant richness in forest communities. Here, we quantify the global correlation between aboveground carbon stocks and vascular plant alpha diversity at 1-ha sampling grain, which is conceptually close to stand-scale forest structure. We harmonized global layers to a 2.5 arcminute resolution and extracted values of plant alpha diversity, aboveground biomass carbon, and biogeographic context for 1,707,819 forest grid cells. We used generalized additive models to account for spatial autocorrelation and modelled the linear correlation of aboveground biomass against vascular plant alpha diversity. Our results show that plant alpha diversity is positively correlated with aboveground biomass (59.7%), however their relationship is strongly dependent on the biogeographic context. Our study emphasizes that conservation and restoration strategies should be set in relation to local ecological context, identifying regions where prioritizing high-carbon forests is likely to deliver biodiversity gains, and flagging regions where this overlap is weak so that biodiversity measures need to be implemented alongside carbon actions to achieve both objectives.

The impact of shrub encroachment on the plant community structure and diversity in Podillia meadow-steppe grasslands

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

Shrub encroachment threatens meso-xeric semi-natural grasslands across Europe, but its drivers and biodiversity effects are poorly known in the Podillia region (Ukraine). We evaluated the roles of climate, topography and land-use regimes (especially grazing) in shaping shrub cover, and assessed diversity and herb-layer changes along an encroachment gradient. We sampled meso-xeric semi-natural grasslands in the Dniester Canyon (Ukraine), characteristic of the Podillia forest-steppe, using 94 plots (10 m^2) classified into five shrub-cover classes (0–20% to 80–100%). Shrub cover was analysed with generalized additive models using beta regression. Herb-layer structure and $_3$-diversity (Shannon, Pielou's evenness, Simpson's 1–D) were evaluated across cover classes using parametric and non-parametric approaches with post-hoc comparisons. Abiotic shifts were inferred from Didukh's ecological indicator values. Diversity showed a hump-shaped response, with maximum values at intermediate encroachment (20–60%). Once shrub cover exceeded 60%, Shannon diversity, evenness, and Simpson's (1–D) declined sharply. Indicator values are consistent with shrub facilitation at early-mid stages via microclimatic buffering and increasing habitat complexity. At late stages (80–100%), shrub dominance likely reduces resource availability (especially light) and intensifies competitive exclusion, consistent with the observed loss of herb layer diversity. Encroachment intensity was explained primarily by current grazing regime and mean annual temperature, while topographic variables (aspect, slope) and past grazing had secondary or modifying effects. Our results indicate a practical threshold near ~60% shrub cover beyond which meadow-steppe $_3$-diversity declines markedly, highlighting the importance of maintaining appropriate grazing regimes to conserve biodiversity under ongoing warming.

USNVC 3.0: The vegetation classification standard for biodiversity monitoring, conservation planning, and natural resource management across the U.S.

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Type: *Poster*

Subject: *Special Sessions*

Session: *Bringing the different vegetation classification approaches together*

The U.S. National Vegetation Classification (USNVC) is a federally mandated national standard for description and mapping of terrestrial vegetation in the U.S. and is widely used by state agencies and organizations. It has been developed through a partnership among federal agencies, the Ecological Society of America (ESA), and NatureServe. The ESA Vegetation Classification Panel maintains a Peer Review Board that solicits and evaluates proposals for classification changes. In October 2025, USNVC 3.0 was released, representing the first vegetation classification for the U.S. to systematically list and describe vegetation for all eight hierarchical levels (based on the EcoVeg approach), from biome to association, across all 50 states and U.S. territories. Significant enhancements include (1) restructured upper levels that closely align with the Global Ecosystem Typology, (2) revised mid-level macrogroup and group types with improved descriptions and distribution maps, (3) updated alliances and associations closely linked with U.S. state classification systems, and (4) public availability of all supporting materials such as keys, type descriptions, and guides at https://usnvc.org. The USNVC ensures vegetation data are consistent across U.S. jurisdictions, and provides a foundation for conservation and natural resource planning that is integrated into the workflows of state and federal agencies across the U.S. The USNVC also informs biodiversity assessments, helps identify at-risk ecosystems, assists in wildfire fuel assessments, guides data collection efforts for rare or poorly understood vegetation types, and is a critical resource for ongoing conservation, restoration, management, and mapping activities from local to international scales.

Ornamental plants from fire-prone ecosystems: linking adaptation, use and conservation

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P82

Type: Poster

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

Conservation gardening of threatened species is complimentary to area-based conservation. We assessed the ornamental potential for the threatened campo rupestre (CR) vegetation, a fire-prone montane ecosystem establishing on nutrient-poor quarzitic and ferruginous substrates in eastern Brazil. It occupies >1% of Brazil's area, yet it harbors approximately 5,700 plant species, of which about 40% are endemic. Native CR species have evolved multiple adaptations to survive under these extreme environmental conditions, including coordinated specialized aboveground and belowground organs produce unique suites of functional traits, resulting in distinctive plant phenotypes with largely unexplored ornamental potential. To assess this potential, we developed an Index of Ornamental Potential (IOP), which enables researchers and practitioners to evaluate the combined contribution of vegetative and reproductive traits. This index provides a robust and practical tool that reduces reliance on arbitrary categories with vague definitions when identifying ornamental potential across broad ecological and applied contexts. The IOP indicates that most CR species possess ornamental potential, particularly endemic species, which remain underrepresented among commercially available native ornamental plants in Brazil. Our literature review identified 375 CR species cited as ornamental, with Melastomataceae, Eriocaulaceae, and Velloziaceae standing out as the most representative families. Expanding the use of native ornamental species could not only promote sustainable economic alternatives for local communities, whose livelihoods are often restricted to low-income activities such as tourism and the harvesting of a limited number of "everlasting" species, but also contribute to the conservation of biodiversity in this highly threatened ecosystem.

Ecological traits of traditionally managed grassland plants that decrease due to the abandonment of semi-natural grassland dominated by *Pleioblastus argenteostriatus f. glaber*

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P158

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

Traditionally managed grassland plants (TMGPs) have been maintained through traditional management with human-induced disturbance. The objective of this study was to quantify the CSR strategies of TMGPs and their ecological characteristics (CSR strategies and life forms) that are likely to decrease with abandonment of management, based on species richness and abundance in semi-natural grassland dominated by *Pleioblastus argenteostriatus* f. *glaber*. Vegetation surveys were conducted in four communities at different stages of succession. We examined the CSR strategies of the observed species based on their leaf traits, and their life forms based on the literature. The changes in CSR strategies and life forms of TMGPs were analyzed in response to the decrease in their species richness. Of the 127 species detected in the vegetation survey, 42 species were classified as TMGPs. Species richness and abundance of stress-tolerant (S-strategy) species were greater in the CSR strategy of TMGPs. Species richness of stress-tolerant TMGPs decreased with decreasing their species richness (i.e., progressing of abandonment of management). The abundance of TMGPs with more ruderal traits declined faster among the stress-tolerant TMGPs. The species with branched and tussock forms and gravity-dispersed seed were more likely to decline with decreasing their species richness. These results indicate that stress-tolerant TMGPs are abundant in the *P. argenteostriatus* f. *glaber* dominant semi-natural grassland. The TMGPs that are susceptible to decline due to abandonment may share common ecological traits (stress-tolerators with more ruderal traits, branched and tussock-form species, and gravity-dispersed seed species).

Filtering the community by size: how pollinator functional traits mediate the reproductive success of *Rosa multiflora*

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Pollinator communities play an important role in regulating plant reproductive success and, in turn, influencing vegetation dynamics. Although previous studies have shown that greater pollinator diversity enhances fruit and seed production, few have experimentally evaluated how pollinator body size affects pollen transfer in natural systems. We examined how pollinator size influences reproductive success in the invasive shrub *Rosa multiflora* and its potential consequences for plant community structure. Field experiments were conducted at three sites in northeast Ohio, where flowering branches were subjected to five mesh-exclusion treatments (1 mm, 3 mm, 5 mm, 10 mm, and a no-mesh control) to restrict pollinator access by body size. Reproductive success was quantified using hip set, seed production, seed mass, and fruit mass. Pollinator visitation and community composition were assessed through standardized observations and malaise trapping, and pollination efficiency was evaluated by measuring pollen deposition on stigmas. Pollen deposition and reproductive output declined with decreasing pollinator size, with the highest deposition rates and fruit and seed production occurring in treatments that allowed access by large-bodied pollinators. In contrast, flowers accessible only to small-bodied insects exhibited significantly reduced pollen deposition and reproductive success. These results indicate that changes in pollinator community structure, particularly the loss of large bees, can strongly influence the reproductive performance of *R. multiflora*. Our findings highlight the importance of pollinator functional traits in shaping plant reproduction and suggest that shifts in pollinator communities may affect the spread and dominance of invasive species, with broader implications for vegetation composition and ecosystem processes.

Impacts of cattle grazing management on seed input and endozoochorous dispersal in the Canadian dry mixedgrass prairies

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

Seed dispersal is critical for maintaining gene and species diversity, by facilitating the movement of seeds across landscapes. Seeds are dispersed by a variety of vectors, culminating in total seed input for an area; an important vector in grassland ecosystems is zoochory by cattle. Adaptive multi-paddock (AMP) grazing, a short-term intensive grazing regime with rapid rotations, is an emerging management system in North America, and contrasts with the more common 'continuous' grazing system. Despite AMP grazing's increasing implementation, impacts on seed dispersal are unknown; our study aims to fill this current research gap. Specifically, our research compares overall seed input to cattle endozoochorous dispersal. Sampling was conducted in Canada's dry mixedgrass prairie, in paired pastures of continuously and AMP grazed treatments. Cattle dung (120) and seed input samples (120) were collected throughout the grazing season. To facilitate comparisons with the aboveground vegetation and account for plant reproductive stages, we recorded vegetation cover, species richness and plant reproductive stage at 192 ($1m^2$) plots. We set up a germination assay to quantify seedling germination and composition. Preliminary results show lower and less variable seed germination in AMP grazed pastures, for both total seed input and endozoochory. Furthermore, germination is greater for endozoochorous samples than seed input, regardless of the grazing treatment. Our initial findings suggest that AMP grazing may reduce grassland seed dispersal, compared to continuous grazing. This reduction in dispersal could alter community composition, and future grazing potential of communities under AMP grazing.

Effects of topography on carbon stocks in cocoa agro-forestry systems in the Bodi District of Ghana

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Cocoa agroforestry systems are recognised for their potential to sequester carbon and mitigate climate change. However, the influence of topography on carbon stock distribution within these systems remains poorly understood, particularly in Ghana. This study compared soil organic carbon (SOC) and biomass carbon stocks in upland (>200 m) and lowland (<150 m) cocoa agroforestry systems in the Bodi District, Ghana. Using field surveys across 30 plots, SOC was determined via soil analysis, while biomass carbon for cocoa and shade trees was estimated using species-specific allometric equations. Results showed that SOC was significantly higher in lowland areas, supporting the hypothesis that depositional processes and favourable microclimates enhance organic matter retention. In contrast, no significant differences were found in the biomass carbon of either cocoa or shade trees between the two topographies, indicating that tree growth and carbon accumulation in biomass were comparable across the studied elevation gradient. Furthermore, no significant correlation was found between SOC and biomass carbon pools, suggesting these compartments are decoupled and driven by distinct factors. The study concludes that topography significantly regulates SOC stocks but not biomass carbon in established agroforestry systems, underscoring the need for tailored, multi-pool carbon management strategies in climate-smart cocoa cultivation.

Long-term persistence and extirpation rates of rare plants in the NE of Spain and the impact of global drivers

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Assessing changes in biodiversity and identifying potential causes is crucial for effective conservation efforts, and urgent for the conservation of the most vulnerable species. Resurveys can be a suitable tool for this purpose, though they are limited to the existence of historical detailed surveys with accurate location. Here, we used plant record matchmaking to the most extensive compilation of botanical information in the NE of the Iberian Peninsula (2.5 M plant records; 140,000 km^2) to estimate the long-term fate (persistence and extirpation) of rare species across habitats over the last century. The influence of land use and climate change on population fate was also assessed. We found that plant persistence in the last century was 9 times higher than extirpation (N=3,622 pairs of past-present information of populations). However, this proportion varied between habitat types, wetland-related species being more prone to extirpation than species typical of rocky habitats. Land use change resulted to be the main variable associated to population extirpation. The comparison of persistence vs extirpation rates suggest that rare plants might be more resistant than expected, at least in some habitats. Our approach based on record matchmaking from information provided by academic sources and expert naturalists highlights its utility in revealing rates of biodiversity loss wherever historical designed surveys are not available.

Linking isoprenoid emissions to tree functional strategies in the Mediterranean basin

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Volatile isoprenoids are specialised metabolites that help plants to mitigate biotic and abiotic stresses. They can help to stabilize thylakoids membranes under high light intensity, help to quench Reactive Oxygen Species produced during high temperature events and act as priming molecules which could result in enhanced defense during periods of stress, while minimizing costs to growth. Not all tree species emit isoprenoids and emissions show strong species-specific variability both in terms of chemical profiles and intensity. Specifically, isoprene and monoterpenes emissions follow one of the strongest functional trade-off observed in plants, suggesting different allocation strategies. Despite substantial knowledge in the functional strategies of Mediterranean trees, whether and how variation in isoprenoids emission patterns relate to trees functional trait axes remains poorly investigated. To address these relationships, we gathered a unique dataset of tree species-specific, leaf-level isoprenoid emission profiles from both the literature and extensive field campaigns. We combined these data with four traits capturing wood and leaf economics (plant height, wood density, specific leaf area and leaf area) across 101 tree species of the Euro-Mediterranean Basin. Our results revealed (I) a higher prevalence of monoterpenes emitters compared to isoprene emitters, likely part of an adaptive strategy to cope with Mediterranean hot and dry conditions (II) that both chemical traits intensity of isoprenoid emissions and proportions of emission types (isoprene or/and monoterpenes) captures interspecific variations that are not captured by usual phenotypic traits, but might be linked to the ability to break trade-offs associated to fast-slow strategies

Training and intercalibration reduce observer-induced variability in forest vegetation surveys

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Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: *Community assembly: Theory and methods in vegetation science*

The increasing availability of vegetation-plot data results from decades of field surveys conducted by numerous observers. This highlights observer error not as a marginal issue but as a structural component of uncertainty, with direct consequences for estimates of species turnover and temporal trends. Observer-related sampling bias can be investigated through variation in species richness, species composition and abundance. Specifically, pseudoturnover refers to changes in species composition caused by overlooking or misidentifying taxa between sampling events or among different observers surveying the same plot. Although the causes and implications of observer error have been widely discussed, it remains unclear whether observer-related pseudoturnover decreases over time within observer groups as a result of training. Using data from training and intercalibration sessions carried out in 2023 and 2025 within two forest monitoring programs in Italy (the LIFE project ModerNEC and the Italian National Forest Inventory), we assessed whether targeted training and collective briefing reduce observer-induced pseudoturnover. We applied Bayesian multilevel models to estimate changes in the precision of species richness assessments and in inter-observer dissimilarity. Precision in species richness estimates increased across observers in both years. Inter-observer dissimilarity declined after training when using Jaccard and Euclidean distances in both years, whereas Bray–Curtis dissimilarity decreased only in 2023 and increased in 2025. Overall, training and intercalibration effectively reduced observer-induced pseudoturnover related to species presence, while variability in abundance estimation remains a key challenge for future vegetation monitoring programs.

Inconsistent relationships between tree ring width and normalized difference vegetation index in montane evergreen coniferous forests in arid regions

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Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Tree ring width and the normalized difference vegetation index (NDVI) are two effective indicators used to monitor changes in forest dynamics. Most studies focus on the relationship between tree ring width and regional NDVI in the mountainous areas of arid regions, failing to reflect the relationship between forest radial growth and forest canopy activities. This study selected four areas ranging from west to east on the northern slope of the Tianshan Mountains in China. In each area, tree cores of *Picea schrenkiana* were collected at three elevations, and meanwhile NDVI values were extracted for the forest cover at each location. Emphasis was placed on the relationship between the tree ring width and NDVI values of montane evergreen coniferous forests in this arid region in the period 2000–2012. There was an inconsistent positive correlation between tree ring width and NDVI in the Tianshan Mountains, and the relationship became increasingly weak from west to east and decreased with increasing elevation. The varied forest growth and its response to climatic factors as a result of different environmental conditions presented in arid mountain regions may be the underlying reason for the inconsistency between the tree ring width and NDVI of forests. Drought stress may be the major driving factor of the positive correlation between the tree ring width and NDVI of montane evergreen coniferous forests in arid regions. This result may be useful for integrating tree ring width and NDVI to study the ecology of montane evergreen coniferous forests in arid regions.

An emerging climate debt in Europe's calcareous grasslands

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation databases: Expanding the utility of plot-based surveys*

Calcareous grasslands are among the most species-rich plant communities in Europe. It is currently unknown if their species composition is tracking the trajectories forced by climate change or a climate debt is emerging in this vegetation type. To address this deficit, we used vegetation plots from the European Vegetation Archive sampled from 1951 to 2024 to analyse whether community composition changes in calcareous grasslands have tracked climate change on a continental scale. We calculated a community temperature index (CTI) and a community moisture index (CMI) for over 75 000 plots based on the temperature and moisture preferences of the co-occurring species. The relationship between the community mean indices and climate parameters was modelled using plots surveyed before the onset of climate change (pre-1980). Then, the fitted models were used to predict community indices for plots surveyed in subsequent years, under accelerating climate change (1981-2024). By comparing the predicted and observed community indices of these more recent plots, we found substantial differences, suggesting lags in plant community responses to climate change. The lags increased over time as community compositions have not shifted as fast as predicted. Different calcareous grassland types and different biogeographical regions showed slightly varied results. Semi-dry grasslands had greater lags than dry grasslands. The Mediterranean region showed smaller lags for CTI and CMI. Overall, calcareous grassland communities seemed to have only partly kept pace with climate warming and drying, leading to an increased climatic debt.

Functional vegetation paleoecology: mitigate the impact of climate change with data-driven insight from past vegetation

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Understanding how ecosystems respond to global climate change requires an interdisciplinary approach due to the complexity of the challenge. My PhD project involves integrating global paleoecological pollen data with contemporary plant functional traits in order to reconstruct long-term changes in functional vegetation patterns and ecosystem properties. This synthesis advances our understanding of how ecosystems vary in space and time, providing new insights into the resilience and vulnerability of ecological communities in the face of environmental change. The project's primary objective is to link global fossil pollen records with contemporary plant functional trait databases in order to investigate how ecosystem functions have shifted since the Last Glacial Maximum. Specifically, the project's main goals are: (A) connecting global fossil pollen assemblages with key contemporary plant traits related to growth, survival and reproduction; (B) estimating Community Weighted Means (CWM) for each spatial and temporal sample; (C) quantifying ecosystem dynamics at multiple spatial scales, from local biomes to the global level; and (D) moving beyond species-based reconstructions by exploring links between community-level trait composition and climatic variability and anthropogenic impact. My project will also pursue several methodological innovations to address long-standing challenges in palaeoecological synthesis. These are: (1) improving the link between contemporary plant and fossil pollen types, and (2) quantifying spatio-temporal ecosystem dynamics under uncertainty.

Litter quality and decomposer communities, not diversity per se, drive leaf litter decomposition along a realistic species-loss gradient

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Decomposition of plant litter is a fundamental process regulating nutrient cycling and carbon sequestration across ecosystems. Experimental studies often report positive relationships between plant diversity and decomposition, often linked to litter chemistry, soil biota, and environmental conditions. Most of these experiments are typically based on randomly assembled communities. Nevertheless, species loss in real ecosystems is non-random producing more heterogeneous and context dependent results. Moreover, belowground decomposition remains poorly studied. We conducted decomposition experiments using root and shoot litter from natural plant community with a biodiversity gradient created by realistic species loss. We combined a field experiment with a controlled mesocosm experiment to separate direct and indirect effect of diversity on decomposition. The mesocosm experiment standardized soil and microclimatic conditions to isolate litter-quality effects, whereas the field experiment captured the combined influence of litter quality and natural decomposer communities. Standardized litter was also used in the field to disentangle plant diversity effects from litter-quality effects. In contrast to artificial BEF experiments, diversity loss did not directly affect decomposition rates in natural communities. Instead, diversity influenced decomposition indirectly via changes in leaf litter quality, consistent with the absence of diversity effects on standardized litter. Under controlled mesocosm conditions, neither diversity loss nor nutrient quality affected decomposition rates. Our results suggest that decomposition is primarily driven by the interaction between litter quality and decomposer communities rather than by plant diversity itself. Climatic variation did not significantly influence decomposition and there were no direct or indirect effects of plant diversity loss on root decomposition.

Linking temperature-duration stress events to dwarf-shrub photosynthetic limits in high-latitude ecosystems

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Classical assays of photosynthetic thermal tolerance limits have focused on brief, singular exposures to temperature stress, but the field is shifting toward approaches that better reflect biologically meaningful thermal events. An emerging direction is the thermal load sensitivity framework, which advocates assessing sub-lethal effects across a range of temperature and exposure durations. In the DURIN project, we explore these concepts within dwarf-shrub-dominated boreal, alpine and sub-arctic landscapes. Though they span broad climatic and geographic ranges, dwarf-shrubs can be sensitive to shifting thermal regimes, with increasing summer heat extremes and seasonal freezing events impacting rates of photosynthesis and carbon gain. We contrast the responses of a range of dwarf-shrub species found in open and forested habitats across latitudinal and continental gradients in Norway, assessing thermal damage by applying combinations of temperatures and exposure durations and quantifying the temperature at which there is a 50% decline in the maximum quantum yield of photosystem II (T_{50} of F_V/F_M). We then compare the extent of photosystem damage to various estimates of temperature extremes as derived from plant-level climate sourced from TOMST loggers, and FLIR imagery deployed in dwarf-shrub and non-dwarf-shrub plots, along with downscaled microclimate estimates from NicheMapR. Together, these results advance our ability to link leaf-level thermal damage to realistic microclimatic extremes, improving predictions of dwarf-shrub resilience under future warming.

A semi-supervised classification of the European alpine vegetation

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Although alpine vegetation in Central and Southern Europe has been documented for more than 150 years through numerous phytosociological surveys, which have resulted in a remarkable amount of relevés and detailed syntaxonomical reviews, little has been achieved to synthesize these communities at a continental scale. To address this gap, two semi-supervised classifications (separating acidophilous from basophilous vegetation) were performed using 16,722 relevés which were previously classified into 53 alpine phytosociological alliances to find their true geographical and typological extent. Expert-revised plots were selected for every individual alliance, giving priority to original syntaxa descriptions. Results indicate that the circumscription and distribution range of some alpine alliances should be reconsidered: this is particularly relevant for alliances that were described from less than five relevés and have not been recorded since then.

Maternal drought legacy shapes offspring subindividual epigenetic and physiological variation in Mediterranean holm oak *(Quercus ilex)*

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Type: *Poster*

Subject: *Special Sessions*

Session: *Integrating intraspecific trait variability into vegetation science for improved ecological predictions*

Epigenetic variation may contribute to phenotypic trait diversity within and among individuals, influencing plant physiological performance under environmental stress. We investigated baseline associations between DNA methylation levels and key physiological traits in Mediterranean holm oak (*Quercus ilex)* saplings grown under environmentally controlled conditions at an Ecotron. Saplings originated from maternal trees treated or untreated to drought stress during 23 years in the Puéchabon forest (France). Maternal and offspring drought treatments induced changes in subindividual epigenetic and physiological mosaics. Overall, our findings highlight the potential importance of epigenetic mosaics in mediating physiological trait variation and transgenerational responses to drought in long-lived forest trees.

Urban drought and fragmentation constrain successional resilience in isolated forests

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Urban plant communities*

Urban forests are increasingly exposed to climatic stress and spatial fragmentation, yet their effects on forest succession remain poorly quantified. We examined how drought and patch isolation influence successional resilience in isolated urban forest patches across seven major metropolitan regions of South Korea. A total of 1,220 vegetation plots within 327 forest patches were surveyed and classified into progressive or retrogressive successional pathways based on canopy-layer dominance shifts. Structural equation modeling and Random Forest analysis were used to identify environmental drivers of successional outcomes. Progressive succession occurred in 83.2% of plots, typically reflecting replacement of early-successional or introduced species by *Quercus*-dominated assemblages. Retrogressive succession (16.8%) involved transitions toward stress-tolerant communities associated with degraded urban conditions. Cumulative drought severity and forest patch size emerged as the strongest predictors of successional direction. Increased drought stress and reduced patch size significantly increased the probability of retrogressive succession, while canopy structural integrity had a secondary stabilizing effect. Pollution variables were not retained in final models, suggesting that climatic and spatial constraints currently dominate urban forest dynamics at the regional scale. These findings demonstrate that urban forest succession is strongly filtered by environmental stress gradients. Under intensifying drought and fragmentation, isolated patches may lose successional resilience and shift toward simplified assemblages. Understanding these thresholds is essential for predicting vegetation change and sustaining ecological function in rapidly urbanizing landscapes.

Aging belowground: anatomical insights into rhizome senescence in clonal herbs

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Clonal perennial herbs rely on belowground organs to integrate growth, persistence, and carbon cycling in terrestrial ecosystems. Their growth strategy involves producing new annual shoots while discarding old rhizome parts that are no longer functional. This shedding represents the final stage of rhizome senescence, a process that may facilitate clonal propagation in branched organs but also exposes internal tissues to pathogens. Despite its ecological relevance, the anatomical and histochemical basis of rhizome senescence remains poorly understood. Here, we investigate how rhizome senescence is linked to clonal growth strategies, focusing on whether this process is mediated by plant ontogeny and seasonal effects. We studied three perennial clonal herbs from contrasting habitats: *Geum urbanum* (forest understory) and *Rumex acetosa* and *Filipendula ulmaria* (meadows) located in Třeboň, Czech Republic. Entire rhizomes from five individuals per species were collected monthly over one year. Rhizomes were segmented into young, connective, and old regions, fixed in 70% ethanol, and processed using standard plant anatomical techniques. Preliminary results show strong anatomical differentiation along the rhizome axis. Older regions exhibit tissue shrinkage associated with cell death and increased lignification, indicating progressive structural senescence, whereas young regions maintain higher tissue integrity. Seasonal effects were mainly reflected in carbohydrate dynamics, with starch accumulating during summer and declining in subsequent seasons. Our findings position rhizome senescence as a key component of clonal plant strategies, in which coordinated anatomical degeneration and seasonal carbon reallocation shape both plant persistence and soil carbon dynamics in perennial herbaceous ecosystems.

Multi–scale environmental drivers of plant diversity and forage quality in wood pastures of Transylvania (Romania)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Traditional wood–pastures are agroforestry systems shaped by long–term low–intensity management, yet the relative importance of drivers of grassland quality operating at different spatial scales in these systems remains poorly understood. We evaluated the interaction between landscape structure, site factors, biodiversity and pastoral value. We measured long-term changes in land-use and woody cover across spatial scales. We investigated 30 traditional wood–pasture sites in Transylvania (Romania) by integrating at the large–scale: historical Corona satellite imagery from 1964, contemporary land–cover data, and CHELSA climatic data; at the intermediate–scale: tree and woody configuration; and at the fine–scale: vegetation and soil surveys. Using linear models, we quantified the effects of large–, intermediate–, and fine–scale environmental determinants on taxonomic and functional diversity, and forage quality of the plant communities. Landscape structure remained largely stable over six decades, although woody cover declined at most sites. Species richness increased with soil carbon and woody cover, functional diversity (plant height, specific leaf area, and seed mass) responded selectively to climate and forest cover, and forage quality increased with aridity but declined with woody cover. Climate, woody cover, and soil carbon were the strongest predictors of functional composition, whereas large–scale landscape metrics had weaker effects. These results indicate hierarchical environmental filtering, regional climate and local habitat structure constrain community assembly more strongly than landscape–scale land–cover structure. Our findings highlight that conserving and restoring wood–pasture functionality requires management practices that optimise woody cover, grazing intensity, and soil quality.

A process-based model of vegetation dynamics under recurrent fire disturbance in Taiwan

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Taiwan's montane forests, characterized by a humid climate, frequent fog, and abundant rainfall brought by monsoons and typhoons, have historically been associated with low fire activity. However, under human-driven climate change, forest fires have increased in both frequency and intensity in recent years. As field-based monitoring is limited in remote mountainous regions, satellite remote sensing provides spatially continuous and consistent observations, enabling both long-term monitoring of vegetation dynamics and quantitative input for simulation models. By integrating remotely sensed time-series data with environmental covariates, the process-based model simulates post-fire vegetation development and the effects of recurrent fire events. In this study, we developed such a model for the Wu-Ling burn scar, a pine-dominated montane forest in central Taiwan that has experienced recurrent fires since 1995, with the aim to (I) characterize the relationship between vegetation dynamics and fire intensity; (II) simulate 30 years of recurrent fire events; and (III) identify the primary environmental drivers of fire occurrence. The modeling framework consists of three components: (I) above-ground biomass as the primary stock variable; (II) fire occurrence as a converter driven by environmental thresholds; and (III) feedback linking biomass accumulation to fire intensity. The historical above-ground biomass was reconstructed from Landsat time-series data with NASA's GEDI Lidar as reference data, and all imagery was processed in Google Earth Engine. This study is expected to provide insights into the environmental drivers of fire occurrence and quantify biomass recovery trajectories under recurrent fire disturbance.

Seed traits and temperature on early-stage performance: effects on congeneric native and invasive species

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Understanding early-stage performance of native and invasive species is fundamental for ecological restoration to avoid invasive species success. We compared germination and seedling responses across different temperatures and seed traits in congeneric native and invasive species from Río de la Plata grasslands. We studied five natives and two invasives from genera *Eragrostis* (grasses) and *Senecio* (subshrubs). We measured seed traits (mass, length, width, area, circularity), then performed a germination trail under two temperatures (15°C/20°C and 20°C/25°C). Over 18 days, we obtained germination and leaf emergence percentages, maximum leaf length (MLL), and maximum root length (MRL). Effects of temperature and species were analyzed separately by genera, using Generalized Linear Models. A Redundancy Analysis including all species was performed to assess species' performance to temperature and seed traits. For *Eragrostis*, we found few differences between invasive and native species in germination and leaf emergence percentages. However, the invasive species showed superior seedling development, with higher MLL than native species, even at lower temperature, and was the unique species to maintain MRL values similar to those at higher temperature. For *Senecio*, the invasive species showed higher MRL, while the native species has higher germination percentage and MLL. In the RDA, circularity and seed mass were associated with species performance, with no clear separation between native and invasive species. Results highlight how invasive species can outperform native species during early-stages and demonstrate the role of seed traits in shaping species responses to different temperatures.

Species-specific patterns shape the nutrient status of halophytes beyond plant functional types

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

Halophytes are plants adapted to complete their life cycle under saline conditions and are commonly classified into two plant functional types (PFTs): hydrohalophytes, which occur in aquatic or waterlogged soils of wetlands and salt marshes, and xerohalophytes, which inhabit dry saline soils of arid and semi-arid inland areas. In this study, we evaluated whether nutritional patterns differ between these two PFTs by analysing six halophyte species. The hydrohalophytes *Atriplex portulacoides*, *Salicornia perennis* and *Suaeda vera* were compared with the xerohalophytes *Atriplex glauca*, *Halocnemum strobilaceum* and *Anabasis articulata* to assess whether plant nutrient status is better explained by functional classification or by species-specific adaptations and local soil conditions. Plant nutrient concentrations were analysed in relation to soil physicochemical properties, microbial biomass and soil enzymatic activities across contrasting saline habitats. Our results showed that species identity explained a substantially larger proportion of the variability in plant nutrient concentrations than PFT classification, whose explanatory power was limited. Plant nutritional status was strongly associated with soil pH, electrical conductivity, organic carbon content and soil texture, particularly clay and silt fractions. Fine-textured soils supported higher microbial biomass and enzymatic activity, highlighting the importance of soil-microbe interactions in nutrient cycling. Among the studied species, the hydrohalophytes *A. portulacoides* and *S. perennis* displayed similar nutritional profiles despite contrasting soil conditions, indicating functional convergence. Overall, our findings demonstrate that nutrient dynamics in halophytes cannot be reliably predicted using broad PFT classifications alone, emphasizing the dominant role of species-specific traits and site-specific soil and microbial interactions.

Tree size and moisture gradient influence the performance of competition indices in uneven-aged interior Douglas-fir dominated stands

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Measures of tree competition are among the most important predictors of individual tree growth. We evaluated how tree size and moisture gradient influenced the performance of competition indices in uneven-aged interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco) dominated stands in central British Columbia, Canada. Specifically, we: (I) identified which competition indices best predict interior Douglas-fir individual tree basal area increment and height increment across a moisture gradient, using 15 competition indices (5 nonspatial and 10 spatial); (II) examined whether small and large trees are best predicted by the same indices; and (III) inferred the underlying competition processes driving these patterns. We analyzed data from 24 plots across 3 blocks differing in moisture gradient and species composition, drawn from a long-term pre-commercial thinning (thinning from below) study with 5 measurements over 21 years. The spatial indices of Martin & Ek and Castagneri consistently outperformed others in predicting basal area increment across a moisture gradient, while height increment was best predicted by different competition indices depending on the block. Competitive effects also varied with tree size, with size-related differences more pronounced for height increment than for basal area increment. These findings indicate that basal area and height growth are governed by different competition dynamics, with aboveground competition for light as the dominant influence, and belowground interactions playing a secondary, context-dependent role. Our results underscore the importance of accounting for both tree size and site conditions when selecting competition indices to model individual tree growth.

Functional reassembly of tree communities: from tropical drylands to rainforests

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Ecotones along strong climatic gradients provide key insights into how plant communities reorganize in response to environmental constraints. However, the trait-based mechanisms underlying these transitions remain poorly understood, especially from tropical dryland forests through Andean rainforests to flooded Amazonian lowland rainforest. Here, we first characterize the distribution of tree functional traits at community level across 5° South in Western Amazonia (from Marañón valley across Peru into Brazil), we then evaluate how these functional patterns are shaped by a longitudinal precipitation gradient partly subject to ENSO anomalies. We integrated species abundance data from the Peruvian National Forest Inventory with original field measurements of leaf, stem, and root traits for the 133 most dominant tree species to calculate Community Weighted Means. Our analysis reveals a pronounced functional reassembly across ecozones: arid communities are characterized by a conservative syndrome (high wood, root tissue density and leaf mass per area), while humid communities shift toward a size driven acquisitive strategy, marked by lower tissue densities. Crucially, we demonstrate that precipitation acts as a deterministic axis that not only shifts trait means but fundamentally rewires functional trade-offs. In dryland communities, wood density and leaf mass per area are positively correlated, reflecting coordination in the leaf economic spectrum. These findings highlight that precipitation thresholds govern the "rules" of functional community assembly, with significant implications for predicting forest resilience to shifting rainfall regimes.

Reduced precipitation alters wood anatomy of two Mediterranean oak species

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Recent changes in climate have altered forest growth dynamics, strongly affecting oak-dominated ecosystems worldwide. However, and despite the ecological importance of these ecosystems,knowledge of the seasonal anatomical responses of oaks to increasing drought remains limited. *Quercus canariensis* Willd. and *Q. suber* L. form a mixed oak forest at "Los Alcornocales" Natural Park, one of the largest oak forests in Spain that are currently experiencing growth decline, defoliation and mortality episodes. In this study, we investigated how drought conditions influence xylem vessels formation in both species. Wood formation was monitored at 15-day intervals under natural conditions and experimentally reduced precipitation. Moreover, we quantified drought-induced changes in vessel density and area to assess their implications for theoretical hydraulic conductivity. Both species exhibited marked sensitivity to drought, characterized by shift in cambial onset and a reduction in earlywood vessel area, suggesting a safer and more continuous water transport strategies under water limitation. These anatomical adjustments indicate a trade-off between hydraulic efficiency and safety in response to increasing drought stress. Our results provide us to assess the role of drought in wood formation in order to predict changes in wood anatomy in the coming decades and the response of oak species to drier climate and offers a valuable information for developing adaptive forest management strategies aimed at conserving one of the region's most important forest resources.

Fragment size and shape as indicators of riparian forest conservation status along the Paraná River (Corrientes, Argentina)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Riparian forests play an important role in landscape connectivity, edge dynamics, and the coupling of aquatic and terrestrial processes. Their general linear configuration and close association with human land use make them especially sensitive to habitat fragmentation. Within a landscape-ecology framework, fragment size and shape capture key aspects of habitat structure that influence their ecological function and conservation value. In Corrientes Province, the Paraná River runs along its northern and western sectors, where the riverbank forms a mosaic of forest fragments, grasslands, wetlands, and monocultures. The analyzed non-floodable riparian forest is characterized by a strong component of Seasonally Dry Forest species. Forest fragments were digitized from Google Earth imagery (2019), and their area and perimeter were calculated. Size and shape complexity was classified using Jenks natural breaks optimization and Shape Index ($SI = P / 2\sqrt{(\varpi A)}$). A total of 430 forest fragments were identified, covering 6,523 ha (0.07% of Corrientes Province area and 0.84% of remaining native forest). Small fragments dominated numerically (75% of patches) but contributed only 25% of total forest area. Fragment configuration differed markedly between riverbanks: the northern bank concentrated 72.6% of forest area and contained the largest, shape-complex fragments forming riparian corridors, whereas the western bank was dominated by smaller, more compact fragments. These patterns highlight strong spatial variation in fragmentation and configuration within this riparian forest system. From a landscape-ecology perspective, highly fragmented sectors represent priorities for restoration, while large, complex fragments and corridors are critical for maintaining connectivity and buffering disturbance in riparian landscapes.

Climate-induced shift from grasslands to shrublands affects the provision of ecosystem services in rangelands of Hindu Kush Himalaya

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

The Hindu Kush Himalaya (HKH) spans over 3.4 million Km^2, with more than 50% as rangelands. These rangelands are under constant threat due to factors such as overgrazing and unsustainable harvesting of non-timber forest products (NTFPs). Moreover, rangelands are facing climate-induced shrub encroachment which alters the provision of ecosystem services, thereby affecting both pastoral livelihoods and regional ecological stability. Despite its ecological and socio-economic consequences, shrub encroachment in HKH has received far less attention compared to other regions. Therefore, this study aimed to synthesize the existing knowledge on climate-driven shrub encroachment in HKH rangelands, with a focus on its effects on the provision of ecosystem services. The findings reveal that although the main drivers of shrub encroachment in HKH are climatic and bio-physical factors, the phenomenon is exacerbated by anthropogenic factors. Shrub encroachment alters soil nutrient dynamics and markedly reduces access to fodder, forage and NTFPs. Policy should prioritize adaptive grazing, community-based conservation, and regional collaboration to sustain rangeland resilience under climate change. There is still a lack of studies quantifying the rate of encroachment, its socio-economic consequences, and the involvement of indigenous and local communities in restoration activities.

Functional and structural drivers of stabilizing ecosystem mechanisms across the globe

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

Understanding the mechanisms buffering communities against environmental fluctuations is critical under global change. The framework proposed by Segrestin et al. (2024) provides a unified approach to decompose 3 main stabilizing mechanisms: dominance, asynchrony, and averaging effect. However, the relative importance of these mechanisms and which functional attributes determine their relative importance remain unresolved questions in community ecology. Using the Long-Term Vegetation Sampling (LOTVS) database and functional trait data, we analyzed these stability dynamics across diverse biomes. Preliminary results indicate that while averaging effect generally dominates community stability, its relative contribution and the role of the other drivers are highly scale-dependent. At the plot level, species asynchrony plays a stronger influence, highlighting the role of species compensatory dynamics within communities. In contrast, aggregating plots at the dataset level shows a more pronounced dominance effect within the local species pool. Structurally, we find that these three pathways are driven by distinct ecological attributes. Asynchrony was more closely linked to functional diversity while the dominance effect is more connected to the Community Weighted Mean of leaf-economic spectrum related traits. By integrating the "stability triangle" proposed by Segrestin et al. with large-scale empirical data from LOTVS, this study shows that ecological stability is defined by a scale-dependent interplay of biodiversity and functional identity. These results provide a refined framework for predicting how shifts in species composition and diversity will alter ecosystem stability across spatial scales.

Role of endozoochory on the post-fire regeneration dynamics of pine forest plant communities

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

In the context of climate change and increasing extreme events such as forest fires, ecosystem regeneration is at the heart of current concerns. Seed dispersal by wildlife, especially mammals, is a key process in vegetation regeneration and it is therefore fundamental to evaluate to what extent seed dispersal can contribute to the resilience of forest ecosystems after fire and how this disturbance can modify this process. In this study we want to compare vector species and dispersed plant species in burned and unburned sites, to assess which animal are important for seed dispersal and which plant species benefit from this process. We collected mammal faeces monthly for one year since June 2025 in two areas of pine forest burned in 2022 in southwestern France. Samples were then placed in a greenhouse to identify and count seedlings emerging from the faeces. So far, we have collected more than 2,000 faeces samples from both herbivorous and carnivorous mammals and identified more than 4,106 seedlings belonging to more than 50 species. Preliminary results show that more faeces were found in burned areas. More carnivore faeces were found in unburned areas, whereas more herbivore faeces, particularly from lagomorphs, were found in burned areas. Further data analyses will allow us to evaluate dissimilarities between plant communities dispersed by endozoochory in burned and unburned areas to evaluate how endozoochory drives post-fire plant communities composition.

Niche margin-based approach to estimate suitable and unsuitable future climatic conditions for native and non-native tree species in Europe

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Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: Community assembly: Theory and methods in vegetation science

European forests are increasingly affected by climate change and drought events, contributing to increased tree mortality rates and economic losses for European forestry sector. To adapt the forestry sector, foresters are turning to assisted migration of tree species exhibiting greater resilience to prolonged drought and thermal stress. However, questions remain regarding the ability of these species to find their climatic niche in future climatic conditions in Europe. We proposed to use a standardized metric, the Niche Margin Index (NMI), computed within PCA-ordinated environmental space, to measure the climatic deviation between the projected future climatic conditions in Europe and the margin of climatic conditions currently occupied by a given tree species. The aim is to determine whether and where future conditions are inside or, importantly, outside the realized climatic niche of 16 native and exotic tree species in Europe. To represent all possible combinations of climatic conditions available in Europe, we selected a set of 15 bioclimatic variables from 1951 to 2100 under three General Circulation Models (GCMs) and two Shared Socioeconomic Pathways (SSPs). We find that, for four Mediterranean tree species native to Europe studied, the proportion of projected climatic conditions suitable (inside their niche) by 2100 is higher than for four Mediterranean tree species exotic to Europe. In contrast, comparisons between native and exotic temperate tree species yield more nuanced patterns. NMI has advantages over traditional niche-based models, showing results in both geographic and environmental space, and provides information on unsuitable (niche outside) environmental conditions for species.

Unveil the unseen impact of forestry vehicles on plant species communities in managed forests

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Most vascular plant species in temperate forests are found within the herb layer. Herb communities undergo important compositional changes over time, as a consequence of global and regional environmental changes. However, local changes, through silviculture mechanisation and the intensification of forest management may disproportionately contribute to the observed changes. Here, we focus on the short and long-term impact of rutting by forestry vehicles on understorey vegetation. We conducted a field survey in the biggest oak-beech forest in Northern France. We designed a chronosequence of managed stands according to time since the last exploitation (1, 6, 8, 19, 23, 54 yrs). We surveyed plant species composition in three 1 m^2-quadrats disposed over one rut, adjacent to it, and 5 m apart (10 replicates per class). We also sampled the mud attached to the tires of some forestry vehicles to analyse its diaspore content, using the emergence method. We show forestry vehicles dramatically alters the floristic composition in closed-canopy forest stands via two mechanisms: (I) the creation of microhabitats, namely ruts, which allows the temporary establishment of (semi-)aquatic plants (bottom) and provides a regeneration niche for poorly competitive species such as ferns and small sedges (vertical sides); and (II) the dispersal of diaspores, which allows many semi-heliophilous edge species to enter the forest interior. We evidence a spatial gradient along which the number of generalist species progressively decreases; and a temporal gradient from the most recent to the oldest ruts, along which the number of generalist species decreases.

Bryophytes and ungulates – Results from a 7-year time series of a large-scale exclosure study in managed forests of Germany

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Type: *Poster*

Subject: Ecosystem-focused topics

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Bryophytes are an important component of forest ecosystems and can function as indicators for forest management and climate change due to their affinity to moist microclimates. Their direct or indirect responses to ungulate impacts have, however, been poorly studied so far. Here I present data from a 7-year time series collected in a large scale exclosure study across Germany. Soil dwelling bryophytes were sampled on 248 plot pairs consisting of a fenced and an unfenced subplot in differently managed forest types. I analysed changes in species richness and species composition in relation to time, fencing method as well as shrub and herb layer development. Preliminary results show an increase in bryophyte cover but a concurrent decrease in species richness across plots, both developments being more pronounced in the fenced subplots. The decline in bryophyte diversity on the fenced subplots can possibly be attributed to increasing competition from other vegetation layers (mainly the shrub layer). In addition, fencing eliminates small areas of disturbance and soil damage caused by ungulates providing microsites for light-demanding pioneer species that were mainly detected in unfenced subplots. Also missing in fenced areas is the potential introduction of moss spores attached to the fur and hooves of ungulates onto the areas. In fenced plots, the vegetative spread of existing species seems to be promoted due to missing disturbances. By focusing on species traits, I will further explore the functional role of bryophytes in different forest types and how ungulates modulate bryophyte diversity and composition.

Effects of sub-canopy weather on understory functional diversity: insights from long-term forest monitoring

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Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: Long-term vegetation dynamics: Insights into the past

Assembly rules are understudied in forest understories, especially at small scales. Partly, this is because a strong and steady filter operates on its biota, resulting in convergent trait syndromes, with a putative quasi-neutral process acting through time. The tree layer provides a distinctive microhabitat for the understory biota, by mediating light availability and through microclimatic buffering, affecting sub-canopy temperature, humidity and nutrient availability. This also affects species coexistence, persistence, and biotic assembly. The question of the effect of local weather on the functional diversity of temperate forest understories remains open. To look for an answer, we applied Bayesian regressions on data from long-term permanent monitoring plots in four old-growth beech forest sites along a latitudinal gradient, including measurements of sub-canopy weather. The availability of time series data allows accounting for time-invariant confounds. Our first finding is a great variability in functional diversity among sampling units at the 1 m^2 scale, as well as among years. The second finding is that, even with data across a timespan of 12 years in four sites, each with repeated measurements, there is considerable uncertainty in weather effects, which are potentially large. In general, it is likely that increased sub-canopy air and soil temperatures lead to increased functional diversity, while there is less evidence of an effect of precipitation. The effects are consistent across different sets of above- and below-ground traits, and are stronger in relation to sub-canopy, rather than open-field weather.

Competition for light and its impact on community structure

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

The loss of species richness following soil nutrient enrichment is a well-documented phenomenon in plant communities and is often attributed to asymmetric competition for light. This study experimentally tests whether competition for light after fertilization is indeed asymmetric. Using a manipulative experiment, we altered the vertical structure of vegetation by removing specific height categories of species. Based on their average height, species were classified as short, medium, or tall, with these categories defined separately for fertilized and unfertilized plots. Two removal treatments were applied: (1) removal of medium-height species (maximizing light asymmetry), (2) removal of short and tall species (minimizing light asymmetry), and one treatment without species removal (3) an intact control. The results show that species of different height groups responded unequally to manipulated light competition, with shorter species showing greater disappearance rates under conditions of increased light asymmetry. Asymmetry manipulation significantly reduced species height within the community and changed its structure. Following the manipulation of asymmetry, species dominance decreased, and species composition became more even compared to control plots. This study thus provides first direct experimental mechanistic evidence that asymmetric competition for light may play a key role in diversity loss caused by nutrient enrichment.

Genetic structure of *Juniperus virginiana* across six Ecoregions: From genetic isolation to local adaptation

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P13

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

A plant species' geographic range is shaped by environmental and anthropogenic factors interacting with the ability for a species to establish, persist, and reproduce in an ecosystem. These factors are dynamic, and as they change, so do species' ranges. In North America, past climatic fluctuations, particularly glacial cycles, have structured the genetic diversity and distribution of many plant species. More recently, changes in temperature and precipitation along with altered disturbance regimes have facilitated the encroachment of woody plants into grass-dominated ecosystems. Eastern red cedar (*Juniperus virginiana*; hereafter ERC) is a conifer native to North America, historically restricted to fire-resistant habitats such as limestone outcrops and rocky slopes. ERC has been introduced widely for anthropogenic use, including horticulture and windbreaks, leading to range expansion, especially in grass dominated ecosystems. Six regional races have been described for this species, each characterized by distinct phenotypic traits, suggesting local adaptation. We evaluate this hypothesis using genome-wide analyses. Single nucleotide polymorphisms (SNPs) generated through double-digest restriction-site associated DNA sequencing (ddRAD-seq) were used to assess genetic differentiation and infer population ancestry. Our results reveal significant genetic differentiation among races and suggest that the typical race represents the center of diversity from which ERC expanded following the last glaciation. Patterns of genetic structure suggest multiple pathways of postglacial expansion and highlight the role of riparian corridors in shaping gene flow. These findings provide new insights into the ecological and evolutionary processes underlying woody plant encroachment in North American landscapes.

Vegetation dynamics and climate resilience in semi-natural grasslands: preliminary insights from the CAROLINA project across management gradients and chronosequences.

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P14

Type: *Poster*

Subject: Ecosystem-focused topics

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Semi-natural grasslands are among Europe's most biodiverse habitats; yet their disappearance is linked to a significant loss of biodiversity across the Mediterranean. In Italy, this decline is largely fueled by the cessation of traditional agro-pastoral practices, which triggers woody encroachment. Central to this issue is the hypothesis that grazing enhances climate resilience by fostering ecological niche diversification. The CAROLINA project (ClimAte Resilience Over Landuse change In semi-Natural grAsslands) investigates how extensive management influences biodiversity conservation, carbon sequestration, and ecosystem stability under shifting land-use and climatic scenarios. We present results focused on the vegetation component, integrating taxonomic and functional approaches. The study employs two complementary methodological approaches: permanent manipulative experiment sites and chronosequences. Fenced open-top chambers (OTCs) were used to simulate the combined effects of reduced precipitation, passive warming and grazing exclusion. Furthermore, the impact of land-use abandonment was assessed by comparing different stages of shrub and forest encroachment (from active pastures to forests). Preliminary analyses reveal a well-known drop in species richness due to grazing abandonment and drought simulations, as well as along the sequence of degradation. Results for functional diversity are less consistent, with more or less pronounced shifts in both the manipulative and chronological sequences. So far, our findings suggest that maintaining extensive management promotes niche diversification, potentially enhancing the capacity of pastoral ecosystems to withstand extreme climatic events. The integration of taxonomic and functional diversity provides a comprehensive tool to evaluate the ecological status and resilience of these threatened habitats.

Effect of climatic aridity on above-ground biomass, modulated by forest fragmentation and biodiversity in Ghana

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Forests play a vital role in the global carbon cycle but face growing anthropogenic pressures, with climate change and forest fragmentation among the most critical. In West Africa, particularly in Ghana, the interaction between increasing aridity and forest fragmentation remains underexplored, despite its significance for forest biomass dynamics and carbon storage processes. This study examined how spatial variation in climatic aridity (Aridity Index, AI) affects above-ground biomass (AGB) in Ghana's ecological zones, both directly and indirectly through forest fragmentation and biodiversity, using structural equation modeling (SEM) and generalized additive models (GAMs). Results from this study show that AGB declines along the aridity gradient, with humid zones supporting the highest biomass and semi-arid zones the lowest. The SEM analysis revealed that areas with a lower aridity index (drier conditions) had significantly lower AGB, indicating that arid conditions are associated with lower forest biomass. Fragmentation patterns align with this relationship, while biodiversity (as measured by species richness) showed weak associations, likely reflecting both ecological and data limitations. GAMs highlighted nonlinear fragmentation effects: mean patch area (AREA_MN) was the strongest predictor, showing a unimodal relationship with biomass, whereas number of patches (NP), edge density (ED), and landscape shape index (LSI) reduced AGB. Overall, these findings demonstrate that aridity and spatial configuration jointly control biomass, with fragmentation acting as a key mediator of this relationship. Dry and transitional forests emerge as particularly vulnerable, emphasizing the need for management strategies that maintain large, connected forest patches and integrate restoration into climate adaptation policies.

Intraspecific trait variability of plant species in response to microclimatic changes in coastal dunes

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Type: *Poster*

Subject: *Special Sessions*

Session: *Integrating intraspecific trait variability into vegetation science for improved ecological predictions*

Climate change is manifested by rising average temperatures and more frequent droughts. In ecosystems that are already experiencing severe water stress, like coastal dunes, the consequences for vegetation are likely to be substantial. However, local factors (e.g. proximity to the ocean and topography in the case of coastal dunes) may modify these conditions and create microclimatic refuges for species. Furthermore, a plant species' ability to respond to water stress depends on its functional strategy and intraspecific adjustment of functional traits. Such adjustments may be allocated to reducing water loss, increasing water storage, or enhancing water uptake. Here, we attempted to characterise spatial and seasonal microclimatic variations in coastal dunes, and then studied how vegetation responds to them. To achieve this, we deployed weather stations at eight sites spanning 230 km of coastal dunes in Nouvelle-Aquitaine, France. At each site, six soil moisture and temperature sensors were installed from the beach to inland areas within each dune habitat (embryonic, shifting and fixed dunes), taking topographical variations into account. At each sensor location, three individuals of the six most frequent species were sampled, with ten above- and belowground functional traits measured. Preliminary findings reveal a drier and warmer microclimate in fixed dunes but modulated by topography. Functional responses to climatic variations depended on the species and traits considered. Deep investigation in functional traits variations at the intra- and interspecific levels will be presented. It should enable us to better understand the effect of climate on species and, ultimately, anticipate changes in vegetation.

Remote sensing to quantify vegetation structural heterogeneity: a tool for sustainable livestock management and natural grasslands conservation

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Natural grasslands sustain extensive livestock production in Uruguay and exhibit marked spatial and temporal heterogeneity. Vegetation is organized as an herbaceous matrix of grasses and forbs, and an upper stratum composed of shrubs, subshrubs, and low-palatability tussock-forming grasses. Upper-stratum cover is a central component of structural heterogeneity because it integrates vertical complexity with patch configuration across the landscape. It also reduces the effective grazing area and may limit forage availability. Quantifying this component is therefore essential to produce ecological indicators that inform grazing management while supporting conservation of natural grassland ecosystems. We evaluated the combined use of multispectral satellite imagery (Sentinel-2) and radar data (Sentinel-1) to predict upper-stratum cover in Uruguayan grasslands. Between 2020 and 2024, we obtained 373 reference observations from high-resolution drone imagery and calibrated random forest regression models using 120 predictors derived from both satellite sources. Optical–radar fusion substantially improved predictive performance relative to single-sensor models, increasing explained variance (R^2) and reducing prediction error (RMSE). The best model achieved R^2 = 0.62 and RMSE = 12%. Variable-importance analyses consistently highlighted radar VH backscatter metrics (Sentinel-1) among the most influential predictors, underscoring the sensitivity of radar information to vegetation structure. Sentinel-1 and 2 images combined and calibrated with drone data provides a robust, scalable approach to map the upper stratum and monitor structural heterogeneity in natural grasslands, supporting adaptive grazing decisions and conservation monitoring, including timely detection of structural change over time.

Automation of burned area and deforestation monitoring in the Cerrado based on artificial intelligence and satellite time series

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Deforestation in the Brazilian Cerrado has intensified as the region becomes part of the Deforestation Arc, driven by soybean expansion. Fire plays a critical role in this transition, acting both as a precursor and a consequence of land clearing. Currently, Brazil's federal monitoring of deforestation and burned areas relies on visual photointerpretation, which is operationally demanding. This study evaluates an automated approach based on a three-dimensional U-Net deep learning architecture to detect deforestation and burned areas in the Brazilian Cerrado. Sentinel-2/MSI imagery was used to generate monthly mean composites, resulting in 36 mosaics over a three-year period. Several spectral combinations were tested, and the red, green, blue, near-infrared, and shortwave infrared bands produced the best performance. The mosaics and reference masks were used to train and evaluate the 3D U-Net model and the validation was supported by random sample selection and targeted field campaigns to resolve uncertain cases and map validation points in situ. Approximately 2,200 samples were used to train burned area detection and 1,800 to train deforestation detection, with independent test datasets of 280 and 231 samples, respectively. The model achieved an overall accuracy of 91% for burned areas and 90% for deforestation, with spatial agreement with observed disturbances of 58% and 75%, respectively. These results indicate that artificial intelligence can support environmental monitoring by guiding photointerpretation toward areas with a higher likelihood of fire or clearing, improving efficiency and contributing to carbon stock assessments.

An experimental study on inducing acorn dispersal by field mice for the regeneration of *Quercus* species on clear-cut conifer plantation sites

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

Natural regeneration through seed dispersal is essential for the restoration of broad-leaved forests on clear-cut sites. Acorns of *Castanopsis* and *Quercus* species that dominate the canopy of evergreen broad-leaved forests are secondarily dispersed by field mice through their caching behavior. Therefore, when evergreen broad-leaved forests are adjacent to clear-cut sites, acorn dispersal into the clear-cut areas by field mice can be expected. The authors previously investigated the dispersal of acorns in sites 3, 4, and 17 years after clear-cutting, and found that acorns were transported more frequently into adjacent residual *Cryptomeria japonica* stands than into the clear-cut sites. This result suggests that field mice may have preferred the adjacent residual stands because of their well-developed understory vegetation. In this study, we examined whether clearing the understory vegetation in *C. japonica* stands adjacent to clear-cut sites could restrict acorn transport by field mice and induce acorn dispersal into the clear-cut sites. One hundred acorns embedded with small magnets were placed and allowed to be transported by field mice, and their locations were searched using a metal detector. No acorns were transported into the understory-cleared plots, suggesting that understory removal influenced the behavior of field mice and altered their acorn transport destinations. All 20 acorns that were recovered had been transported into the adjacent evergreen broadleaved forest. This presentation also reports the transport outcomes of the remaining acorns.

Vegetation differentiation between natural and planted forest remnants in metropolitan landscapes

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Metropolitan forests comprise mosaics of natural remnants and planted stands, yet their vegetation is often assumed equivalent. We examined whether forest origin corresponds to distinct vegetation communities in isolated urban patches across seven major cities of South Korea.Standardized vegetation plots were surveyed, and community types were classified using TWINSPAN to identify indicator species and dominant assemblages. Forest patches were categorized as natural-origin or planted-origin through historical documentation and field verification. Spatial configuration was quantified using GIS-based landscape metrics describing patch size, edge exposure, and structural heterogeneity.Six vegetation community types were identified. Natural remnants were characterized by oak–pine assemblages consistent with regional temperate forest composition, supporting higher species diversity and multi-layered vertical structure. Planted forests formed simplified assemblages dominated by a limited number of species, with reduced understory complexity. Spatial analyses revealed that natural patches were generally larger and more heterogeneous, whereas planted patches showed elevated edge-to-area ratios and greater homogeneity. These differences were consistent across metropolitan regions, indicating a reproducible origin-based vegetation pattern. Vegetation origin therefore represents a primary axis of ecological differentiation in metropolitan forest mosaics. Recognizing this distinction advances understanding of urban vegetation organization, supports origin-aware vegetation classification, and provides a transferable framework for interpreting ecological variation among isolated forest remnants in human-dominated landscapes worldwide.

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Thermal niches and light responses in post fire germination of eight *Cistus* species

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Type: *Poster*

Subject: Ecosystem-focused topics

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Temperature and light are key factors regulating seed germination, the first and highly sensitive stage of the plant life cycle. In Mediterranean ecosystems, fire has acted as a major selective force and many species have evolved traits such as physical seed dormancy (PY), that allow persistence under recurrent fire regimes. In fire-prone habitats, PY is typically broken by the high temperatures reached during fire, after which seeds are assumed to germinate across a broad thermal range under both light and darkness. However, rising temperatures under climate change may alter these regeneration dynamics. We examined the thermal requirements for seed germination of eight *Cistus* species after exposure to a heat shock simulating fire. Seeds were incubated on a thermogradient plate from 5 to 40 °C under both darkness and alternating light/dark conditions. Optimum germination temperatures were similar among species, around 18 °C, although the breadth of the thermal niche varied and depended on the light. Most species germinated across the full gradient, but germination declined at the extremes, especially at the highest temperatures, where viability loss was evident. Light responses were species-specific: several species were indifferent to light, *C. clusii* showed enhanced germination under light, *C. salvifolius* performed better in darkness, and others germinated better in darkness at suboptimal temperatures but declined at supraoptimal ones. These results highlight the diversity of regeneration strategies within *Cistus*. As Mediterranean regions warm and fire regimes shift, differences in thermal niches may affect species post-fire recruitment, potentially reshaping community composition.

Ghosts of adult architecture: do young herbs allocate biomass like adults?

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Adult architecture, especially the development of belowground clonal organs that enhance disturbance tolerance but represent a substantial carbon sink, may cast a "ghost of adult architecture" in young perennial herbs by shaping their biomass allocation. We hypothesised that, if this imprint exists, clonal and non-clonal herbs diverge early, with isometric belowground–aboveground scaling in young non-clonals but more allometric scaling in young clonals. Early disturbance responses will manifest as shifts in allocation scaling. We conducted a greenhouse experiment with 31 perennial herbs and exposed them to one of five disturbance types (aboveground biomass removals, belowground injury, flooding, spring frost). We analysed scaling relationships of major biomass compartments. Belowground-aboveground scaling was isometric at two months of age, shifting weakly toward allometry at five months of age, with no differences between strategies. Disturbance did not alter belowground-aboveground, leaf-stem, or generative-aboveground scaling. In contrast, a strategy signal emerged in turnover. Dead-to-aboveground biomass scaling was allometric, differed between clonal and non-clonal herbs, and disturbance reduced this allometry in non-clonals while leaving it stable in clonals. During the first year, the "ghost of adult architecture" was not found in allocation among major living compartments but was detectable in aboveground turnover. This implies that establishment and early recovery of perennial herbs are shaped within conserved scaling constraints. Focusing on the later developmental window when belowground clonal organs begin to form, and juvenile scaling shifts to adult allocation, may explain strategy-specific differences in disturbance tolerance during establishment in perennial herbs.

Effects of grazing and spatial heterogeneity on biotic interactions and community structure in gypsum drylands

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Type: *Poster*

Subject: Cross-cutting topics across ecosystems

Session: Community assembly: Theory and methods in vegetation science

Biotic interactions play a key role in community assembly, yet how they are shaped by environmental heterogeneity and land-use remains poorly understood. Iberian gypsum vegetation, a conservation-priority habitat of high ecological singularity with restrictive soil constraints, strong topographic heterogeneity and widespread grazing, offers an ideal system to address this gap. Therefore, we assessed the effects of grazing and environmental heterogeneity on biotic interactions (facilitation and competition) and evaluated how these factors, together with interactions, influence both taxonomic diversity and functional diversity in Mediterranean drylands. Results showed that grazing and environmental heterogeneity strongly modulated biotic interactions and both dimensions of diversity. Facilitation was the dominant interaction across the study area, although its intensity was reduced in north-facing slopes, where environmental conditions are benign, in agreement with the stress-gradient hypothesis. Both facilitation and competition also showed significant effects, particularly on functional diversity, and these were further influenced by environmental heterogeneity and grazing. For instance, higher levels of positive associations promoted acquisitive trait syndromes in grazed plots, hilltops, and north slopes, whereas conservative traits dominated in ungrazed plots and south slopes. These results indicate that positive associations play a central role in community assembly, but their functional consequences depend strongly on grazing and environmental heterogeneity. Overall, this study highlights the need for more detailed research on biotic interactions and abiotic filters in gypsum soils to better understand community structure in such environmentally restrictive and conservation-priority habitats.

Velocity changes of elevational range shifts differ from the Alps to the Arctic

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Type: *P34*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Mountain plants are widely reported to shift their elevational ranges in response to climate warming, yet the differences in direction and magnitude of these shifts remain largely unexplained. As warming accelerates and the rates of warming differ between mountain regions, range shifts are expected to become increasingly nonlinear and regionally variable. We therefore ask whether elevational range shifts are accelerating over time and whether this acceleration differs along a latitudinal gradient from the Alps to the Arctic. We analysed 188 years (1835–2023) of resurveys of upper elevational limits for 240 vascular plant species across 77 mountains spanning a European latitudinal gradient from the Alps to Svalbard across five biogeographic regions (Alps, Southern Scandes, Northern Scandes, Greenland and Svalbard). By providing at least three points in time for each mountain, this dataset allows a rare long-term view of temporal changes in the velocity of elevational range shifts. Overall, we find a clear acceleration in the velocity of elevational range shifts over time. Upslope shifts have accelerated most strongly in the Alps, remained strong but largely constant in Svalbard, and show little to no or even deceleration at intermediate latitudes. These responses highlight pronounced regional differences in the impact of climate change, which is more strongly expressed through precipitation in the Scandes compared to warming in the Alps and Svalbard. Our results demonstrate that mountain plant range shifts are not only ongoing but increasingly uneven across Europe, highlighting the importance of regional climate trajectories for predicting future redistribution of alpine floras.

Effect of recent forest dynamics on taxonomic and functional diversity

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

Recent forest dynamics following historical land use can strongly influence taxonomic and functional diversity, with direct implications for ecosystem resilience and management. In this study, we analyze how these components of biodiversity vary between young and persistent forests (defined as forests that have been continuously established and maintained over long periods of time without interruption), and assess whether forest persistence is indicative of a higher degree of ecological maturity. To this end, we used floristic inventories conducted in six National Parks of the Iberian Peninsula, considering both forest types. Taxonomic diversity was assessed using observed species richness and the Shannon and Simpson diversity indices. Functional diversity was calculated from hypervolumes constructed using plant functional traits—SLA, plant height, and seed dry weight.

Our results show that young forests exhibit higher species richness than persistent forests. However, no clear differences in taxonomic diversity were detected, as species abundance distributions were similar in both forest types. Regarding functional diversity, persistent forests showed higher functional evenness, whereas the expected increase in functional richness and divergence associated with more mature successional stages was not observed. Overall, although persistent forests display some characteristics typically associated with greater ecological maturity, the observed values of taxonomic richness and functional diversity suggest that they have been subject to recent disturbances. Therefore, temporal persistence alone does not necessarily imply ecological maturity.

Does ruderal vegetation explain how urban ecosystems function?

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Urban plant communities*

The rapid expansion of urban areas is increasing the importance of urban greenspaces for human well-being. Within these spaces, ruderal vegetation is a major yet understudied component, and its ecological functioning as an indicator of urban ecosystem condition remains poorly known. To understand how urban greenspaces function, we studied four spontaneous ruderal communities widely distributed in Mediterranean cities: annual grasslands, perennial grasslands, annual herbs, and perennial herbs. We assessed: 1) their contribution to ecosystem support services (biodiversity maintenance, primary production and nutrient cycling); 2) the properties of the soil associated with them; and 3) the diversity of soil microbiota associated. The study was conducted in 48 plots of 1 m^2, in four greenspaces of Madrid city, where plant species richness, diversity indices and biomass were measured. Macronutrient content was analysed in leaves and roots of dominant species, besides soil physicochemical and biological properties. Soil microbial diversity was characterised using metabarcoding. Differences among communities were tested using diversity indices and GLMs. Perennial herbs communities developed in soils with higher macronutrient content and enzymatic activity, showing the highest primary production and lowest plant diversity. Annual herbs communities exhibited higher plant diversity and soils with higher sulphur availability and lower enzymatic activity. Grasslands showed lower sulphur content and higher phosphorus-related activity. Microbial communities associated with each plant community have different taxonomic compositions. Canonical correspondence analysis showed that spontaneous vegetation types could serve as indicators of urban ecosystem functionality. Our results highlighted the importance of ruderal vegetation knowledge to understand urban ecosystem functioning.

How do microtoponyms and old land registers provide keys for understanding diachronic interactions between human uses and vegetation dynamics ?

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

In historical ecology, old land registers from the 18th and 19th centuries can be used to understand the origins of landscapes and the interactions between human societies and their local environments.Highly localised place names (microtoponyms and phytotoponyms) can reveal details about the ecology, agropastoral practices and former vegetation of an area. At three Natura 2000 sites on the Atlantic coast of Brittany –Ouessant (650 ha), Cap Sizun (120 ha) and Belle-Île-en-Mer (Bangor) (250 ha)–, maps of current vegetation (phytosociology) and old land registers allow a diachronic approach of plant communities over time, based on transition analysis, which combines traditional practices, microtoponyms, shape of historical plots and plant associations. Coastal grasslands and heathlands have microtoponyms that reveal the age and stability of this formerly grazed vegetation. Scrub or bracken communities are present on historical cultivated soils, thickets where seaweed was dried and burned, brambles on artisanal quarries, etc. The dynamics of these plant communities vary depending on the types and intensities of past land use. The remains of prehistoric and recent historical periods influence the soil and coastal plant communities. Nowadays, woodlands occupy wet areas or hillsides behind the coastline, and their toponyms reveal information about another former vegetation. These results, supplemented by a literature review in Europe, reveal that data from old land registers and microtoponymy offer insights into the conservation of species and plant communities, as well as ecological restoration. They help to define reference ecosystems and guide management operations.

Effects of pine plantation management on plant diversity of Sierra Nevada National Park (SE Spain)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

During the last century, forestry administrations promoted pine plantations across thousands of hectares of what is now Sierra Nevada National Park (SE Spain). The aims were to reduce erosion, stabilize slopes, protect the headwaters of major watersheds, and generate local employment. Although these objectives were achieved, the pine plantations now exhibit severe problems of decline, disease, high fire risk, and very low biodiversity. In this study, we analyzed the effects of forest thinning on vascular plant diversity. For that, fifteen pine plantation plots were selected along an elevation gradient with varying thinning intensities, along with several control plots of native vegetation. In total, 222 vascular plant species were recorded, many of them endemic. The results showed a strong relationship between native species richness and cover and thinning intensity, measured in terms of tree density and basal area. Densities between 100 and 400 trees per hectare showed vascular plant richness and cover values similar to those of the control plots. In conclusion, forest management can greatly enhance the plant diversity of pine plantations, and therefore their resilience and ecosystem services. Therefore, reducing the density of pine stands is strongly recommended.

Keywords: thinning, vascular plant diversity, tree density, basal area, Sierra Nevada National Park

Mapping and ecological assessment of *Pteronia incana* encroachment in the Eastern Cape province of South Africa

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

This study mapped the distribution of *Pteronia incana* (Blue bush) in Ngqushwa, Eastern Cape, and evaluated its ecological impacts under climate change. The shrub *Pteronia incana* has transformed native grasslands and savannas into dense thickets, thus reducing grazing land productivity and biodiversity, thereby threatening local livelihoods that are dependent on livestock. Using sentinel-2 satellite imagery (10m × 10m resolution), field data (116 plots), and species distribution modelling (MaxEnt), the study mapped the current and future shrub spread. Results indicated that *Pteronia incana* occupies 23.7% of Ngqushwa area, exceeding grasslands (11.8%) and shrublands (11.7%). The Area Under Curve (AUC) on the MaxEnt model (AUC=0.96) identified temperature extremes and dry season precipitation as critical drivers for this species's distribution. Future projections under warmer, drier conditions predict a 24% decline in high suitability habitats, with shift towards higher elevations. Ecological assessment confirms reduced native plants diversity, altered soil properties, and lower resilience to drought in invaded sites. The findings showed synergy between climate change and encroachment in degrading rangelands. Therefore, targeted clearing and restoration of affected rangelands is recommended to support grazing resources and improve species diversity. This study presents a replicable framework for upscaling, utilizing remote sensing for monitoring invasive and encroaching species, thus informing climate adaptive land management.

Effects of woody species structure on fire severity: LiDAR-derivated products and field measurements

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

In recent years, there has been an increase in the number of large forest fires, which have affected vast areas of vegetation of all types, and with varying degrees of severity. The extent of the areas affected by a fire usually means that the composition, structure, and distribution of the affected vegetation are heterogeneous. This may influence, in addition to other characteristics of the fire's behaviour, differences in severity among areas of the affected surface. We evaluated the effects of woody species structure on fire severity in an urban–forest interface, combining LiDAR-derivated products with field measurements. The study area corresponds to a holm-oak forest affected by a 1230 ha wildfire in June 2019, where low-, medium-, and high-severity zones were identified. In each severity category, 10 plots of 312 m^2 were established after the fire. The structure of vegetation and fire severity were measured immediately after fire in the plots, and pre- and immediately post-fire vegetation height data was obtained from the National Aerial Orthophotography Program product "Surface Digital Model – vegetation coverage". This is an official output product from the LiDAR National flights. Data were analysed by ANOVA. The vegetation cover and height before the fire were similar across the different severity classes. Similar results were obtained from measurements taken in post-fire plots. These results suggest that the previous structure did not influence fire severity. However, LiDAR-derived imagery showed that vegetation cover and height were higher immediately after the fire in low-severity plots than in high-severity ones.

Structural responses of Río de la Plata grasslands to grazing exclusion

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P17

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Grasslands are an extensive yet poorly protected biome worldwide, exposed to anthropogenic and environmental pressures. One of the causes of grassland degradation is poor grazing management, and, as an attempt to conserve these habitats, protected areas often exclude grazing completely. As grassland plant species are adapted to grazing through coevolution with large herbivores, grazing exclusion may lead to the accumulation of tall and standing dead biomass, affecting vegetation structure across environmental gradients. Here, we assessed how grazing exclusion alters the frequency and height of plant functional groups in Río de la Plata grasslands. We analyzed vegetation structure along a ~1600km latitudinal gradient encompassing 18 sites in Argentina, Uruguay, and Brazil within the Pampas Biome. At each site, we established six to eight 30-m transects in paired grazed-ungrazed areas, recording at 1-m intervals the maximum vegetative height of the most conspicuous functional groups, including grasses, forbs, legumes, woody plants, and standing dead biomass. Grazing exclusion increased median vegetation height across functional groups, with grasses and forbs rising from 13 to 31 cm and from 8 to 22 cm, respectively. Woody plants became more frequent toward wetter sites, where median height increased from 39 to 152 cm. In contrast, legume frequency declined with grazing exclusion, while median height increased only slightly. Grazing exclusion also enhanced structural variability, particularly for woody plants and standing dead biomass. Overall, grazing exclusion reshapes grassland structure across regional gradients, altering biomass distribution and its heterogeneity in human-modified landscapes, with implications for ecosystem functioning and services.

What influences the change in composition of semi-dry grasslands in Slovakia during the past decades?

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation databases: Expanding the utility of plot-based surveys*

Decline of grasslands across Europe has become a major conservation issue in recent decades. We aimed to determine how species richness and composition of semi-dry grasslands (*Bromion erecti*) have changed over the past decades and which factors have significantly reflected these processes.Floristic changes between 62 plots resampled in 2021–2023 after 20–25 years were quantified using the Bray-Curtis dissimilarity index and visualised via Raincloud plot. To identify key environmental variables, multiple regression analysis was applied. Analysis of functional shifts focusing on the impact of vegetation changes on the representation of plant life forms and strategies was conducted. To determine relationship between the occurrence of annual, biennial, perennial, and graminoid species and degree of vegetation change, quadratic regression analysis was applied.A high rate of floristic turnover (median Bray-Curtis dissimilarity of 0.57) confirmed significant transformation in the studied grasslands. The analysis showed a clear successional trajectory towards more mesophilous habitats, with nutrient accumulation identified as the primary environmental driver of change. From a functional perspective, there was a massive decline in the proportion of CSR strategists and hemicryptophytes, which were replaced by phanerophytes and competitors. Additionally, quadratic models revealed a non-linear trend in the proportion of perennial species, which significantly decreased in favour of annual and biennial taxa.These results indicate gradual change in species composition and loss of ecological integrity in semi-dry grasslands due to environmental and socio-economic changes, especially succession following the abandonment of traditional management and effects of climate change (extreme droughts).

Burning season determines the response of vegetation in a South American grassland

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P85

Type: Poster

Subject: Ecosystem-focused topics

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

In the natural grasslands of the Eastern hills of Uruguay, farmers often use fire to reduce the abundance of unpalatable species and improve forage quality. The objective of this study was to evaluate grassland community responses to autumn and spring burning. An experiment was conducted in a grazed grassland dominated by clump-forming grass, using three treatments: 1-autumn burning, 2-spring burning, and 3-unburned control. Each treatment had five replicates of 25 m². Vegetation surveys were carried out in four 1 m² plots per replicate on six sampling dates: before burning and at 6, 12, 18, 30, and 42 months after burning. Initially, whenever it was applied, burning markedly altered species composition. However, grasslands subjected to spring burning converged more rapidly toward the control treatment than those burned in autumn. Both burning treatments increased species richness relative to pre-burning values, and this increase persisted throughout the study period. In contrast, species richness in the control treatment did not differ from initial values. The pattern differed for plant cover, as spring burning reached high cover values after six months, whereas autumn burning required twelve months. Our study suggests that burning at different times of the year leads to distinct successional dynamics, potentially favoring the conservation of species with different strategies and life cycles. Although burning in this region is carried out in small patches, autumn burning leaves soil exposed for longer periods and may increase erosion risk.

A controlled experiment testing how microbiome presence and diversity modulate plant performance under increasing drought stress.

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Climate change is increasing the frequency and intensity of drought events, constraining plant performance and survival. While plant-associated microbiomes are known to influence plant nutrition, growth, and stress tolerance, it remains unclear whether their beneficial effects persist across increasing drought intensity or whether a threshold exists beyond which microbial buffering breaks down.This study investigates how microbiome presence and diversity influence plant performance under different levels of water stress using a controlled gnotobiotic experiment with *Arabidopsis thaliana*. Plants are grown under sterile conditions or inoculated with microbial communities differing in diversity and climatic origin and exposed to a gradient of water availability ranging from severe drought to well-watered conditions. This experimental design allows the independent and combined effects of microbiome presence, microbiome diversity, and drought intensity to be disentangled.Plant performance will be assessed using morphological and physiological traits, providing an integrated view of plant responses to water limitation. By comparing sterile controls with plants hosting low and high-diversity microbiomes, this experiment aims to test whether more diverse microbial communities better mitigate drought stress and whether microbiomes originating from contrasting climatic backgrounds differ in their effects on host plants.Overall, this work seeks to identify the conditions under which plant-associated microbiomes enhance plant performance under drought and to determine whether microbial buffering capacity declines beyond a critical stress threshold. These findings will contribute to a better understanding of plant–microbiome interactions under climate-driven drought stress and provide insights into how belowground biodiversity may influence plant resilience to future drought scenarios.

Limited recovery of the bud bank during passive restoration of natural grasslands after pine afforestation in Uruguay

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Grasslands are ancient ecosystems that provide a wide range of ecosystem services. Despite their importance, they are threatened by land use changes, particularly commercial afforestation, and their restoration potential has been scarcely explored.This study aimed to assess the role of the bud bank across sites with different times since pine plantation harvest, and to compare them with a reference natural grassland. In Northwestern Uruguay, we selected sites representing three harvest-time categories (6–80 months post-harvest), together with natural grassland sites. For each treatment, six to eight soil–vegetation samples (20 × 20 × 10 cm) were collected.Our results indicate significant differences among treatments. Sites in category 1 (shortest time since harvest) had substantially lower bud densities than categories 2 and 3 (<500 vs. 2000–3000 buds/m²), and all harvested sites had markedly fewer buds than the natural grassland (12,500 buds/m²). When analyzing buds by organ type, the native grassland showed a strong advantage in the abundance of rhizomes (9000 vs. <2000 buds/m²) and bulbs (900 vs. nearly 0 buds/m²) compared with the other treatments. Overall, these findings suggest that the recovery of the bud bank following pine plantation harvest is slow and remains incomplete even several years after harvest. In this context, assessing the bud bank, particularly the below ground organs that store it, appears crucial for understanding and guiding restoration trajectories.

Distance-dependent neighborhood interactions shape tree growth across an evergreen-deciduous broad-leaved forest ecotone in Japan

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Neighborhood interactions affecting tree growth were examined by increasing the maximum distance between target trees and their neighbors across an ecotone between evergreen and deciduous broad-leaved (EB and DB) forests in Japan. Census data of 1-ha three plots established along an elevational gradient were used to calculate neighborhood competition indices for evergreen (NCI_{EB}) and deciduous (NCI_{DB}) neighbors, and their relationships with the relative growth rates (RGR) of target trees were examined, including the diameter at breast height (DBH) as a covariate.Results showed negative relationships between NCIs and RGR. Model Akaike information criterion (AIC) values decreased with increasing distance and stabilized at 15-30 m. These distances varied among life forms and growth stages, being longer for EB species than for DB species, and for canopy trees than for understory ones. This pattern suggests that the growth of DB species is primarily regulated by light availability determined by neighbors at short distances. For understory trees, EB species showed negative responses to both NCI_{EB} and NCI_{DB}across all plots along an elevational gradient, whereas DB species were mainly affected by NCI_{DB} at lower elevations. The weak effect of NCI_{EB} on understory DB species at lower elevations may reflect niche partitioning between EB and DB species.Overall, these findings indicate that neighborhood interactions influencing tree growth operate over characteristic distances depending on life form and growth stage. Even near the upper elevational limits of EB species, where their abundance is low, the dominance of EB neighbors may suppress DB species growth.

Functional trait–performance relationships in native herbaceous plants: Implications for Cerrado restoration

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P177

Type: *Poster*

Subject: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Tropical grassy biomes support exceptional biodiversity and provide key ecosystem services. However, restoring their grassy component remains a major challenge, particularly in the Cerrado, the Brazilian savanna, where grass species are still poorly studied, and invasion by African grasses is widespread. Our goal is to identify the functional mechanisms that promote the establishment and growth of native graminoids in Cerrado communities under restoration. The biodiversity-ecosystem functioning (BEF) Cerrado field experiment was designed to evaluate the role of species richness and functional diversity for the restoration of degraded Cerrado. The experiment was established in one area degraded by decades of pasture use and with intense presence of exotic grasses, like U*rochloa sp*. More than 14,000 individuals of 15 Poaceae and one Cyperaceae species were grown in a greenhouse and planted in the field during the rainy season in early 2025. We quantified 13 above- and below-ground plant functional traits related to establishment, competition with invasive species, drought resistance, fire resilience, and flammability, aiming to characterize the functional strategies of the 16 target species. We then linked the functional strategies to performance indicators such as survival, growth rates, and vegetation cover, measured during the first year of the experiment. We hypothesize that species exhibiting more acquisitive strategies will survive and grow better during the rainy season, whereas species with more conservative traits will show greater survival following dry-season stress.

Fire-related functional traits across graminoid functional groups in a Cerrado savanna - BEF restoration experiment (Brazil).

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P199

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Fire is a key ecological driver shaping plant strategies in tropical savannas, particularly in the Brazilian Cerrado, where recurrent fires interact with seasonal drought to structure plant communities.Understanding how fire-related traits are distributed between grass species is critical for predicting species persistence and ecosystem functioning in a restoration context. The study is embedded in the BEF-CERRADO experiment established in the Chapada dos Veadeiros National Park (Brazil) to test the role of species richness and functional diversity for Cerrado restoration. This study focuses on the 16 target native graminoid species (15 Poaceae and 1 Cyperaceae) selected for the experiment, based on their natural abundance and assigned to four functional groups based on growth form and propagation strategy: (I) caespitose species with fine leaves, (II) caespitose species with broad leaves, (III) single-stemmed and/or rhizomatous species, and (IV) fast-growing and/or mat-forming species. Ten individuals of each species were sampled in the field, to quantify key fire-related traits: crown depth, grass bulk density, presence and number of buds, and presence of underground organs.We examined how these traits are distributed across functional groups and assessed whether predefined classification capture meaningful variation in fire-related strategies. We expected conservative, caespitose species to exhibit deeper crowns and more protected buds, ensuring post-fire resprouting capacity, whereas fast-growing or mat-forming species would show higher bulk density, potentially increasing flammability. By linking functional group identity to fire-related trait syndromes, this work aims to improve trait-based species selection for the restoration of fire-prone Cerrado grasslands.

Effectiveness of Protected Areas in conserving biodiversity and ecosystem processes

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Biodiversity is declining at an unprecedented rate under the combined effects of climate change and land-use intensification, threatening ecosystem functioning. Protected Areas (PAs) are central to conservation strategies, yet their effectiveness in conserving biodiversity and sustaining ecosystem processes remains insufficiently quantified. Conservation assessments still rely largely on taxonomic metrics, often overlooking functional traits, despite their key role in mediating species' responses to environmental pressures and their contributions to ecosystem processes. An additional, frequently neglected dimension is intraspecific trait variability (ITV), which can enhance population persistence and buffer ecosystems against environmental change. Focusing on different forest habitats at national scale (Italy), the PACE project will assess how PAs influence biodiversity patterns and ecosystem processes over space and time by resampling vegetation plots inside and outside PAs along a latitudinal gradient. Field-based trait measurements, including ITV, will be combined with existing forest and environmental databases to quantify how species traits shape community vulnerability to global change and drive key ecosystem processes such as carbon storage and nutrient cycling. The project will provide a trait-based evaluation of PA effectiveness and deliver actionable insights to improve conservation planning, habitat management, and the long-term maintenance of ecosystem services under ongoing environmental change.

The high alpine-subnival vegetation types of Dena Mountains, Southern Zagros (SW Iran)

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P35

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

This study presents a phytosociological analysis of high alpine vegetation types of Dena Mountain in Southern Zagros Mountains (SW Iran). The main objectives were to identify and classify high-elevation plant communities, clarify their syntaxonomic relationships, and assess the key environmental factors influencing species composition. The study area comprises Dena Mountains (4,409 m a.s.l.), with many summits exceeding 4000 m a.s.l. which support rich and diverse alpine and subnival vegetation types. A total of 172 phytosociological relevés were recorded in summer 2019 and 2025 from the elevations between 3700 up to 4300 m a.s.l. of Dena, documenting 111 vascular plant species. Vegetation data were databased in Turboveg, classified using the TWINSPAN algorithm in Juice, and the resulting units were interpreted within a syntaxonomic framework following the International Code of Phytosociological Nomenclature. Floristic patterns and ecological gradients were explored using Detrended Correspondence Analysis. A total of ten associations were identified, in four alliances, three orders and three classes. The classes belong to three main vegetation types, i.e. snowbed habitats, alpine thorn-cushion grasslands and high alpine-subnival scree communities.Preliminary results indicate a clear differentiation of alpine plant communities related to snow cover duration, elevation, substrate characteristics, and topographic factors. Final analyses are expected to refine the delimitation and syntaxonomic placement of the identified vegetation units. This contribution provides the first quantitative phytosociological baseline for alpine vegetation of the Southern Zagros mountain range and offers a foundation for future ecological and conservation-oriented studies in this biodiversity-rich but poorly documented mountain system.

Canopy closure drives functional trait filtering and community assembly in Sub-Mediterranean silvopastoral grasslands

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

Sub-Mediterranean grasslands are biodiversity-rich silvopastoral systems that deliver key ecosystem services, yet their persistence is increasingly jeopardized by climate change within the fine-scale environmental mosaic generated by scattered trees. Tree canopies can buffer these impacts by providing shade that dampens extreme temperatures and alleviates water stress in the understory. In this setting, management strategies that enhance canopy shading while maintaining grassland diversity become crucial to secure their long-term stability. We investigated how functional structure varies along a shading gradient in sub-Mediterranean grasslands dominated by Eurosiberian, Mediterranean or cosmopolitan species under four tree species (*Fagus sylvatica*, *Quercus robur*, *Q. faginea* and *Q. rotundifolia*). We quantified ten above- and belowground traits related to resource acquisition and dispersal, and calculated community-weighted means (CWMs) and functional diversity. CWMs revealed clear functional contrasts among biogeographic groups, especially in leaf economic traits such as specific leaf area (SLA). Moreover, functional composition and diversity changed sharply along the shading gradient, as canopy-driven cooling and microclimate buffering interacted with biogeographic history to filter traits and govern community assembly. Canopy closure emerged as the principal environmental variable explaining variation in functional structure. Together, these findings underline the joint role of tree canopy shading and biogeographic origin as key mechanisms structuring the functional composition of sub-Mediterranean grasslands and enhancing their resilience to ongoing environmental change.

Range expansion of *Juniperus virginiana*: Is there local adaptation?

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P18

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

The eastern redcedar (*Juniperus virginiana*) is a widespread species of conifer common in the United States. Originally confined to steep cliff faces, where they could not be outcompeted by grasses, they have begun encroaching into grassland habitats further west in states such as Oklahoma and Kentucky. This range expansion is caused by both human transplantation of trees in previously uninhabited regions for use as windbreaks, as well as natural expansion as conditions increasingly favor eastern redcedar establishment. To study this encroachment, we have collected eastern redcedar berries from five separate populations. These populations span the centers and edges of two demes of eastern redcedar: Typica (native) and Ozark (encroaching). We will conduct a common garden experiment as well as field measurements of wild trees, recording functional traits relevant to fecundity and growth, and use quantitative analysis to identify differences between encroaching populations and native populations. We will also subject trees grown in the common garden experiment to treatments involving grass competition and fire to determine differences in response to disturbances between populations. A path analysis will be developed to compare our results and determine the degree to which encroaching populations are exhibiting local adaptation as they expand their range into ecologically different regions. This research will help to understand the process of encroachment in woody species, which is becoming a more common occurrence alongside global climate change, and will provide insights into areas that may be threatened next by eastern redcedar encroachment specifically.

Fire, herbicide, and mowing as management tools to control the invasive grass *Eragrostis plana* in a southern Brazil grassland

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P19

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Biological invasions represent a major threat to natural ecosystems worldwide. In southern Brazil grasslands, the exotic grass *Eragrostis plana* often dominates invaded sites, challenging both biodiversity conservation and grassland management for livestock production. Management actions aiming at reducing its abundance are therefore necessary, but they may also affect resident plant communities. We conducted a field experiment in a grassland invaded by *E. plana*, in southern Brazil, to evaluate the effects of different control methods on the invasive species and on native vegetation. The experiment followed a randomized block design with five blocks and four treatments: (I) prescribed fire, (II) selective herbicide application, (III) periodical mowing, and (IV) no control. Vegetation surveys were conducted before and after treatment application, and changes in species cover were used to assess community responses. Preliminary results indicate heterogeneous responses among species and functional groups, with differences in *E. plana* dominance and resident community composition. Herbicide application was the only treatment that significantly reduced the invasive species cover (ca. 98% of suppression). However, it also negatively affected the resident community, reducing species richness and cover across functional groups. In contrast, fire and mowing favored forbs and prostrate grasses, which may have benefited from increasing light availability after disturbance. Our study highlights the challenge of reducing invasive species dominance while avoiding negative effects on the resident community and emphasizes the need to evaluate control methods beyond their effectiveness on the target species.

Disturbance-sensitive vegetation recovery in a coastal loess steppe enclave

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Type: *Poster*

Subject: *Special Sessions*

Session: *Impact of Military Conflicts on vegetation and habitats*

We evaluated post-agricultural recovery of a loess steppe enclave on Stepok Island (Sea of Azov, Ukraine), where fieldwork has been halted since 2022 due to military occupation, using field-based vegetation classification and mapping with Sentinel-2 NDVI time-series (2017–2025). We analysed 70 relevés from 1999 and 2019–2021; the 2019–2021 dataset (57 relevés) was classified with modified TWINSPAN into five clusters representing a disturbance-driven steppe–fallow–ruderal continuum. Ordination and permutation-based tests indicated overlap among clusters and long-term persistence of a steppe–halotolerant floristic core, with a weak compositional shift between 1999 and 2019–2021. We produced a dominance-based vegetation map for 2019–2021 by integrating relevés and 24 rapid mapping records with 10-m NDVI scenes and compared it with the 1999 baseline map, revealing a post-arable mosaic in which steppe-oriented states persist not only in remnants but also as a floristically masked component within transformed dominance types. Remote sensing supported this interpretation: annual median NDVI showed no directional trend, yet seasonal metrics captured recovery signals, with higher lower-quartile NDVI and lower within-season variability in April and August and longer mid-NDVI phases, consistent with reduced bare-soil exposure and greater perennial continuity. Recovery remains disturbance-sensitive; closely spaced episodic events and mechanical disturbance can locally divert trajectories toward ruderal states and help explain contrasting NDVI patterns across the island. Sustained satellite monitoring, together with formal protection, is essential for safeguarding recovery potential under ongoing land-use pressure and the current inaccessibility of this Ukrainian territory due to Russian military aggression.

Plant biodiversity effects on the survival of *Axonopus siccus* (Poaceae) - Evidence from a Biodiversity–Ecosystem Functioning (BEF) experiment in the Cerrado savanna, Brazil

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P201

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

The restoration of tropical grassy biomes remains a challenge, particularly in the Cerrado (Brazilian savanna) where herbaceous plants are poorly studied. Using a biodiversity-ecosystem functioning (BEF) experiment manipulating both species richness and functional diversity, our goal is to understand the functional mechanisms promoting the establishment of native graminoids in Cerrado communities. This study explores the role of diversity in the survival of *Axonopus siccus*, a fast-growing Poaceae with a particularly high post-establishment mortality in our experiment. We used 15 Poaceae and one Cyperaceae and replicated in five blocks. The plots containing *Axonopus* include: a monoculture of 64 *Axonopus* individuals (n=5), 4-species communities with 16 *Axonopus* individuals (n=10), 8-species communities with 8 *Axonopus* individuals (n=10) and 16-species communities with 4 *Axonopus* individuals (n=20). In February 2026, after one growing season, we measured *Axonopus* survival in these communities. When individuals were alive, we assessed the presence of ants or scale insects, recorded disease symptoms (twisted leaves), and assigned a plant health score ranging from 1 (poor) to 5 (good). We found that mortality of *Axonopus* individuals was higher in monocultures (30.3%) compared to communities with 4, 8 or 16 species (2.6%). Individuals that were still alive had a significantly lower health index in monocultures (1.39 vs. 3 for the other communities) but no significant differences in ant or scale insect colonization or unhealthy leaf number. Taken together, these findings demonstrate that increased biodiversity diminishes pathogen susceptibility in a fast-growing species. We will discuss possible reasons underlying these results.

Clonality patterns along large-scale environmental gradients

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Charles University in Prague

P165

Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

One of the determinants of plant community diversity and structure is plant clonality. Clonal growth has a number of ecological effects, namely space monopolization, resource accumulation, regeneration after injury, and sharing of resources among plant individuals. We know that clonal plants prefer nutrient poor, wet and cold places but the knowledge is based on limited number of central European species.We used plant community data spanning from South to North Europe (EVA database) and analysed how proportion of clonal species and types change along environmental gradients extracted form CHELSA climatic variables. Clonality generally increased with wetness and lowering temperature while weather seasonality affected it less. The clonal type analysis shows that clonal types with bigger clonal spread (hypogeogenous rhizomes and stolons) are more common in wet and cold climate and in lower altitudes. Epigeogenous rhizomes prefer higher altitudes and are somewhat similar to non-clonals. Finally non-clonal plants prefer warm, dry and stable climate and higher altitudes. This also differs between woody and herbaceous plants.We show that clonal plant cover changes along large scale gradients a lot but different clonal types can behave very differently.

A Biodiversity–Ecosystem Functioning (BEF) experiment to support the restoration of the grassy layer of the Cerrado, a major Brazilian tropical savanna biome.

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P178

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Tropical grassy biomes like savannas support outstanding biodiversity and provide key ecosystem services. However, the restoration of their grassy component remains a challenge, particularly in the Cerrado where establishment of herbaceous and grass species is poorly studied. Our goal is to understand the functional mechanisms promoting the establishment and growth of native graminoids for restoring invasion-resistant, self-sustaining, fire-resilient Cerrado plant communities. The study aims at presenting the experimental setup of this biodiversity-ecosystem functioning (BEF) experiment. We manipulated both species richness and functional diversity of plants using 15 Poaceae and 1 Cyperaceae species classified into four functional groups according to growth form and propagation strategies: (I) caespitose species with fine leaves, (II) caespitose species with broad leaves, (III) single-culmed and/or rhizomatous species, and (IV) fast-growing and/or mat-forming species. The experiment was set up during the rainy season of 2025 (January). The experimental design comprised 165 plots arranged in five blocks within a 1.5-ha former pasture at Chapada dos Veadeiros National Park, following the removal of 30 cm of topsoil containing invasive grass propagules. Within each block, 33 communities were established: 16 monocultures, four plots containing 16 species, 12 communities comprising four or eight species and spanning one, two, or four functional groups, and one unplanted control plot. We will perform regular vegetation surveys and assess above and belowground plant functional traits associated with species establishment, resistance to invasive species and flammability. Along with vegetation establishment, we are monitoring different ecosystem functions: erosion control, productivity, and carbon and water cycles.

Plant age determines post-fire survival and recovery in *Aristida riparia*: a Cerrado native grass

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P202

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Fire is a recurrent disturbance in tropical grassy biomes, strongly influencing plant traits and ecosystem dynamics. However, the age at which young plants acquire fire resilience remains poorly understood, with important implications for fire management and ecological restoration. We investigated the time required for the native Cerrado grass *Aristida riparia* Trin. to become resilient to fire. Plants aged 3, 6, 12, and 18 months were subjected to controlled burning (10 replicates per age), and survival and post-fire regrowth traits (number of tillers and leaves, and aboveground biomass) were monitored for 120 days. We calculated the differences between pre-fire values and those measured four months after burning. Survival was 70% at three months of age, increasing progressively and reaching 100% regrowth at 18 months, although differences were not statistically significant. Tiller number variation was greater in three-month-old plants than in 18-month-old individuals, while leaf number variation did not differ among age classes. Eighteen-month-old plants showed a greater capacity to recover lost biomass. Fire resilience increased with plant age, with near-complete recovery from 12 months onward and greater post-fire biomass accumulation at 18 months, likely reflecting higher stored reserves and resprouting capacity. Our findings demonstrate a rapid acquisition of fire resilience in Cerrado grasses and highlight plant age as a key determinant of post-fire survival and recovery. These results suggest that prescribed burning in restoration areas should be applied only after initial plant establishment (3 months) to increase grass persistence and ecosystem recovery.

Community structure and environmental characteristics of vascular epiphytes in the shrine forests in southwestern Japan

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P179

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Elucidating the geographical patterns of vascular epiphytes and the factors governing their distribution is essential for comprehending the mechanisms maintaining biodiversity in forest ecosystems. Epiphyte species richness is known to be higher in areas with greater water availability as well as in old-growth forests than in secondary forests. However, the uneven distribution and fragmentation of old-growth forests may hinder our understanding of the geographical distribution of epiphytes and the factors influencing it. Preserved forests of Shinto shrines are scattered throughout the landscape in Japan and often harbor many epiphytes. This study aimed to clarify the differences in epiphyte species richness and species composition within shrine forests in Kochi Prefecture, as well as the factors influencing them. Field surveys recorded the species names, diameter at breast height, and individual locations of 10 trees, along with the species names of epiphytes attached to them, at 20 shrine forests. The analysis revealed that epiphyte species richness in each shrine forest was most strongly influenced by the surrounding forest area, followed by the topographic position index. Species richness was higher in shrine forests with larger surrounding forest areas and those located in valleys rather than ridges. Calculating the beta diversity between shrine forests using the Podani and Schmera indices showed that species composition differed between forests, with the differences being strongly explained by the nesting component. This suggests that differences in species composition between shrine forests are better explained by the nesting pattern than by species turnover patterns.

Adventisation of the forest vegetation cover in Ukraine as a result of damage by military actions

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P100

Type: *Poster*

Subject: *Special Sessions*

Session: *Impact of Military Conflicts on vegetation and habitats*

Modern Russian military aggression is characterized by the use of a diverse arsenal of weapons, the impact of which destroys and damages the natural ecosystems.During 2023-2025, we conducted monitoring studies of the pioneering stages of vegetation restoration in field fortifications and craters caused by shell explosions in the forests of northern Ukraine.These forests belong to six habitat types: T1E, T19, T1B, T1C, T35, T3N. Restoration of vegetation cover depends on the type and degree of damage, the scale of destruction, and the initial state and type of biotopes.Initial recovery occurs through the entry of diaspores from nearby species, both native (aboriginal) and alien. In the second year of monitoring, the participation of alien species mostly decreases, and the rhizomatous grasses and sedges, which are characteristic components of local meadow and forest coenoses, are increasing. The appearance of seedlings of tree and shrub species, which are the basis of the stands of the studied forest areas, was noted.121 synanthropic species were identified, including up to 65 apophytes and 56 alien species, and the most common of them are *Erechtites hieraciifolius*, *Padus serotina*, *Erigeron annuus*, *E. canadensis*, *Robinia pseudoacacia*, *Acer negundo*, and *Ambrosia artemisiifolia*. The species composition of alien plants did not show significant quantitative changes; all of them were recorded in the first year after damage. The transformation of the plant cover of natural ecosystems is a precondition for the further active spread of alien species that were adapted to the changed environment.

Reconstructing Historical Land-Use Legacies Shaping Oak Regeneration Across Spain

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P115

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Forest landscapes in Spain are undergoing transformations driven by land-use change and socio-economic dynamics. Rural abandonment has promoted the expansion of secondary forests, while successional processes in established stands—particularly those originating from afforestation—are increasing the presence of broadleaved species such as oaks. In a region affected by increasing aridity and climatic extremes, understanding how land-use legacies shape forest regeneration requires long-term, large-scale perspectives, yet they remain poorly characterized. This study reconstructs historical land-use configurations associated with current oak (*Quercus* spp.) presence by combining photointerpretation and landscape metrics. 29,530 plots from the Spanish National Forest Inventory (SNFI3 and SNFI4) containing at least one oak individual were photo-interpreted using 1956-1957 American Flight aerial imagery and classified as wooded and non-wooded. These historical land-cover classes were used to infer colonization trajectories. To capture spatial land-use legacies relevant for oak colonization, we quantified forest cover within a 500m buffer using the Spanish Forest Map (SFM50, 2007-2024), providing a proxy for propagule availability and connectivity. Preliminary results indicate that ~95% of plots were wooded, mainly open forests (47%) and scattered trees (30%) in the fifties, shrubland (2.7%) and agricultural or herbaceous areas (2%) dominated non-wooded plots. In 71.4% of plots, oaks were already present within its distribution range in 1956-1957, with no evidence of colonization, whereas 10.8% of plots showed colonization. Combining historical stand structure with landscape context enables the assessment of how past land-use configurations constrain or facilitate oak regeneration under land-use and climate change.

In search of allies: fungal diversity associated with the root systems of Atlantic oak forests

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Plant community interactions: Relationships with symbiotic and mutualistic organisms*

Understanding the diversity and ecological roles of root-associated fungi is crucial for comprehending forest functioning, particularly in ecosystems situated at biogeographical margins. The study provides the first comprehensive characterization of fungal communities associated with the root systems of *Quercus petraea* in Atlantic oak forests at the southwestern limit of the species' distribution in the Cantabrian Mountains (northern Spain). Root samples were collected from trees representing four sociological classes across three protected areas. A combined approach integrating macroscopic and histological analyses of ectomycorrhizal morphotypes with high-throughput metabarcoding of the ITS1 region revealed a highly diverse fungal assemblage comprising 1,043 ASVs. Despite similar richness across sites, only a few ASVs were shared, indicating strong compositional turnover driven by local environmental conditions. Functional assignment revealed saprotrophs as the richest guild, but symbiotrophs were dominant in terms of read abundance, highlighting their central ecological role. Intermediate-class trees consistently harbored the highest taxonomic uniqueness in two of the three sites, suggesting that canopy position influences fungal associations. Indicator species analysis revealed taxa strongly associated with specific protected areas, emphasizing the ecological specificity of local fungal communities. This study uncovers the complex and functionally diverse fungal networks supporting *Q. petraea* in vulnerable Atlantic forests, providing baseline information relevant for conservation and forest-management strategies under ongoing environmental change.

Long-term mowing regimes affect phenological growth stages and morphological characteristics of plants in Trisetion grassland

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Phenological growth stages and morphological characteristics of plants during the growing season reflect plant adaptations to different long-term grassland management regimes and represent key indicators for evaluating management effects relevant to adaptive conservation management. Therefore, this study examined how four contrasting long-term management treatments influence phenological phases and morphological characteristics of selected plants. The experiment, established in 1999, is arranged in a randomized block design with four treatments and five replicates, with a plot size of 5 × 5 m. Management treatments included mowing (I) once per year; (II) once every two years; (III) once every four years (all with biomass removal), and an (IV) unmanaged control. Mowing was applied in mid-July each year. Phenological growth stages and morphological characteristics were recorded for six dominant plant species (*Cirsium heterophyllum*, *Hypericum maculatum*, *Geranium sylvaticum*, *Rhinanthus minor*, *Veronica chamaedrys* and *Festuca rubra*). A long-term mowing regime significantly affected the onset of individual phenological phases and plant morphological characteristics. Frequent mowing delayed the onset of the generative growth stage, with many plants remaining in the vegetative growth stage under annual cutting, whereas flowering occurred more frequently under lower mowing intensity. Sward height declined consistently with increasing mowing frequency, indicating a strong management effect on plant stature. Leaf length varied with the phenological growth stage of the plants. Sustained suppression of flowering under intensive mowing may reduce seed availability and constrain generative regeneration of plant populations, and could lead to a decrease in plant diversity in *Polygono-Trisetion* mountain meadows.

Small mice, big problems: The invasive house mouse alters plant abundance, habitat use and community composition on a sub-Antarctic island

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P20

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

The house mouse (*Mus musculus*) is one of the most widespread and harmful invaders of ecosystems worldwide, with pronounced impacts on islands. However, their effects on plant communities are largely unexplored and often difficult to quantify. On sub-Antarctic Marion Island (MI) the house mouse has the potential to profoundly impact vegetation through seed predation, burrowing activity and changes in the nutrient cycles. Using a paired island comparison between mouse-invaded MI and the neighbouring mouse-free Prince Edward Island (PEI), this study assessed the ecological effects of the house mouse on plant characteristics. Detailed vegetation plot data collected in four habitat types on both islands showed that several plant species consumed by mice had lower cover and/or prevalence on MI than PEI after accounting for environmental effects. Species distribution models show that, compared to PEI, some of these species are limited at lower elevations on MI, where mouse densities are higher. At the community level, mouse invasion was an important predictor of differences in vegetation cover, but it did not strongly influence vascular species richness. Community composition differed significantly between islands, especially for habitat types in which mice are most abundant. These results indicate that, while mouse predation has little effect on overall plant richness, it reduces the abundance of mouse-consumed species, probably replacing them with more tolerant taxa, and drives shifts in habitat use. These results provide insight into ecosystem responses to invasion, reinforcing the house mouse as a major driver of ecosystem change on MI.

Direct sowing of acorns can be as successful as planting for tree regeneration of dehesas

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

The dehesa is the most widespread agroforestry system in Europe and one of the most important threats it is suffering is the loss of trees and the lack of regeneration. This study analyses the direct sowing of acorns versus outplanting in the survival and development of the holm oak (*Quercus rotundifolia* Lam.), as well as the effect of the mother tree, the acorn mass and the planting/sowing site. To this end, in November 2022, acorns were collected separately from 10 selected mother trees. In February 2023 the acorns were sown in a nursery, in deep containers of 41 cm long and 7 liters volume, and conventional forestry trays of 18 cm long and 300 cm3 volume cells. In November 2023, 720 holm oaks were planted in the field. At the same time, direct sowing of acorns collected from the same mother trees but one year later was carried out, with 360 sowing points in total. The experiment was replicated in 3 experimental sites of southeastern Spain, with 3 blocks per site. Results showed that direct sowing of acorns, when carried out as in this study, can be just as successful or more successful as planting, especially in sites with harder environmental conditions.

Keywords

Dehesa, acorn seeding, nursery, container, semi-arid

Growth and trait plasticity drive above- and below-ground acclimation of seagrasses to long-term bathymetric change in a lagoon system

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P96

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

Coastal lagoons represent transition zones between land and water and host habitats of high ecological value. Among these, seagrass meadows can be strongly influenced by changes in sediment dynamics and budget, affecting light availability, burial, and nutrient conditions; however, long-term effects on seagrass traits remain poorly investigated.

We used long-term bathymetric changes (as a proxy of sediment stability) in the Lagoon of Marano and Grado (NE Italy) between 1966 and 2010, which were assessed and related to seagrass growth and functional traits. Five lagoon areas, including different levels of bathymetric change, were selected. Within each area, seagrass meadows were sampled and species-specific plant growth and traits were measured, including aboveground and belowground biomass as well as key canopy and rhizome characteristics. Bathymetric deepening significantly affected the dominant seagrass species of the lagoon, namely *Cymodocea nodosa* (CN), *Zostera marina* (ZM) and *Z. noltii* (ZN). Aboveground biomass patterns revealed a marked reorganization of canopy architecture. CN and ZM exhibited a self-thinning strategy, expressed as a reduction in leaf number per shoot, shoot density, or both, whereas ZN appeared to benefit from reduced competitive pressure. Increase depth-related responses were also evident in belowground biomass. *Zostera* species enhanced their belowground development, likely to improve anchorage in a highly dynamic environment, whereas CN showed reduced belowground biomass, possibly to maintain a positive carbon balance under suboptimal conditions. Overall, our results highlight that morphological plasticity enables seagrasses to cope with long-term sediment dynamics, supporting species-specific acclimatization strategies to the highly dynamic lagoon environment.

Mapping invasive and expansive plant species in rugged mountain terrain using unmanned aerial vehicle and deep learning

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P74

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Efficient management of both alien and native species that spread in protected areas requires precise and up-to-date mapping of their distributions. We developed a monitoring pipeline that combines multitemporal UAV imagery with botanical reference data to map alien invasive (*Rumex alpinus, Lupinus polyphyllus, Telekia speciosa*) and native expansive species (Veratrum album, Senecio hercynicus) in the Krkonoše and Orlické hory Mountains (Czech Republic) under different management regimes. UAV flight campaigns followed by botanical fieldwork were conducted repeatedly in 2024 and 2025, capturing key phenological stages and outcomes of management measures. UAV data (RGB and multispectral) were acquired using a DJI Mavic 3 Multispectral with a ground sampling distance of approximately 1 cm. Species presence and absence were recorded as georeferenced circular plots with centimeter-level GNSS accuracy. Species detection was performed in ArcGIS Pro using convolutional neural networks (U-Net and DeepLabV3) trained primarily on RGB orthomosaics. Under optimal phenological and imaging conditions, detection accuracy reached 90%, with the highest values for species most different from background vegetation (*Rumex, Veratrum*). Species with compound leaves (*Lupinus*) were best detected during early growth or flowering. The added value lies in the integration of conventional botanical and geoinformatical approaches: While UAV mapping provides a rapid, area-wide overview of high accurate species distribution and its changes, botanical field data remain essential for ecological interpretation and validation. Together, they represent a scientific basis for targeted management, the evaluation of its effectiveness over time, and allow for the detection of the early invasion stages, when eradication is most successful.

Fifteen-year restoration effect of mulching and mowing on semi-dry grasslands

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Short-term vegetation dynamics*

Mulching is increasingly used to maintain grasslands; however, it can have adverse effects on biodiversity. A field experiment established in abandoned semi-dry grassland in the White Carpathians (Slovakia) was monitored from 2009 to 2023 to determine: i) whether mulching is an appropriate management for restoring grassland, ii) whether summer/ autumn mulching differs in its effects, and iii) how mulching and mowing differ in their effects on species composition. The effects of four management treatments were tested: mowing, summer mulching, autumn mulching, no management. Results of Multi-way ANOVA showed significant interaction between Treatment and Time for species richness at scales 1×1 m (P=0.01) and 0.1×0.1 m (P=0.001). During the first three years, any type of applied management had positive effect on species richness in both scales. Later, both mulching treatments led to lower species numbers than mowing. After 15 years, autumn mulching exhibited contrasting effects at different spatial scales: a decline of 3.4 species at the 1×1 m scale but increase of 1.0 species at the 0.1×0.1 m scale. Summer mulching showed consistently negative effects at both scales (losses of 7.8 and 1.3 species, respectively). Species richness in mown plots decreased in extremely dry years. Mulching can be used as an initial restoration management, but its regular use over a longer period may lead to declines in species richness and changes in species composition. Mowing in early summer has to be applied carefully in extremely dry years. Research was supported by VEGA 2/0062/25.

Pairwise interactions between native and invasive species: effects of species density and life forms

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P21

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

The study of interactions between co-occurring native and invasive species enhances understanding of invasion impacts on native populations and native resistance to invasion success. A mesocosm experiment evaluated native species responses to increasing invasive abundance and variation in life-form interactions. Pairwise interactions were assessed by manipulating the relative abundance (0–3 individuals) and life form (grass or shrub) of invasive neighbors while maintaining constant density (four individuals per pot). Two native species (*Eragrostis lugens* and *Senecio brasiliensis*) and two congeneric invasive species (*Eragrostis plana* and *Senecio madagascariensis*) from Uruguayan grasslands were selected. The experiment was conducted in a growth chamber under non-limiting resource conditions, with species propagated from seeds in the laboratory and grown under the interaction treatments for 60 days. Mean individual dry biomass was used to calculate 95% confidence intervals of the Relative Interaction Index (RII) to determine interaction sign and magnitude. As a result, the invasive shrub S. madagascariensis exerted the highest negative effects on both native species, particularly at high abundances, indicating strong competitive interactions. In contrast, the invasive grass *E. plana* did not reduce native performance and, notably, facilitated *S. brasiliensis* across all abundances. Only the invasive species *E. plana* was inhibited by native species, whereas *S. madagascariensis* was facilitated through interactions with them. Overall, the effects of invasive species on native performance varied depending on the relative abundances and life forms of interacting species, highlighting the context-dependent nature of plant invasions and the importance of assessing the effects of each invasive species individually.

The multifunctionality of bulbs: Storage, economic co-ordination, clonal multiplication, and protection from stress

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P166

Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Belowground organs can be a centre of many different non-acquisitive functions for plants. These functions include storage, economic coordination, clonal multiplication, and protection from stress. To better understand these functions, we surveyed belowground allocation in over 100 southern African Oxalis species planted in pots as individual bulbs. We measured initial (parent) bulb size and offspring bulb size, number, and location relative to the parent bulb. To understand the relationship between storage and aboveground economy, we also measured leaf and floral economic traits (e.g. dry matter content and specific area). Storage allocation, as bulb size, was key to explain variation in flower economy, with larger bulb size linked to production of more, cheaper, and especially, short-lived flowers. Clonal offspring allocation varied among species, with a clear size/number trade-off. Around 2/3 of species produced offspring bulbs in different locations and sizes from a given individual simultaneously, as potential bet-hedging. Shallower offspring bulbs were generally smaller than deeper offspring bulbs for a given parent bulb, potentially related to dispersal abilities versus providing greater protection from stress under soil. Belowground storage organs are complex and versatile, even within a single type, such as bulbs. Storage allotment and soil depth can be modified for different purposes and even vary between offspring from the same parent plant. Storage allocation of individual bulbs is further integrated into strategies aboveground, linked to flower economy. Bulbs are hidden below the soil but still provide integral functions for plant life.

Wildfire Risk Modeling in Taiwan's High-Mountain National Parks

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

As climate change intensifies, wildfires have become a major threat to ecosystems. In Taiwan's high-mountain national parks, fires not only destroy habitats and destabilize wildlife populations, but also disrupt essential ecosystem functions. These parks, characterized by intact forests, high biodiversity, and rich cultural heritage, serve as refuges for many endemic and threatened species. Under future climate scenarios, escalating wildfire risk may threaten these irreplaceable resources. Consequently, establishing a reliable wildfire risk prediction and early warning system has become essential for protected area management. This study aims to develop a wildfire risk assessment model using the Random Forest algorithm based on historical wildfire records. Wildfire occurrence and severity are used as response variables, while environmental predictors include both static and dynamic factors. Static factors include topographic attributes and anthropogenic infrastructure such as roads, trails, and mountain lodges. Dynamic factors encompass climate variables, vegetation characteristics, and moisture conditions. The modeling framework adopts a two-tier approach. First, static variables delineate baseline wildfire risk zones. Second, dynamic factors simulate temporal variations in fire risk. The model is then applied to future climate scenarios to assess potential shifts driven by climate change. These results provide guidance for fire prevention planning and adaptive management in Taiwan's high-mountain protected areas.

Long-term succession after abandonment of livestock grazing in subalpine and alpine grasslands (Northern Alps, Switzerland)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Livestock grazing is a key driver of plant diversity and vegetation patterns in subalpine and alpine meadows. However, understanding its role has become more important as subalpine and alpine grazing sites are increasingly abandoned. We studied 34 vegetation plots in subalpine and alpine meadows of the Northern Alps, Switzerland, representing different vegetation types. The plots were formerly intensively grazed by sheep and were regularly resurveyed over two decades. Four vegetation types showed significant changes in species richness since abandonment, with a strong decline for *Poion alpinae* and no changes for *Rumicion alpini*, which is shaped by intensive grazing. Regarding vegetation parameters we found an increase in litter cover and a decrease in uncovered soil for all plots. The vegetation got over all denser and taller in the observed plots, with strongest changes in *Poion alpinae*. Across the full species list, ten species showed a significant decline in frequency, while two showed a significant increase over time, with *Rhinanthus alectorolophus* (increase) and *Poa annua* (decrease) showing the most significant changes. These results suggest that the studied vegetation types in subalpine and alpine grasslands react very slowly to a change of grazing regime in terms of composition and biodiversity. This underlines the importance of an adjusted grazing management of subalpine and alpine grasslands. Different vegetation types vary in their sensitivity to grazing, and overgrazed sites may require decades to recover. However, an extensive summer pasture might be beneficial for the plant diversity of subalpine and alpine regions.

Floristic chorotypes in northeastern Spain: distribution patterns and the role of endemism

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Although the marked environmental heterogeneity of the Iberian Peninsula and its well-known floristic richness have attracted considerable interest, the chorotype-based approach to Iberian plant diversity remains a promising yet understudied topic in phytogeography. Our aim was to identify and characterize chorotypes in northeastern Spain, with particular emphasis on the role of endemic species. We compiled a curated dataset comprising the distribution of 3,722 plant species across 1,016 UTM 100 km2 grid cells. Species were classified into major floristic groups (chorotypes) using K-means clustering and, to facilitate interpretation, the resulting groups were compared with previous bioregionalization frameworks. Chorotypes were characterized by its representative species, taxa showing the highest degree of membership in each cluster according to Fuzzy C-means (FCM). We further evaluated the representativeness of endemic species within each chorotype and their relevance as indicators of areas of endemism. Thirteen major floristic chorotypes were identified along the territory, showing varying degrees of concordance with established Spanish biogeographic classification, while also revealing cluster overlap in transitional zones characterized by fuzzy boundaries. Endemic species were especially significant for mountain chorotypes, and in contrast, clusters with fewer endemics corresponded to geographically localized zones with distinctive floristic composition, often overlapping with protected areas of high conservation value. Overall, this study proposes a methodological framework that can be applied to neighboring territories, contributing to a broader understanding of Mediterranean biogeographical patterns and guiding future research in floristic and conservation strategies based on floristic coherence.

Shaping the stability of clonal growth in *Cymodocea nodosa* meadows: the role of functional traits and plant-soil feedbacks on fairly circle formation

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

Seagrasses play a key role in coastal ecosystems by providing essential services. In sheltered environments, seagrass meadows often exhibit self-organized spatial patterns, including circular vegetated patches, unvegetated gaps or so-called *fairy circles*. These patterns arise from clonal growth dynamics and can undergo rapid regime shifts, sometimes leading to collapse processes potentially intensified by altered environmental conditions associated with global changes. The emergence and configuration of these patterns are tightly linked to ecological condition and stability of seagrass communities. Strong plant–plant and plant–soil feedback suggests nonlinear responses to environmental pressures, yet experimental evidence identifying drivers of abrupt pattern shifts remains limited. Understanding these mechanisms is crucial for assessing resilience under changing hydrological conditions. To investigate these dynamics, 52 *Cymodocea nodosa* meadows were sampled across a vast lagoon system in the Northern Adriatic Sea along a gradient of patch age, comparing edge and center locations. Patch diameter and historical orthophotos were used to estimate patch age and clonal expansion. At each site, above and below-ground biomass, functional traits, and sediment properties were measured. Linear mixed-effects models and trait correlation networks were applied to assess spatial and temporal patterns. Preliminary results indicate that early clonal expansion is characterized by increasing patch size, biomass, and shoot density. Over time, however, progressive loss of above-ground biomass occurs in patch centers, sometimes leading to fairy circle formation, while below-ground biomass remains stable. Changes in trait correlation networks highlight shifts in phenotypic integration, underscoring the importance of plant–soil feedback in regulating long-term meadows stability.

Species-Specific Heat Tolerance Strategies in Mediterranean Urban Woody Species: A Comparative Study of Evergreen and Deciduous

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Urban plant communities*

Urban thermal rise represents a major threat to vegetation, primarily due to heat-induced damage to Photosystem II (PSII). This study investigates the functional relevance of two thermal tolerance indices, Tcrit and T50, defined as the temperatures at which maximum PSII efficiency (Fv/Fm) decreases by 15% and 50%, respectively. The analysis was conducted on three common woody species of Mediterranean urban vegetation: the evergreen *Quercus ilex,* the deciduous *Acer campestre* and *Fraxinus ornus*. Thermal indices were derived from Weibull response curves (R software) across a temperature range of 25–60 °C. To elucidate interspecific differences in heat resistance, Tcrit and T50 were integrated with key physiological and morphological traits using multivariate analyses. *Q. ilex* exhibited a lower Tcrit compared with the two deciduous species. This lower threshold did not indicate reduced thermal resistance but reflected a downregulation strategy, as PSII activity persisted, although at reduced efficiency, up to 60 °C. *A. campestre* and *F. ornus* maintained higher PSII efficiency until reaching Tcrit, followed by a rapid decline in PSII functionality. Across species, Tcrit was mainly associated with physiological traits, whereas T50 was more strongly correlated with leaf morphological characteristics. Morphological traits explained most of the variability in thermal resistance in *Q. ilex*, physiological traits were predominant in *A. campestre*, and a combined contribution emerged in *F. ornus*. These results indicate that thermal resistance is governed by species-specific strategies, providing preliminary insights into the adaptive responses of Mediterranean urban vegetation to increasing temperatures and intensifying urban heat island effects.

Ecophysiological evaluation of urban trees under stressful abiotic conditions.

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P188

Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Urban plant communities*

Urban trees are increasingly exposed to multiple, interacting environmental stressors that challenge their physiological functioning and long-term persistence. This study is part of a three-year monitoring program aimed at assessing the ecophysiological responses of four Mediterranean tree species to stress conditions representative of highly anthropized urban environments. We investigated leaf functional traits as indicators of adaptive strategies and species-specific resilience in the Metropolitan City of Rome. Under controlled greenhouse conditions, plants were exposed to four experimental treatments: thermal stress, thermal stress combined with soil compaction, thermal stress combined with water deficit, and a multi-stress treatment integrating heat, soil compaction, and water deficit. Microclimatic variables and soil moisture were continuously monitored, maintaining stressed plants at 50% of field capacity and controls at full field capacity. The experiment was designed as a stress-testing framework to disentangle physiological response mechanisms relevant to real urban vegetation communities. The study included two evergreen species (*Quercus ilex* and *Viburnum tinus*) and two deciduous species (*Acer campestre* and *Fraxinus ornus*). We focused on photosynthetic performance was evaluated using P_N/C_i response curves and chlorophyll a fluorescence, and plant water status was assessed through relative water content and leaf water potential measurements. Results, for now, highlighted strong species-specific responses to stress. *Fraxinus ornus* and *Viburnum tinus* showed the highest sensitivity, with pronounced reductions all compartment. *Acer campestre* and *Quercus ilex* exhibited greater physiological plasticity under moderate stress. These findings improve our understanding of urban tree resilience and provide insights for species selection and management in Mediterranean cities.

Assessing the impacts of invasive and expansive plant species on mountain grasslands using unmanned aerial vehicles and botanical field surveys

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P36

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Mountains are exceptional biodiversity hotspots characterized by pronounced habitat heterogeneity, high endemism and relict-species richness. Alongside climate and land-use change, the spread of alien plant species is an important driver of vegetation change, promoting biotic homogenization, particularly at low and mid elevations. Restoration in harsh mountain environments is slow and uncertain, making early detection and rapid management responses critical. We integrated multispectral UAV surveys with detailed botanical fieldwork to quantify the impacts of three alien invasive species (*Rumex alpinus, Telekia speciosa, Lupinus polyphyllus*) and two native expansive species (*Veratrum album, Senecio nemorensis* agg.) in montane meadows and alpine grasslands of the Czech Republic. During 2024–2025, vegetation was repeatedly sampled on 50 plots 25 m² in size with nested 10 m² subplots to capture scale-dependent effects across a range of management regimes (mowing, grazing, mulching, hand pulling, and herbicide application). Plant functional traits (height, phenology, leaf area index; seed germination in Lupinus) were recorded to assess vegetation responses to management interventions, while UAV-based mapping quantified species cover at the site scale. Dominant species displaced grasses typical of nutrient-poor soils, indicating the ruderalization of native vegetation. *Lupinus* and *Rumex* caused the most substantial shifts in community composition. *Lupinus* showed the highest variability of invaded communities and a pronounced capacity for post-disturbance regeneration and reproduction from both mature and immature seeds. Its ability to dominate the oligotrophic grasslands of the Nardo strictae-Agrostion tenuis alliance and spread along tourist trails towards high elevations poses a serious threat to the Arctic-Alpine tundra.

Insights on the relationships between species functional originality and plasticity, and growth and recruitment, in a montane cloud forest of Taiwan

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National Taiwan University

P180

Type: Oral

Subject: Ecosystem-focused topics

Session: Tropical ecosystems: Vegetation from the tropics and the subtropics

Understanding how biodiversity, species, and individuals' functional originality and plasticity are related to growth and recruitment is critical for predicting ecosystem responses to environmental change. We analyzed tree growth and recruitment patterns within a 1-ha permanent plot of montane cloud forest in Taiwan, using inventory data combined with leaf functional trait measurements. Individual diameter growth was calculated from repeated DBH measurements, and recruitment was quantified as the number of newly established individuals per subplot over two sampling times (2020-2025). Functional distinctiveness was computed locally, as the mean functional distance of species from all other species present within a subplot. Trait plasticity was calculated as the individual coefficients of variation (CVs) for specific leaf area (SLA), leaf area (LA), leaf dry matter content (LDMC), leaf thickness (LT), and Chlorophyll content (Chl). We formulated two main specific research questions: i) How are growth and recruitment related to species richness? ii) How are growth and recruitment related to species' trait variation and functional distinctiveness? Our results indicate that species growth was positively related to species richness, particularly among saplings. Moreover, we found that saplings' individual growth was associated positively with LA variation and negatively with Chl variation, while recruitment was positively associated with LDMC and Chl variation and negatively with SLA variation and functional distinctiveness. Our study highlights the importance of trait-specific plasticity and functional originality in regulating growth and regeneration processes, where they may be acting as a mediating factor in the biodiversity-productivity relationship.

Influence of vegetation regeneration in energy-sector footprints on the spatial and temporal dynamics of boreal bird communities

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

The boreal forest of Alberta is heavily fragmented by energy-sector footprints. After abandonment, some footprints regenerate vegetation at different rates. However, bird community responses to vegetation recovery across different footprint types have not been explicitly studied. We monitored bird communities and on-footprint vegetation across multiple temporal and spatial scales, including ~1,000 linear features and wellsites of varying vegetation recovery, and 34 long-term monitoring stations representing different types and intensities of energy-sector footprints, over 5 to 14 years in boreal forests of Alberta, Canada. We addressed two questions: (1) how do varying levels of on-footprint vegetation influence bird communities, and (2) how does on-footprint vegetation recovery influence temporal bird community dynamics? Linear features such as pipelines and powerlines with early successional vegetation supported early seral birds, whereas narrow seismic lines, regardless of on-footprint vegetation, were not dominated by early seral birds. Vegetation dynamics substantially influenced temporal bird community dynamics. Reduced vertical vegetation and higher temporal variability in ground cover facilitated pronounced, rapid directional change. Convergent and stable community dynamics were associated with stable vegetation and older reclamation. Across spatial scales, influence of vegetation dynamics on bird communities were strongest at the local scale (150 m radius). We conclude that, in most cases, on-footprint vegetation, combined with other footprint attributes, drives spatial and temporal variation in boreal bird communities, with a few exceptions where responses to footprints appear independent of vegetation recovery.

Ecotone effect of cloud forest boundaries drives multimodal pattern of ferns species richness along elevational gradient.

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Understanding species richness patterns along elevational gradients is a central issue in ecology. However, recent studies have reported multimodal species richness patterns along elevation gradients in various mountain regions, indicating that additional mechanisms, such as community ecotones or climate thresholds, may be influencing species turnover. In ecotone, species richness pattern shows a peak and climate factors rapidly shift. In this study, we tested whether a multimodal fern richness pattern with elevational gradient from 50 m to 3,884 m in southwestern Taiwan is associated with ecotone effects at cloud-forest boundaries.We applied Maxent to build species distribution models (SDMs) for an indicator fern species in cloud forest (*Dryopteris paleolata*) to delineate the potential distribution and boundaries of cloud forests. We also characterized elevational patterns of key climatic variables to identify zones of rapid climatic change, particularly in humidity and fog. Mean Diurnal Range (Bio2) and Mean Temperature of Coldest Quarter (Bio11) were the most important variables in the distribution model. The predicted distribution range overlapped with the elevational bands where fern species richness peaked (1,200 m and 2,300 m a.s.l) in southwestern Taiwan, and relative humidity and dew-point temperature showed changes rapidly within the same elevation bands. Based on species richness patterns, modeled distribution ranges, and climatic gradients, our results indicate that ecotone effects at cloud-forest boundaries are among the key drivers shaping elevational richness patterns and helping to explain the multimodal species richness pattern across elevation.

Species-dependent changes in clonal growth rates during grassland succession: a long-term field study tracking clonal colonies

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Clonal patch formation strongly influences vegetation structure and biotic interactions in recovering communities. Although more than two-thirds of grassland species are clonal, annual genet-level growth rates are rarely quantified, particularly across succession. We studied the clonal expansion dynamics of two species with different clonal growth organs (*Fragaria viridis* - stoloniferous; *Teucrium chamaedrys* - belowground rhizomatous) in a loess old-field abandoned in 2009 in Hungary. Established colonies were tracked individually (n=10 per species) in four permanent plots of 1000 m^2 over 14 years (2012–2025), measuring maximum colony diameter (distance between furthest rooting daughter ramets) and estimating cover. Both species were considered targets for recovery. In early-establishing *F. viridis* colonies, clonal growth declined sharply ten years after abandonment, with mean growth rate declining from 198.3 to 15.3 cm/year. Colonies reached 986.7 cm in diameter and 26.0 m^2 cover by year 16, whereas late colonizers remained small. In contrast, *T. chamaedrys* showed near-linear clonal expansion at 42.3 cm/year, reaching 430.7 cm diameter and 8.5 m^2 cover. Establishment timing significantly influenced colony size in both species: early establishment led to 7.7 and 2.2 times larger colonies and 130 and 7.7 times greater cover in *F. viridis* and *T. chamaedrys*, respectively. However, growth of *T. chamaedrys* remained steady regardless of establishment timing. In our study, stoloniferous growth enabled rapid space monopolization followed by stagnation, likely due to competition, whereas rhizomatous growth maintained steady expansion. These results suggest that successional time can strongly impact clonal growth, with responses being species-dependent and linked to clonal architecture.

Assessing the resistance of functional traits in saltcedar woodlands under global change.

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P57

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Saltcedar (*Tamarix* spp.) adapts to stressful, changing environments through drought resistance, salt tolerance, phenotypic plasticity and local adaptation. Arid and semiarid environments hosting *Tamarix* woodlands are highly vulnerable to global change drivers. Increasing aridity can induce abrupt changes in ecosystem attributes, including declines in plant species richness and productivity, thereby promoting land degradation and desertification. In this context, plant functional traits may play a key role in modulating the effects of aridity on ecosystem functioning. This study assesses how functional diversity in *Tamarix* spp. communities responds to an aridity gradient and quantifies the functional consequences for multiple ecosystem services. A total of 40 saltcedar woodlands were sampled throughout southeastern Spain, obtaining a database of abiotic variables, plant functional traits and ecosystem services. Our results show that aridity shapes trait covariation patterns and functional diversity in saltcedar woodlands. Increasing environmental constraints associated with global change drivers significantly affected trait covariation, reducing the number of viable trait combinations within the assemblage, consistent with strong environmental filtering acting simultaneously on multiple traits. Furthermore, our analyses establish the resistance of functional traits in *Tamarix* woodlands under global change and reveal that these species have a high capacity for adaptation to environmental stressors, including increased aridity, high salinity and temperature fluctuations. Finally, we provide a trait-soil model for Mediterranean saltcedar woodlands, linking functional traits to abiotic factors, which enables the assessment of associated ecosystem services. This model may allow identification of communities with low functional redundancy and reduced resistance under future environmental change scenarios.

Floristic Characterization of High-Mountain Semi-natural Grasslands in the Northwestern Cantabrian Mountains

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Mountain semi-natural grasslands in Europe, shaped by centuries of traditional agricultural practices, are biodiversity hotspots that provide essential ecosystem services such as forage production, erosion control, carbon storage, and water regulation. In the Cantabrian Mountains, these habitats are currently threatened by rural abandonment and the intensification of livestock farming. This study aimed to characterize mountain grassland habitats according to their floristic composition, edaphic constraints, and management regimes. In 2010 and 2011, we surveyed 15 alpine mountain pastures subjected to mowing or grazing by sheep or cattle, under a traditional transhumance system, across calcareous and siliceous substrates in the "Babia y Luna" Natural Park (NW Cantabrian Mountains). In each pasture, vascular plant species were recorded in three 10 × 10 m plots, and soil samples were collected for further analysis. Floristic similarity was assessed using hierarchical cluster analysis based on presence-absence data. The cluster analysis revealed a hierarchical community structure shaped by management regime and soil reaction. The primary division separated grazed from mown pastures, while a secondary division within grazed systems revealed a pH gradient. These results suggest that strong abiotic filters, mainly driven by the contrasting bedrock in the area, are

overlaid by management regimes. Accordingly, greater attention should be paid to the consequences that current trends toward the intensification or abandonment of traditional practices such as transhumance (i.e., seasonal grazing of alpine pastures, mainly by shepherded sheep) may have for the preservation of biodiversity in such high-natural-value landscapes.

Looking for general functional diversity patterns in plant communities: a meta-analysis

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

The study of community functional diversity patterns (alpha diversity) has been seen as a promising tool to obtain general insights into the mechanisms involved in plant community assembly. To evaluate the studies carried out in this context in the past ~ 15 to 20 years, we conducted a meta-analysis of results from studies describing functional diversity patterns in plant communities based on null models. We conducted a search in Web of Science, including terms related to: plant functional diversity, richness or evenness, different diversity indices, community assembly, null models, convergence and divergence patterns. From 346 results obtained, we selected 132 papers, from which we extracted data related to the study site, sampling design, abundance measure, trait information, alpha functional diversity index, null models and effect size index used. After conducting preliminary analyses with data from 66 papers, we found that the frequency of trait convergence or divergence patterns varies de-

pending on the functional diversity index used, but also on the trait studied (with seed mass, leaf P, N or C showing convergence patterns more often than traits such as leaf area, for which divergence patterns were more frequently found). Thus, after decades of studies, the original question whether there are general rules governing plant community assembly remains not clearly answered. The results therefore confirm recent suggestions that functional diversity indices based on species means in combination with difficult to construct and potentially naïve null models are unlikely to significantly improve our understanding of community assembly.

Vegetation classification and mapping of Maputo National Park (Mozambique)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Maputo National Park, located in southern Mozambique, supports a heterogeneous mosaic of subtropical coastal ecosystems of high conservation value. However, a comprehensive and detailed vegetation classification and mapping of the park has been lacking. This study aimed to classify vegetation communities and produce a high-resolution vegetation map to support conservation planning and ecosystem management. Vegetation classification was conducted through field surveys using a phytosociological approach. Vegetation data were analysed using Cluster Analysis and Indicator Species Analysis, allowing the identification of 14 vegetation classes, 37 alliances and 45 associations, together with diagnostic species characterizing each group. These results provided a robust ecological framework describing vegetation composition and structure across the park. The vegetation classes were subsequently used to produce an updated vegetation map of the park, by integrating environmental ancillary data and high-resolution Sentinel-2 satellite imagery (10 m spatial resolution). This approach enabled accurate spatial delineation of vegetation units and captured the ecological heterogeneity of the park. To our knowledge, this represents the first vegetation map of Maputo National Park produced at this level of thematic and spatial detail. The resulting map provides critical information to support park management and conservation strategies, including the protection of endemic and threatened plant species, improved fire management planning, wildlife habitat management linked to vegetation distribution, and the identification of biodiversity hotspot areas requiring priority conservation. The study provides an essential baseline for long-term ecological monitoring and a replicable framework for vegetation mapping in subtropical protected areas of southern Africa.

Argania spinosa as a Hydrological Memory System: Linking Root Architecture, Subsurface Water Storage and Spatial Organization

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

This study provides a multi-scale investigation into the ecohydrological adaptations of the drought-tolerant tree *Argania spinosa* in the semi-arid regions of Morocco. By integrating non-invasive geophysical methods, including multi-profile Electrical Resistivity Imaging (ERI), Ground-Penetrating Radar (GPR), and trunk resistivity tomography, complemented by spatial point pattern analysis, we elucidate the intricate soil-root-trunk continuum that underpins the species' resilience. Results confirm that *A. spinosa* operates as a sophisticated "hydrological memory system". Contrary to assumptions of deep groundwater dependence, the tree primarily exploits soil water within the unsaturated zone (0-4 m), where it captures and stores infiltrated rainwater. Time-lapse geophysical monitoring reveals the formation of dynamic, persistent conductive compartments following rainfall events, indicating water storage and gradual redistribution over several months, rather than immediate consumption. This buffered use of a spatially and temporally variable subsurface water reservoir is a central drought-survival strategy. The architecture of this system is characterized by an extensive lateral root network. ERI-derived mapping shows the root influence zone extends radially 8 -10 m from the trunk, significantly exceeding the canopy projection and defining a substantial belowground footprint. Internally, trunk resistivity tomography reveals pronounced hydraulic heterogeneity, with distinct conductive pathways suggestive of optimized water transport and storage capacities. At the population scale, spatial analysis using Ripley's functions indicates a non-random, scale-dependent structure: short-distance inhibition implies belowground competition, while aggregation at broader scales reflects environmental heterogeneity. We translate root architecture findings into management guidelines, recommending inter-tree spacing of 16-20 m for new argan plantations in similar environments.

Vegetation database of Gran Paradiso National Park (Italy)

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

National parks play a key role in biodiversity conservation by protecting habitats and species while supporting the collection of ecological data. Structured vegetation databases provide a solid foundation for environmental management, long-term monitoring, and scientific research. Here we present a vegetation database for the Gran Paradiso National Park, Italy's first national park, established in 1922. The park hosts a rich floristic diversity, including over 1,100 vascular plant species and more than 500 bryophytes, including over 80 Alpine endemics and more than 40 species of conservation concern. This database integrates decades of botanical research through structured field surveys with targeted research projects. Vegetation data was sampled employing different methods. To ensure consistency and interoperability, all records are georeferenced and harmonized. The dataset comprises three interconnected tables: a species-by-relevé matrix, relevés metadata and a EUNIS habitat classification. It includes 853 taxa (816 vascular plants and 43 bryophytes) recorded across 1,203 relevés, largely collected in high-elevation environments above 2,000 m a.s.l. More than 100 species are of conservation concern, and nearly 7% are Alpine endemics. Most relevés were assigned to a EUNIS habitat category, predominantly grasslands. This database provides a robust foundation for phytosociological research and long-term ecosystem monitoring, facilitating evidence-based conservation strategies. The standardized data enable large-scale comparative studies and offer crucial insights into alpine vegetation dynamics under climate change and shifting land-use patterns.

Contrasting responses of dominant and non-dominant species groups underlie community biomass–environment relationships in species-rich grasslands

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

While responses of total biomass to environmental gradients are well studied, it remains unclear which abundance groups, dominant, subordinate, or rare species, drive these responses and whether aggregate patterns reflect species-level sensitivities or emerge from compensatory dynamics. We used vegetation-plot data from species-rich mesic hay meadows, integrating species-specific biomass measurements. We partitioned community biomass into three groups based on relative abundance: dominant, subordinate, and rare species. We used Random Forest and linear mixed-effects models to quantify environmental sensitivity at group and species levels. Spatial biomass stability and compensatory dynamics were assessed using coefficients of variation and species synchrony metrics along soil, climatic, and topography-related gradients. Random forest models for the non-dominant group (subordinate and rare) closely matched the performance and predictor importance of the total biomass model, despite weak and heterogeneous responses of individual species to abiotic gradients. In contrast, dominant species, when considered as an aggregate, showed no detectable environmental signal, whereas they exhibited strong species-specific responses, exceeding those of subordinate and rare species. This apparent mismatch arose from strong asynchrony and compensatory turnover among dominant species along environmental gradients. Non-dominant species responded more synchronously to environmental variation, increasing positive covariance among species. Our results reveal a decoupling between species-level environmental sensitivities and abundance-group biomass responses, demonstrating that community-level patterns emerge from the dominance structure and covariance of species responses rather than from mean species effects alone. Dominant species stabilise biomass through compensatory dynamics, whereas non-dominant species more directly track environmental gradients and thereby govern community-level biomass responses.

Multi-year analysis on climate variability and vegetation spectral indices in the mountain ecosystems of Sardinia (Italy)

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

The study investigates the relationships between recent climate conditions and the response of vegetation in mountain ecosystems of Sardinia (Italy). The anomalous marked decline observed by satellites in the trend of vegetation spectral indices recorded in almost all eastern sectors of Sardinia during 2024 was investigated. The analysis focused on the correlation between the spectral indices extracted from satellite time series (LANDSAT, SENTINEL-2) and climate indicators (2015–2025) derived from data measured by in-situ meteorological stations managed by the Sardegna Clima APS and ARPAS. The climate dataset includes five macro-areas (Sarrabus-Gerrei, Baronia, Nuorese, Ogliastra and Sulcis), and within each, five sub-areas with a prevalent exposure towards East-South-East and five with a prevalent exposure towards West-North-West. Twenty weather stations, one per each sub-area, were considered. Results show a strong temporal coherence between Normalized Difference Vegetation Index (NDVI) and Soil-Adjusted Vegetation Index (SAVI) over the 2015–2025 period: negative anomalies in SAVI almost always correspond to declines in NDVI, although with different intensity and temporal phase. SAVI appears to be more sensitive to surface water stress conditions, anticipating signs of vegetative distress by several weeks compared to NDVI. The combined analysis of precipitations, EO spectral indices (NDVI, SAVI), and reference climatology highlights how the state of vegetation in the investigated macro-areas is not governed by the amount of annual rainfall alone, but by a set of interconnected factors like seasonal distribution of rainfall, thermal stress (and therefore increased potential evapotranspiration), and, above all, multi-year accumulation of water deficit in the soil.

WetFlorVegChange: floristic and vegetation changes in European wetlands.

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

European wetlands are among the most threatened ecosystems, yet comprehensive vegetation-based evidence of their long-term changes remains scarce. Most existing studies are limited to local floristic observations, restricting their ability to identify trends at finer scales. Despite a rapid increase in permanent plots and vegetation resurveys in recent decades, wetland vegetation remains underrepresented in resurvey databases. We present the ongoing project WetFlorVegChange, which analyses long-term floristic and vegetation changes in European wetlands, with particular focus on the past three decades. The project begins by mobilizing existing wetland resurvey data, promoting new data collection across Europe, and establishing a European expert network. Permanent, semi-permanent (quasi-permanent) vegetation plots and localized wetland floristic resurveys will be collected into a newly established working database, "ReSurveyWetlands", which will be integrated into the existing initiative "ReSurveyEurope". We will investigate temporal changes in species composition, richness, and functional and ecological characteristics across major wetland vegetation types. Special emphasis will be placed on comparing trends across regions and habitat types, and on assessing differences between managed and unmanaged sites. Vegetation changes will be analysed in relation to environmental gradients, eutrophication level, human impact, management regimes, and species attributes, including conservation status and alien origin. By explicitly adopting a vegetation science and resurvey-based approach, this project aims to provide a robust framework for understanding long-term wetland vegetation dynamics at the European scale. WetFlorVegChange is currently seeking vegetation-plot data from all wetland types across Europe. Researchers interested in contributing data or participating in the initiative may contact the project team.

Assessing the drivers and patterns of species diversity and composition across a socio-economic gradient in the City of Tshwane, South Africa

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Urban ecosystems are increasingly recognised as novel vegetation systems shaped by both environmental and socio-economic factors. However, in African cities, empirical evidence remains limited. Understanding the multi-faceted drivers of biodiversity in green spaces is critical, especially in rapidly growing urban areas such as the City of Tshwane (CoT) in South Africa, where environmental factors intersect with socio-economic pressures. This study aimed to determine the patterns and drivers of woody and herbaceous vegetation diversity in several urban green spaces (UGS) in the CoT, in order to assess their ecological status. The objectives of this study were to (1) determine environmental drivers of plant diversity, (2) determine the influence of management practices, and (3) determine the influence of socio-economic pressures (unemployment) on vegetation. For this study, UGS refers to nature reserves and open green spaces. Woody and herbaceous vegetation was sampled using standardised plots:20 x 20m for woody species and 2 x 2m for herbaceous species. We calculated species richness, Shannon-Wiener diversity, and Simpson's diversity. Data was analysed using Generalized Linear Mixed Models (GLMMs) with Poisson and Beta distributions, incorporating site-level random effects to account for spatial nesting. The analysis revealed a divergent response between the two vegetation types. Socio-economic status emerged as a primary driver of woody biodiversity, with unemployment negatively correlating with species richness. In contrast, herbaceous vegetation showed no significant response to socio-economic and environmental predictors. The negative impact of unemployment on woody diversity highlights the need for urban conservation strategies that integrate social upliftment with biodiversity management.

Mapping alien-dominated vegetation in Italy: towards a national vegetation framework

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Biological invasions are an increasingly relevant global phenomenon resulting from human-driven environmental change. The establishment and spread of Invasive Alien Species affect multiple ecosystem processes, functions and services, including community composition and biotic interactions, and causes a general deterioration of plant communities. Although our understanding of the distribution of alien plant species in Italy has improved considerably in recent years, only few studies have focused specifically on alien-dominated plant communities. In 2020, a comprehensive checklist of these vegetation types in Italy was published. However, the local distribution of these communities remains largely unknown to researchers and policymakers. To this end, the Italian Society of Vegetation Science (SISV) has launched a cartographic project, which is open to SISV members and any other scholars interested in this subject. The project has two aims: (I) to update and critically revise the checklist of alien-dominated and co-dominated vegetation types, and (II) to produce the first georeferenced distribution maps of these syntaxa across Italy. The data were derived from an extensive review of the literature and a critical reassessment of the phytosociological sources. This was followed by the georeferencing and standardisation of the records within the EEA's 10 km × 10 km reference grid. To date, the database includes more than 1,400 georeferenced data points from over 150 bibliographical references. Such data is crucial for conserving native biodiversity, monitoring invasive species, devising management strategies to counter alien plants, and preserving the habitats in which they grow. The preliminary results of this work are presented here.

Climate and forest structure drive occurrence and abundance patterns of the woody evergreen climbing liana *Hedera helix* in Italian forests

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

In forests, liana species play a key structural and functional role. While large-scale factors such as climatic conditions are expected to influence species spatial niches, local factors such as forest composition and management may modulate liana abundance across forest vertical layers. We investigated how climate, forest composition, and management influence the occurrence and cover of *Hedera helix* (ivy) across multiple forest layers along the Mediterranean–temperate transition zone. We collected vegetation data across seven mountain areas in Italy, for a total of 336 sites and 1,344 plots, and ran mixed-effects models to assess the relative importance of environmental factors operating at different spatial scales. Ivy occurrence and cover across all layers were mainly associated with increases in the minimum temperature of the coldest month, while a higher proportion of winter-deciduous trees exerted a positive effect on its occurrence and cover in all vertical layers except the tree layer. Forest composition and management primarily influenced ivy cover, with responses depending on the forest layer context. Additionally, strong co-occurrence patterns were detected between ivy and deciduous tree species (e.g., *Quercus cerris* and *Fraxinus ornus*), shrub species (e.g., *Rosa canina*, *Rubus ulmifolius*), and understory evergreen species (*Brachypodium sylvaticum*, *Clematis vitalba*). Our findings confirm that climate is the primary determinant of variation in species occurrence, whereas small-scale factors mainly determine species cover across forest vertical layers.

Seasonal eco-physiological and biochemical responses of *Corema album* in Doñana National Park

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Corema album, a dioecious shrub endemic to the Atlantic coastal dunes of the Iberian Peninsula, has gained attention for its ecological and pharmacological relevance. Doñana National Park, one of Europe's most important protected coastal dune systems, provides a key setting to assess its functional responses under natural conditions in the context of Mediterranean climate change. In this study, we aim to understand how seasonal environmental conditions shape the physiological and biochemical functioning of *C. album*, with particular emphasis on the production of phenolic compounds and other bioactive metabolites, linking its ecological stress tolerance with its pharmacologically relevant traits. Seasonal responses were monitored in El Asperillo (Doñana) through an integrated assessment of gas exchange, chlorophyll fluorescence, plant water relations (water and osmotic potential), total phenolics, antioxidant capacity, carbohydrates and metabolomic profiles. Overall, the species showed a marked seasonal adjustment, with higher physiological performance during cooler and wetter periods and a coordinated downregulation during summer drought, accompanied by pronounced declines in plant water status. Preliminary analyses of biochemical traits indicated higher phenolic concentrations in older leaves, while ongoing analyses are expected to clarify biochemical seasonal patterns and their relationship with environmental stress. These results indicate a coordinated link between seasonal physiological responses and phenolic metabolism, providing a new insight into how environmental conditions may influence both plant performance and the production of bioactive metabolites, and contributing to a better understanding of the ecological resilience of this species for its conservation and potential sustainable cultivation.

Oak colonization patterns in Mediterranean environments and determining factors

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

Mediterranean forest landscapes are undergoing significant transformations due to changes in land use and socio-economic dynamics. In this context, understanding the abiotic and biotic factors controlling tree colonization is essential to anticipate changes in vegetation dynamics. Oaks (*Quercus* spp.), dominant late-successional tree species in Mediterranean forests, show contrasting ecological strategies between evergreen and deciduous species, which may determine their colonization success under different environmental conditions. This study aims to analyze large-scale colonization patterns of Mediterranean oak species (*Q. ilex, Q. suber, Q. faginea, Q. pyrenaica, Q. canariensis, Q. pubescens* and *Q. coccifera*) in the Iberian Peninsula and to identify the abiotic and biotic factors that drive their establishment across environmental gradients. We used data from the Spanish National Forest Inventory (SFI3 and SFI4) in secondary forests and reforestations and characterized the presence and abundance of juvenile individuals. Using generalized linear mixed models, we estimated the probability of colonization in response to climatic variables (water availability index, radiation), soil properties (pH, nutrients), forest structure (basal area), and propagule pressure (adult conspecific basal area and cover in the landscape). Our results suggest higher colonization capacity for evergreen species in drier and resource-limited environments, while deciduous species were favored in less extreme conditions and in fertile soils. Propagule pressure was key in facilitating oak colonization. These results improve our understanding of forest dynamics in Mediterranean ecosystems and support restoration and forest management measures aimed at facilitating the recruitment of the most vulnerable species.

Data-driven habitat-based bioregionalisation of the Alps for conservation assessment

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P133

Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Establishing protected areas is one of the most efficient ways to address the biodiversity crisis; nevertheless, countries rarely protect a representative portion of their national biodiversity. To assess whether the European protected area network represents all the diversity of the Alps, we developed a new regionalisation. Then, we evaluated whether the European targets of 30% of land protected and 10% strictly protected in the Biodiversity Strategy for 2030 are reached in all the resulting bioregions. Specifically, we performed a hierarchical cluster analysis based on the structural similarity of the Natura 2000 habitat types as collected from the fourth report of Article 17 of the Habitats Directive. After identifying five bioregions, we then characterised them using the phi coefficient of association and five environmental variables (temperature, precipitation, elevation, slope, and terrain ruggedness). All bioregions show specific patterns for all environmental variables, except precipitation, and the associated habitats are coherent with the environmental ranges. To assess the biodiversity representativeness of the European protected area network, we overlaid the protected areas (all, strict, non-strict, Natura 2000 sites) with the bioregions. Three bioregions are covered by protected areas by more than 30%, reaching the first target of the Biodiversity Strategy for 2030, but none of them are covered by more than 10% by strict protected areas. This new habitat data-driven regionalisation of the Alps is reproducible across other mountain environments, allowing for a new comprehension of the biodiversity distribution of such areas.

The impact of Russian aggression on the Kamyanska Sich National Natural Park

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P101

Type: *Poster*

Subject: *Special Sessions*

Session: *Impact of Military Conflicts on vegetation and habitats*

The Kamyanska Sich National Nature Park has twice been a site of active combat. In March 2022, the territory was occupied by Russian forces; subsequently, during the liberation in the fall of 2022, the front line remained within the park for over a month. Intense fighting during this period caused severe environmental and infrastructural damage, including: widespread wildfires and destruction of tree cover; extensive land mining and unexploded ordnance; physical degradation, such as craters from explosions, fortification construction, and soil compaction by heavy machinery; chemical pollution from fuel, lubricants, and solid waste. Throughout 2023, park staff conducted extensive recovery operations, clearing debris, removing over 20 vehicles, and neutralizing more than 8,000 explosive objects. During this time, damage documentation and preliminary scientific research were initiated. However, the destruction of the Kakhovka Hydroelectric Power Plant dam by the Russian military dealt a catastrophic blow to the park, resulting in the total elimination of its aquatic and wetland ecosystems. By 2024 and 2025, the rapid proliferation of drone technology made field operations impossible due to extreme security risks, as the park sits only a few kilometers from the occupied left bank. In 2025, Russian drone strikes destroyed two park vehicles, and the territory was subjected to remote re-mining. Ongoing shelling continues to cause further destruction and recurring fires.

Scale- and taxon-dependence of mean ecological indicator values

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Type: *Poster*

Subject: *Special Sessions*

Session: *Scaling laws in (vegetation) ecology*

While bioindication with ecological indicator values (EIVs) is very widely used by European vegetation scientists, little is known about how methodological choices affect its accuracy. We thus conducted a comprehensive test comparing plot sizes, taxonomic groups and EIV systems, focusing on soil reaction. For this purpose, we sampled 42 nested plots of 0.1, 1 and 10 m^2, including all vascular plants as well as terricolous bryophytes and lichens across the full range of subalpine and alpine habitats on limestone and siliceous bedrock (grasslands, heathlands, forests, wetlands, sparse vegetation) in Preda, canton of Grisons, Switzerland. We measured soil pH in H_2O from mixed top-soil samples of the 126 subplots. To quantify prediction quality we calculated Pearson's r between measured pH and mean EIV for reaction. We compared mean unweighted EIVs of vascular plants for EIVE 1.5, EIVE 1.0, Tichý et al. (2023), Landolt (2010) and Ellenberg & Leuschner (2010). To test the dependence of prediction quality on taxonomic groups, we compared vascular plants, non-vascular taxa, and all taxa in the two EIV systems that contain non-vascular taxa (Landolt 2010; EIVE 1.5). We found that prediction quality increased with plot size and was highest when combining vascular plants, bryophytes and lichens. Moreover, among the five systems compared, EIVE 1.5 performed slightly better than the others. We conclude that for bioindication studies in Europe, currently EIVE 1.5 without cover-weighting is the gold standard, and it is beneficial to include non-vascular taxa and avoid plots that are too small.

The effects of sustained nutrient addition to local grasslands under different environmental conditions

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P61

Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Nutrient enrichment can modify grassland species composition and ecosystem functioning, yet its effects may vary across environmental conditions. This study investigated the impact of long-term nitrogen (N), phosphorus (P), and potassium (K) addition on plant species composition, diversity, biomass, and soil-related responses under different environments at Ukulinga Farm and Mount Gilboa in the KwaZulu-Natal province of South Africa. The experimental design consisted of a factorial combination of N, P, and K treatments arranged in three blocks, with ten plots per block, including single-nutrient treatments, combined NPK treatments, and controls. Plant species composition and biomass were measured across all plots. Nitrogen significantly influenced species diversity, whereas P and K showed no significant main effects, and no two/three-way interactions were detected. Species richness differed significantly between sites, with higher richness recorded at the lower-altitude Ukulinga site compared to Mount Gilboa; however, nutrient treatments other than N did not affect richness. Species evenness remained unaffected by nutrients or site. Grass biomass responded significantly to P addition, with significant site and Site × P interaction effects, while N and K had no direct effects. Legume biomass was significantly influenced by N, K, and site, with significant Site × N, Site × K, and Site × P × K interactions. Forb biomass showed no significant responses. Overall, nutrient effects were nutrient-specific and site-dependent, highlighting the importance of environmental context in mediating grassland responses to sustained fertilization.

A phylogenetic backbone for global vegetation analyses using sPlot 4.1

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation databases: Expanding the utility of plot-based surveys*

Species co-occurrence data from plot-based vegetation surveys are fundamental to understanding vegetation patterns and, more broadly, ecosystem structure and functioning. Plant diversity at the community level is a key driver of ecosystem resilience and nature's contribution to people. While taxonomic and functional diversity are commonly addressed in vegetation science, phylogenetic diversity remains comparatively underexplored. Nevertheless, it can reveal biogeographic and evolutionary processes underlying community assembly and ecosystem functioning. Here we present the phylogenetic tree of plant species in sPlot 4.1, one of the largest global vegetation-plot databases. The tree was built using the mega-tree GBOTB.extended.TPL.tre, which is based on The Plant List (TPL) phylogeny. This choice ensures compatibility with sPlot, whose taxonomy has been harmonized using the World Flora Online backbone, also derived from TPL. Of the 81,228 valid species recorded in sPlot 4.1, 79,635 were successfully resolved in the phylogenetic tree. Among these, 30,287 species were directly pruned from the mega-tree, while 49,348 were bound either to the most recent common ancestor of present sister taxa or to the half of the family branch. Only 1,593 valid species could not be incorporated because their families are absent from the mega-tree. The phylogenetic tree of sPlot 4.1 is available to sPlot members upon submission of a research proposal and represents a valuable resource for integrating phylogenetic perspectives into large-scale vegetation analyses, thereby advancing our understanding of vegetation patterns and their links to ecosystem processes.

Mapping EUNIS Habitats in the Special Nature Reserve "Gornje Podunavlje" (Vojvodina Province, Serbia)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

The Special Nature Reserve "Gornje Podunavlje" is located in northwestern Serbia and is classified as an IUCN Category IV protected area. It has been designated as an IBA, IPA, PBA, EMERALD, and Ramsar site and forms part of several international conservation networks, including the Mura–Drava–Danube Transboundary Biosphere Reserve. The reserve covers 19,354.81 ha in the Danube alluvial plain. It features lowland Pannonian and floodplain forests intersected by river branches and canals, as well as the Apatin and Monoštor marshes. Before flood-protection embankment construction, vegetation was dominated by marsh ecosystems and willow–poplar floodplain forests, while oak–elm–ash communities occurred on higher ground. Field surveys conducted in 2025, combined with GIS-based analyses, enabled the identification, classification, and mapping of habitat types within the management units "Kolut–Kozara" and "Karapandža," in accordance with the National and EUNIS habitat classification systems. A total of 15 EUNIS Level 3 habitat classes were recorded. Forest plantations of native (*Populus alba*, *Quercus cerris*, *Q. robur*, and *Salix alba*) and several allochthonous species were found to be dominant. Particularly valuable habitats include azonal floodplain forests, old oak stands, and remnants of saline and steppe vegetation. Compared with habitat mapping conducted in 2007, notable changes were detected, especially the shift from open habitat types (Q53, R35, R62) to shrub-dominated vegetation (S35, S92, S93). The best-preserved habitats were identified in unembanked areas influenced by the natural flood regime, whereas embanked sections were characterized by anthropogenically modified forests.

Patterns of ecological specialisation across the Slovenian flora

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation databases: Expanding the utility of plot-based surveys*

Plant species differ in their realised niche breadth along multiple environmental gradients. The degree of specialisation can be estimated from their co-occurrence with other species within the community, using the metric theta, in which Whittaker's (1960) multiplicative beta is used as a measure of beta diversity between the plots containing the focal species. We calculated the Ecological Specialisation Index (ESI) for species of Slovenian flora based on a geographically stratified subset of the Vegetation of Slovenia Database, which contains community samples from 21,473 vegetation plots and 2,511 plant species. To gain a better ecological understanding of the patterns described by the ESI, we compared the values of individual species with several of their attributes. The most specialised species in our dataset were *Vaccinium uliginosum*, *Oxycoccus microcarpus* and *Sarcocornia fruticosa*, whereas the most generalist species were *Poa bulbosa*, *Silene vulgaris* and *Dactylis glomerata*. ESI significantly correlates with the number of phytosociological associations and habitat types in which the focal species occur. In both cases, generalists occur in greater numbers. On average, the species listed in higher risk categories on the National Red List and those considered rare tend to be more specialised. Therophytes tend to be generalists, whereas geophytes and phanerophytes tend to be more specialised. Regarding Ecological Indicator Values, Slovenian specialists tend to be shade-tolerant or heliophilous species that thrive in humid or aquatic habitats and are better adapted to nitrogen-poor and acidic soils.

Nucleation-based restoration initiates community recovery in relict alkaline fens of the Central Apennines (Italy)

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Low alkaline fens (EU Habitat 7230) are among the rarest wetland ecosystems of the Central Apennines, persisting as small relict patches dependent on stable groundwater conditions and traditional management. In the Colfiorito Marsh (Natura 2000 site IT5210072, Central Italy), abandonment of mowing and shrub control promoted the expansion of competitive helophytes (*Phragmites australis*, *Deschampsia cespitosa*, *Phalaroides arundinacea*) and the shrub *Rhamnus cathartica*, causing a marked decline of *Caricion davallianae* communities. Within the LIFE Integrated Project LIFE19 IPE/IT/000015 – LIFE IMAGINE ("Integrated Management and Grant Investments for the Natura 2000 Network in Umbria"), an active restoration program was implemented to re-establish suitable ecological conditions and characteristic fen species. After assessing conservation status, hydrology and vegetation dynamics, restoration actions included: (I) removal of secondary successional vegetation, (II) ex situ propagation of locally collected propagules, and (III) transplanting of target species (*Eriophorum latifolium*, *Carex panicea*, *Carex flava agg.*, *Epipactis palustris*, *Anacamptis laxiflora*). Planting was performed in replicated 5 × 5 m plots using a patch-based scheme (1 tuft m_3^{-2}). Groundwater level and climatic variables were monitored through piezometers. Three years after planting, *Eriophorum latifolium* showed high survival, vegetative expansion and flowering, while competitive tall helophytes were reduced inside restored plots. Early colonization by accompanying fen species indicates the onset of community assembly processes driven by facilitation around planted tussocks. These results show that nucleation-based restoration can effectively trigger recovery trajectories in relict mountain fens, providing a transferable framework for Mediterranean alkaline fen conservation.

Intra-specific trait coordination of above- and below-ground plant economics in lentisk (*Pistacia lentiscus L.*) is driven by land cover

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Type: *Poster*

Subject: *Special Sessions*

Session: *Integrating intraspecific trait variability into vegetation science for improved ecological predictions*

There is still open debate about plant traits coordination between above- and below-ground organs, which understanding is essential for predicting ecosystem processes. Here we evaluated the intra-specific trait variation (ITV) of *Pistacia lentiscus* L. in three main ecosystems of the Pianosa Island, a small Mediterranean island of the Central Italy: abandoned croplands/pastures, macchia, and woodlands. Three plots were established within each ecosystem type where soil nutrient content was measured in 2000 and 2010. Within each plot we selected five individuals, to measure: plant height and specific stem density, leaf area and dry weight, leaf dry matter content, specific leaf area, leaf carbon and nitrogen content. Fine roots (< 2 mm) were sampled up to 30 cm soil depth and we measured: length and dry weight, dry matter content, specific root length, carbon and nitrogen content. Most (60 %) of ITV was captured by a two-dimensional space mostly representing whole plant economics, confirming its relevance for adaptive strategies in Mediterranean vegetation. One dimension reflected leaf economics spectrum, and mirrored ITV changes from open to close vegetation (more conservative leaves vs. fast acquisitive ones). The second dimension represented the fine-root economics spectrum, which was aligned with soil nutrient content, i.e. from more conservative roots in macchia, to acquisitive roots in abandoned crops/pastures. Fine-root changes were mostly reflected at 0-10 cm and for smaller diameters (< 0.05 mm) highlighting higher plasticity for pioneer roots. Our results can help improving models for predicting future vegetation change taking place in harsh environmental conditions.

Floristic changes of vegetation in the Dubrovnik region (southern Croatia) - vegetation re-survey 1944-2024

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Over the past century, global environmental changes, particularly anthropogenic pressures, have significantly altered the vegetation of coastal areas in the Mediterranean. We analysed vegetation changes in one of the most impacted areas of the eastern Adriatic, the surroundings of Dubrovnik. We obtained unpublished vegetation relevés of grasslands, shrubs, and forests recorded by V. Tregubov in 1944 and conducted a re-survey in quasi-permanent plots in 2024. In total, we were able to re-survey 110 out of the original 155 plots. Differences among vegetation types were assessed using Principal Coordinates Analysis (PCoA) ordination, and transitions among vegetation types were visualized using a Sankey diagram. Analysis of vegetation types showed a successional mosaic of progressive and degradative processes, depending on different management practices and environmental conditions. The most changed are *Pinus halepensis* forests, which have been altered above all by urbanisation. Some macchia stands have changed to forests or remained unchanged. Changes in open habitats (*Erica verticillata*, *Inula candida*, *Salvia officinalis* types) are the most diverse. A significant proportion of *Quercus ilex* and *Quercus pubescens* forest plots remained unaltered. Succession in this typical Mediterranean area is slow, but changes are more pronounced due to human impact.

Context matters: village-specific management drives plant diversity in Carpathian grasslands

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Various factors affect plant diversity (PD) in mountain grasslands: topography, soil, agricultural legacy, recent management, subsidy support, farming systems, and local social settings. We conducted in-depth research on grassland vegetation in three Slovak mountain villages (Nová Bošáca, Liptovské Revúce, and Nová Sedlica) to determine how current grassland management practices vary among villages and how they relate to PD. Do management and PD exhibit universal or village-specific patterns? How do farm size and subsidies affect management and, consequently, PD? Is PD primarily driven by current management, or do environmental conditions (soil, topography), social context, and historical land-use legacy exert stronger influence? Relationships among plots based on management were assessed using PCoA with Gower distance, enabling identification of main management-intensity gradients. Relationships between species richness and multiple explanatory variables (topography, soil, vegetation structure, management, social elements, land-use legacy) were analysed using multiple linear regression. We found that management systems differed substantially across the study villages (land-use categories, main management gradients). Socioeconomic factors (farm type, subsidy) exhibited a marginal effect, primarily affecting management practices rather than diversity, with effects strongly context-dependent and village-specific. Across all villages, subsidy effects outweighed farm-type effects, suggesting that agricultural policy has a stronger influence on management decisions than farm size. PD was primarily driven by management intensity rather than management type (mowing vs. grazing) or abandonment. Plots with higher PD tend to exhibit sufficiently high grazing and mowing intensity, low litter accumulation, and minimal mulching, reflecting traditional forms of active management.

The classification of evergreen broad-leaved forests in Japan and summergreen broad-leaved forests in Asia-geohistorical and climatic background

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Type: *Poster*

Subject: *Special Sessions*

Session: *Bringing the different vegetation classification approaches together*

The Japanese archipelago was formed approximately 15 to 26 million years ago when the eastern edge of the Eurasian continent split, separated, and shifted due to active volcanism and tectonic movements. Vegetation has been discussed as sharing commonalities with China, Korea, and the Russian Far East. It is also argued that evergreen broad-leaved forests (EGBL-F), and the EGBL-F culture, spread from Yunnan Province, while summergreen broad-leaved forests (SGBL-F) reached Japan via the Korean Peninsula from northern China and Hokkaido via Far East. This study compares the phytosociologicaly and distribution of EGBL-Fs and SGBL-Fs as well as analyzing geological and climate factors. Japanese EGBL-Fs are classified as a separate class in Asia, the *Camellietea japonicae*. The formation of the Okinawa Island Group in the southern part of the Japanese Archipelago differed in geological history due to factors behind island's uplift. The alkaliphobic *Castanopsis* was unable to occur on the raised coral-reef island, and tropical forest species occur. This vegetation was separated into an order of EGBL-Fs from other regions. SGBL-Fs are classified to the warm-temperate, typical temperate and cool-temperate (mixed coniferous-broadleaved) forests. Chinese beech forests are distributed and remain in the EGBL-F zone. Typical and cool temperate oak forests are distributed north of the warm-temperate deciduous forest zone. Eastern Eurasia is divided into different vegetation zones caused by temperature and humidity.

Drought memory as a mechanism of physiological stability in *Atriplex halimus*

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

Plant performance under climate change will depend not only on intrinsic stress tolerance, but also on the capacity to integrate past environmental experiences into future physiological responses. As recurrent drought events increasingly replace isolated episodes across many regions, understanding how plants adjust to repeated water deficits is critical. Stress memory thus emerges as a central mechanism linking short-term signaling with longer-term functional stability. Xero-halophytes represent a particularly suitable yet underexplored model for addressing these questions, given their natural exposure to strong fluctuations in water availability. Here, we investigated how recurrent drought affects water relations and photosynthetic performance in *Atriplex halimus* L., a perennial shrub adapted to arid and saline habitats. Fully developed plants were subjected to one or multiple drought–recovery cycles to disentangle immediate stress responses from acclimatory adjustments associated with repeated exposure. The first drought event induced a conservative strategy, characterized by strict stomatal control and rapid regulation of plant water status. In contrast, subsequent drought cycles led to progressive physiological reorganization: plants maintained leaf water status, sustained photosynthetic activity, and improved coordination between carbon assimilation and water use. Rather than reinforcing the initial response, stress repetition promoted whole-plant functional acclimation. Hormonal signaling and antioxidant regulation likely underpin this transition from short-term avoidance to longer-term tolerance. Overall, our results demonstrate that *A. halimus* develops an active drought memory that enhances physiological stability under recurrent stress, providing an eco-physiological framework for anticipating vegetation responses in increasingly drought-prone ecosystems.

Restructuring savanna ecosystems: the role of fire following woody thinning

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Selective tree thinning is widely used to control bush encroachment in savanna rangelands; however, its effects are often temporary due to insufficient post-thinning measures to suppress woody regeneration. The use of fire following thinning may enhance long-term control of woody species. This study aimed to: (1) evaluate the effects of fire as a post-thinning treatment on herbaceous vegetation (species diversity, biomass, and rangeland condition); (2) assess impacts on tree seedling establishment; and (3) determine effects on woody plant mortality. In 2018, selective thinning was implemented to reduce woody density (4065 ± 76 plants ha_3 [1] in control plots) to 10%, 20%, 50%, 75%, and 100% woody plant removal intensities (WPRI). These plots were subsequently burned between 2023 and 2024. Herbaceous species diversity did not differ among treatments, likely reflecting dominance by a few common species. However, standing grass biomass and herbaceous cover increased significantly in the 20%, 50%, 75%, and 100% thin-burn treatments compared to burn-only plots. These treatments promoted desirable perennial grasses, including *Digitaria eriantha* and *Panicum maximum*. Thin-burn treatments had limited effects on coppice-based tree seedling recruitment, but seed-based recruitment increased notably under 50%, 75%, and 100% WPRIs. While juvenile tree mortality remained largely unchanged, mortality of large trees increased significantly under 50% and 75% WPRIs, particularly among palatable microphyllous species (e.g., *Vachellia* spp.). Although moderate to high-intensity thinning combined with burning improved herbaceous forage conditions, its application requires careful consideration of trade-offs involving tree mortality, species composition, fuel dynamics, and long-term ecosystem resilience.

Establishment, reproduction and impact of prickly pear cactee, *Opuntia humifusa*, in grasslands of Hungary

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Assessing the invasibility of new alien plant species requires detailed knowledge of their reproduction biology and dispersal capacity. In case of the prickly-pear cactus (*Opuntia humifusa*), appearing in dry grassland habitats in Hungary, there was a lack of information. Thus, our aim was to examine its germination, vegetative propagation and impacts to evaluate the need of effective early control measures. Native to North America, this species has been naturalized in Hungary since 2000 and is becoming an increasingly popular ornamental plant. We performed germination experiments; assessed the speed of vegetative establishment and evaluated the present population size around one of the oldest stands in Kiskunság, Hungary. In addition, we investigated the role of roads and habitats on its distribution; and its impact on sandy grasslands. The species produce viable seeds, which germinate rate is almost 100% under alternating 15/30°C temperatures, on sand. Vegetative shoots developed roots within four weeks. A total of 64 stands were around the first establishment point, and these stands are significantly closer to roads, and significantly more stands are found in dry grassland than at random points of the same density. The characteristics of prickly-pear are significantly different from native species in dry grassland (perennial succulent, C4 photosynthetic pathway, fleshy fruit), thus presence and abundance alter the community composition locally. Although its growth rate is relatively slow, the reproduction is effective, leading to fundamental changes in grassland structure. Thus, there is an urgent need to control this species and to develop an invasion-resistant community.

Enhancing structural heterogeneity in managed forest landscapes promotes gamma but not beta diversity in understorey plant communities

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

Habitat heterogeneity is known to enhance local species diversity, but the effects of management-driven structural heterogeneity on understorey plant communities across spatial scales remain poorly understood, despite their crucial role for forest biodiversity and ecosystem functioning. To analyse how understorey plant communities respond to an experimental enhancement of structural heterogeneity in managed forests, we established 11 sites, each consisting of an untreated homogenous control and a treatment district (ESBC, Enhancement of Structural Beta-Complexity). In treatment districts, we experimentally enhanced forest structure through different plot-scale manipulations of canopy conditions by either gap felling or distributed tree removal in combination with manipulation of deadwood features. Here, we present results from a meta-analysis across these 11 sites using Hill-Chao numbers and sample coverage standardisation. Gamma diversity increased across taxonomic, functional and phylogenetic facets in structurally heterogeneous forests via higher alpha diversity. In contrast, we found no evidence that species turnover among patches (i.e., beta diversity) significantly contributes on average to the increase in gamma diversity. Overall, structurally heterogeneous forests supported higher species richness for both open and closed forest habitat species. Our findings highlight the benefits of enhancing structural heterogeneity for understorey plant diversity in managed forests. Importantly, management strategies that create a spatial mosaic of interventions, such as combining single-tree removal with gap felling, can increase the variety of light niches among forest patches, thereby supporting the conservation of a wide range of understorey plant species, including forest specialists.

Ecophysiological thresholds drive plant strategies and community structure across Mediterranean drought gradients.

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Predicting plant responses to increasing drought remains a central challenge in Mediterranean semiarid ecosystems. Shrubland ecosystems in Doñana National Park (Spain) combine exceptional conservation value with intense climatic and hydrological pressures, providing an ideal model system to investigate the mechanisms driving community shifts and to identify species most vulnerable to drought events. These shrublands span pronounced moisture gradients, across which species exhibit contrasting strategies to cope with water limitation. Along this gradient, evergreen and semi-deciduous species display divergent drought-response strategies, ranging from xerophytic to hygrophytic. Understanding how these strategies relate to performance under drought events is essential for explaining community structure and anticipating ecosystem vulnerability under intensifying drought. We assessed key ecophysiological and functional traits across these communities to evaluate species vulnerability and functional differentiation. Measured traits included leaf relative water content (RWC), minimum water potential ($_{3\,min}$), midday and predawn water potentials ($_{3\,mid}$, $_{3\,pd}$), carbon isotope composition ($_{3}{}^{13}C$), and osmotic potential at turgor loss point (ϖ_{tlp}). We hypothesized that traits associated with water-status regulation would best discriminate drought-tolerant from drought-avoiding species and their distribution along local gradients of groundwater availability. Our findings reveal the ecophysiological mechanisms underlying species vulnerability to increasingly frequent and intense heatwaves and severe drought events. By identifying the key traits that underlie plant performance, we provide a mechanistic framework to predict which species are most at risk and how Mediterranean shrubland communities may reorganize under future climate change.

Spatial patterns of functional and taxonomic facets in the understory of a tropical plant community

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Multiple ecological factors at different scales shape the spatial patterns of plant communities. Determining how these factors structure the taxonomic and functional facets of communities is essential to the understanding of how communities assemble. We investigated the spatial patterns of species abundance and functional structure in the understory of a tropical forest community, and the causes of these patterns along a topographic gradient. We tested the hypothesis that the topography imposes similar spatial structuring scales on both facets. The study was conducted in an Atlantic Forest fragment in southeastern Brazil. We sampled all treelets and shrubs with diameters at breast height between 1 and 10 cm in 100 10 × 10 m plots distributed across valleys, slopes, and ridges. Economic, hydraulic, and reproductive traits were measured in the ten most abundant species (83% of total abundance). Environmental data comprised elevation, slope, terrain curvature, and exposure. We analyzed data using community-weighted means, multi-scale ordination, redundancy analysis, and variation partitioning. The two facets exhibited contrasting spatial patterns, with the taxonomic facet showing a significant spatial structure up to 430 m, while the functional facet was structured only up to 150 m. The fractions of shared spatial and environmental variation were similar across both facets. We found larger patch sizes for the species abundances than for the functional structure, even though the topographic variation similarly constrained both. Functional redundancy and differences in resource-use, hydraulic, and dispersal traits were important in explaining the observed patterns.

Legacy of military activities in Mediterranean vegetation: a phytosociological perspective

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Type: *Poster*

Subject: Special Sessions

Session: *Impact of Military Conflicts on vegetation and habitats*

This study addresses gaps in phytosociological knowledge of the Oštra Peninsula, the southernmost peninsula of Croatia, an area influenced by two centuries of military activity. Strategically located for controlling access to the Bay of Kotor, the peninsula has held considerable military importance throughout history. The peninsula covers 0.93 km^2, with a maximum altitude of 65 m. From a phytogeographical perspective, the area is primarily characterized by meso-Mediterranean evergreen vegetation of the alliance *Fraxino orni-Quercion ilicis*, while southern slopes host communities of *Oleo-Ceratonion siliquae*. A total of 97 vegetation plots (relevés) were recorded between November 2023 and June 2025 using the Braun-Blanquet approach. The aims of the study were to provide new phytosociological data, evaluate the ecological significance of the recorded vegetation within the eastern Adriatic context, and identify vegetation types most closely associated with past military presence in order to support conservation and potential restoration efforts. Stands of the association *Myrto communis-Quercetum ilicis* occupy the largest part of the peninsula. Based on physiognomy and floristic composition, two type of these stands can be distinguished. The first type comprises a group of relevés corresponding to tall (3-5(-8) m), dense, and almost impenetrable maquis with a typical floristic composition characteristic of the eastern Adriatic coast. The second stand type corresponds to a generally lower maquis (mainly 2-3 m), characterized by a pronounced abundance of cultivated and allochthonous species; it therefore exhibits the strongest anthropogenic impact attributable to past military activities.

Assessing the effect of climate change on fir forest communities in south-central Greece

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

The endemic oro-Mediterranean fir (*Abies cephalonica*, *A.* x *borisii-regis*) forests in Greece are ecologically and economically important ecosystems. However, predicted climate change is likely to alter the suitability of many habitats for fir forest growth in the Mediterranean region. This study aims to assess the potential effect of climate change on fir forest communities by quantifying changes in their potential distribution under future climatic conditions. We examined two time periods (2041–2060, 2061–2080) and two climate change scenarios (SSP245, SSP585) to estimate current and future climatic conditions in the study area. Vegetation relevés were classified and ordinated, and recursive partitioning was applied to identify key factors distinguishing the main plant communities and their ecological thresholds. To estimate the future potential distribution of forest communities, we used a species distribution modeling analysis (MaxEnt). The effect of climate change on fir forests varies and depends on the projected period, the emissions scenario, the elevation of the mountain and the forest community type. Our findings suggest that climate change will lead to a reduction in suitable bioclimatic space for fir forests in south-central Greece, with shifts to higher altitudes, particularly under the SSP585 scenario by 2061–2080. The effects will be more pronounced for xerophytic forest communities, which are expected to face greater reductions in their potential range.

AdaptaClimaVeg: A research network assessing the effects of grazing and fire management on reducing wildfire risk under climate change

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

More than half of Earth's land surface is covered by fire-prone vegetation, largely composed of grassy ecosystems. Their flora and fauna have, in general, coevolved with large grazers and fire. However, the risk of wildfires in native vegetation has increased due to more frequent extreme climatic events. Through a research network established as a National Institute of Science and Technology (INCT) in Brazil, where grassy ecosystems originally covered an estimated 27% to 43% of the territory, we aim to investigate how the management of grassland and savanna vegetation affects biodiversity and services, while accounting for wildfire risk under climate change scenarios. Extreme droughts increase the risk of catastrophic fires, particularly following periods of high primary productivity. Under these conditions, grazing management of grassy ecosystems can modulate fuel loads and spatial heterogeneity in biomass, potentially reducing flammability and wildfire risk. Also, best practices in grazing management, either with or without controlled burns, could promote the conservation and sustainable use of biodiversity and ecosystem services. The approach involves an extensive research network, integrating syntheses of existing data, new experimental and non-experimental studies, and simulation models under climate and management scenarios. New experiments will use common protocols to assess at least two grazing levels (grazed vs. ungrazed) and, if pertinent, fire and their interaction. We expect the results to inform national and global public policy on climate crisis adaptation. Our network is open to further collaboration with other research teams interested in contributing data and establishing new experiments to improve global coverage.

The impact of war on cultural heritage sites rich in natural biodiversity (Ukraine)

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Kherson State University

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Type: *Poster*

Subject: *Special Sessions*

Session: *Impact of Military Conflicts on vegetation and habitats*

Cultural heritage sites have been subject to considerable negative impacts caused by the war. Military fortifications (i.e. trenches, observation posts, combat positions) have been built on burial mounds, ancient settlements, and defensive earthworks. As with other sites, old parks are suffering from fires caused by the war. Cemeteries and other sites have been damaged by shelling and bombing. Russian aggression is causing significant damage to Ukraine's cultural heritage sites. At the same time, a significant part of cultural heritage sites are refuges for biodiversity, including protected and endangered steppe species. Simultaneously, in the Kherson region, we studied 194 cultural heritage sites, where 1,147 species of vascular plants have been recorded (about 70% of the total number of species in the region), including 41 protected species (almost 30% of protected species in the region). The surveyed sites included 140 burial mounds (587 species in total and 19 protected species), 18 ancient settlements (512 and 17), 13 old cemeteries (437 and 17), and 23 old parks (515 and 28). 194 sites are located in the combat zone or under occupation. Consequently, the destruction of cultural heritage sites has been demonstrated significant harm to the biodiversity in southern Ukraine.

A resurvey of *Batrachium* communities points to a decline in Mediterranean freshwater habitats over the last two decades

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Freshwater ecosystems: Vegetation from wetlands, mires, and water bodies*

Mediterranean wetlands have been severely degraded in recent decades as a consequence of multiple factors such as eutrophication or land use changes including urbanization, cultivated land and dam construction, among others. Our work aimed to resurvey 43 localities of central Iberian Peninsula in which the white-flowered aquatic *Ranunculus* habitats were previously studied two decades ago. Specific objectives were a) to study the current floristic composition and their relationships with physical-chemical water variables; and b) to identify habitat changes when compared to existing conditions two decades ago. Direct gradient analysis revealed two main drivers in *Ranunculus* communities' distribution: calcium and phosphates water content. *R. trichophyllus* communities were restricted to calcium-rich mineral waters whereas the rest were related to calcium-poor waters. In addition, *R. pseudofluitans* and *R. peltatus* habitats were characterized by lower content of phosphates in the water whereas *R. penicillatus* communities were from more eutrophic waters. An overall habitat change was found in 20% of the localities. It was based on Ranunculus species replacement or disappearance. In some cases, this was attributable to eutrophication of the water or land use change. In other cases, no apparent explainable cause was identified.

Drought effects on the phylogenetic structure in the understory of a tropical plant community

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

Droughts are becoming more severe and frequent due to climate change. Resilience, as a measure of both resistance and recovery, is paramount for understanding how tropical forests respond to drought. However, our understanding of how species' evolutionary histories shape the resilience of tropical forests to drought remains limited. This is especially important for communities in heterogeneous environments, where habitat phylogenetic filtering is more relevant. We determined the resilience of the tropical forest understory plant community to a severe El Niño-induced drought (2015-2016) using phylogenetic community structure. The study was conducted in an Atlantic Forest fragment in southeastern Brazil. In 2013, we sampled all treelets and shrubs with diameters at breast height between 1 and 10 cm in 20 10 × 10 m plots distributed across valleys, slopes, and ridges. We repeated the sampling in 2017, during the drought, and in 2019, after the drought. We calculated phylogenetic distances between species using phylogenetic reconstructions. Principal Coordinates of Phylogenetic Structure (PCPS) were derived from a matrix in which species relative abundances are weighted by their phylogenetic distance. We found that the effects of drought on phylogenetic structure depended on topographic variation. While valleys and slopes remained constant over time, the ridge showed a decline in Malvids followed by an increase in Fabids in 2017. However, the Malvids increased in 2019. The results corroborate previous findings on the role of valleys as climate-change refugia and indicate that ridges in the understory of this tropical forest exhibit phylogenetic resilience to drought. (FAPES, CAPES, CNPq)

How do leaf functional traits change in dry alluvial pioneer grasslands invaded by alien species?

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Anthropogenic ecosystems: from invasions to novel communities*

Invasive species differ in functional traits associated to rapid growth and resource acquisition from native species. As such, due to the mass ratio hypothesis, communities with abundant invasive species should have shifted values of some functional traits from communities dominated by native species. Dry alluvial pioneer grasslands tend to be dominated by species with rapid growth and an annual life cycle. Our aim was to test whether leaf functional traits shift in dry alluvial pioneer grasslands when invasive species are abundant, expecting increased Specific Leaf Area (SLA) and predominant competitive strategy. We analyzed 58 phytosociological relevés of dry alluvial pioneer grasslands previously clustered in two groups: one (28 relevés) with low and one (30 relevés) with high cover of invasive species. We calculated the mean values of SLA, Leaf Area (LA), and Leaf Dry Matter Content (LDMC) based on TRY Plant Trait Database. We calculated the community weighted mean (CWM) trait values and C-, S- and R-scores and tested through a non-parametric analysis of variance whether they differed between the two groups of pioneer grasslands. Even if SLA, LA and C-score seem to be higher in grasslands with abundant invasive species, we did not find any significant difference in the considered traits and in C-, S- and R-scores between the two types of grasslands. Our results suggest that in ruderal communities the impact of invasive species on functional diversity is less evident, probably due to the pioneer character of the native community.

Recent vegetation shifts in Northern Fennoscandia – a systematic review based on long-term evidence from repeated samplings

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Long-term evidence on vegetation responses to global change is increasingly required in the rapidly changing circumpolar regions. Although temporal datasets spanning decades remain generally rare, information is accumulating from certain, well-studied regions, allowing us to synthesize their long-term vegetation patterns and trends. Despite the need to understand how biodiversity has changed around the world, studies at the global, continental and circumpolar scales often fail to reveal regional trends. In this systematic review, we synthesize long-term evidence on vegetation shifts, based on repeated samplings, in the biogeographical region of northern Fennoscandia (covering northernmost Norway, Sweden and Finland, and Kola Peninsula) for the past 100 years. Northern Fennoscandia lies within the transition zone between boreal and arctic vegetation. Although it is a relatively well-studied cold region with several research stations and a long history of experimental studies, long-term vegetation changes based on observational temporal data have not yet been synthesized. We therefore reviewed studies that documented vegetation changes through repeated sampling with a minimum of ten years. Studies focusing on vegetation changes based on only one measure and experimental studies that did not report change within unmanipulated control plots were excluded. Along with synthesizing observed vegetation trends, this review identifies key research gaps and guides future research within the region. The findings are highly relevant for policy, conservation, long-term monitoring, and ecosystem management. Moreover, they facilitate comparison of long-term patterns and trends between this region and other circumboreal and -arctic areas.

Biophysical trait-based vegetation mapping at large scale using Landsat imagery

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Earth Observation of vegetation: Linking in-situ data with remote sensing*

Remote sensing offers extensive opportunities for large-scale vegetation monitoring. However, classifications relying solely on reflectance data may fail to discriminate among vegetation types that, being structurally and compositionally distinct, show similar spectral responses. This study evaluates whether incorporating remotely sensed biophysical traits can improve regional vegetation mapping by reducing spectral convergence. Broad vegetation types (including sparsely vegetated areas and pasturelands, agricultural lands, heathlands and shrublands, broad-leaved forests and fast-growing tree plantations) were mapped across Asturias (NW Spain) within a Google Earth Engine framework. Training data were derived from PNOA orthophotos and validated through field surveys. Spectral predictors comprised visible, near-infrared and shortwave infrared reflectance values extracted from a 2025 Landsat image, capturing information on canopy pigment concentration, structural complexity, and water status. Biophysical traits, including fractional vegetation cover, leaf water content and chlorophyll content, were retrieved from the same image through a PROSAIL radiative transfer inversion, providing proxies for canopy structure and physiological condition. Two Random Forests models were compared: a spectral-only model and a biophysical trait-informed model, including both reflectance and biophysical predictors. Incorporating biophysical traits increased overall accuracy from 0.86 to 0.90. Improvements were most pronounced for heathlands and shrublands ($_3$F1 = 8%). Gains for forests and tree plantations were modest ($_3$F1= 2%) and negligible for sparsely vegetated and agricultural classes ($_3$F1 < 1%). These results show that trait-informed approach enhances the discrimination of functionally distinct vegetation types. While overall accuracy gains are moderate, integrating biophysical traits improves ecological interpretability and supports more robust large-scale vegetation monitoring.

High-mountain Pyrenean mire vegetation dynamics along the Holocene through macrofossils

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

High-mountain peatlands are key archives for reconstructing Holocene vegetation dynamics, hydrology, and climate variability. Our study addresses a paleoecological reconstruction of the Bassa Nera peatland (Pyrenees) based on a macroremain and multiproxy analysis of a 2.7-m peat core covering the last ~10,100 cal BP. Plant macroremains were identified and quantified using the Quadrat and Leaf Count method and integrated with pollen, non-pollen palynomorphs, sedimentary charcoal, loss-on-ignition, and radiometric dating ($^{1}{}_{3}$C, $^{21}{}_{3}$Pb). Five main vegetation stages were identified: (1) lacustrine conditions, (2) shallow-water lake, (3) *Sphagnum*-dominated mire, (4) periodically flooded mire, and (5) recent ombrotrophic *Sphagnum* mire. Vegetation succession generally follows the classical hydrosere model, evolving from open-water macrophyte communities to minerotrophic fens and finally to ombrotrophic hummocks. However, several regressive phases interrupt this trajectory, reflecting abrupt hydrological changes linked to climatic oscillations and allogenic disturbances. A marked mid-Holocene forest retreat coincides with cooler and drier conditions and increased anthropogenic pressure, evidenced by charcoal peaks and declining arboreal indicators. The late establishment of the current *Sphagnum* hummock system appears to be recent and possibly linked to land-use abandonment and modern environmental change. Overall, this multiproxy approach highlights the complex interplay between autogenic peatland development, climate variability, and human impact in shaping high-mountain wetland ecosystems during the Holocene.

The role of snowmelt timing on temporal dynamics and stability in alpine snowbed communities

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Type: Poster

Subject: Special Sessions

Session: Mechanisms of stability: from individuals to ecosystems

Snowbeds, alpine environments where snow lasts until mid-summer, are natural climatic sensors that can inform about the response and resilience of alpine ecosystems to global warming. There, snowmelt timing acts as a key seasonal filter that defines the length of the growing season and affects species selection based on their phenological strategies. Earlier snowmelt associated with climate change may relax this filter, allowing generalist alpine species with contrasting phenologies to establish and potentially reorganize community composition and dynamics. Within this context, we aim at investigating how snowmelt timing and inter-annual variability within and between sites, structure synchrony, and temporal stability in snowbed communities. To do so, we used a multi-year dataset spanning natural snowmelt gradients across several Pyrenean sites sampled from 2013 to 2025. Snowmelt dates followed marked trends across years and locations, largely attributable to climate change. Contrasting patterns in community stability and synchrony emerged along the snowmelt gradient, revealing that snowmelt timing itself —beyond its long-term trends— acts as a primary ecological filter structuring alpine snowbed communities and regulating their temporal dynamics. Inter-annual synchrony was lower in plots with late snowmelt dates and higher variability, and higher where snowmelt date has changed the least during the study period, particularly when the effect of population trends was excluded. By highlighting the effect of a key factor as a driver of ecosystem stability in harsh environments, our study underscores the potential for ongoing environmental shifts to alter not only their species composition but also their dynamical properties.

Mechanistic role of plant community dynamics on ecosystem stability: insights from a long-term grazing experiment in subtropical grasslands.

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Type: *Poster*

Subject: *Special Sessions*

Session: *Mechanisms of stability: from individuals to ecosystems*

Stability is the capacity of ecosystems to maintain ecological processes and services through time in the face of adversities. Primary productivity is a key process in this context, as it is crucial for carbon capture and, in the case of grasslands, for forage production, important ecosystem services. Two main mechanisms explain the role of biodiversity in stabilizing primary productivity within the plant community. I) The capability of certain species to endure major stress (mass effect), and II) the temporal substitution of species composition (compensation effect). To evaluate the role of these mechanisms, we test how the temporal variation in primary productivity (stability) responds to community characteristics, such as diversity, dominance, and temporal variation in species composition, in a grazing experiment spanning six grassland physiognomies in southern Brazil. The experiment was established in 2011, with three grazing management treatments, each consisting of a 70 x 70 m paddock. The plant community was surveyed in 1 to 2-year intervals in 9 permanent plots of 1 m^2 at each paddock. Primary productivity was assessed in exclusion cages and through the Normalised Difference Vegetation Index and other vegetation indices throughout the period. Preliminary results show no relationship between stability and overall species diversity or dominance. We expect to find a positive relationship between the temporal variation in species composition and ecosystem stability, with a weaker trend at the ungrazed paddocks, where the development of taller, woody, and conservative species is expected to enhance stability at the population level.

Comparative metabolomics unravels species-specific and ecological strategy-driven adaptations in halophytes

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Type: *Poster*

Subject: *Special Sessions*

Session: *Integrating intraspecific trait variability into vegetation science for improved ecological predictions*

Salinity is a major abiotic stress limiting plant productivity worldwide. While most crops are salt-sensitive, halophytes have evolved diverse adaptive mechanisms, including anatomical, physiological and metabolic adjustments such as osmolyte accumulation and the development of efficient antioxidant systems that mitigate osmotic stress and oxidative damage. These salt tolerance mechanisms enable them to survive and proliferate in high salinity environmental conditions. However, metabolomic studies in halophytes have largely focused on bioactive compounds discovery for pharmaceutical and nutraceutical purposes or stress-response experiments, while no studies have compared different metabolomic profiles from a functional ecology perspective across contrasting ecological strategies, like xero- and hydro-halophytes, which are classified according to their habitat and biogeographical distribution. Here, we present for the first time a comparative untargeted HPLC–MS metabolomics analysis of six halophyte species representing two ecological strategies: hydrohalophytes, from Atlantic salt marshes (*Atriplex portulacoides*, *Salicornia perennis*, *Suaeda vera*) and xerohalophytes from arid Mediterranean saline habitats (*Atriplex glauca*, *Anabasis articulata*, *Halocnemum strobilaceum*). Three natural populations per species were sampled to evaluate both interspecific differentiation and intraspecific metabolic variability. Multivariate analyses (PCA, PLS-DA) and correlation-based approaches were applied to assess whether metabolomic profiles follow common patterns at the ecological strategy level or were primarily species-specific. Also, metabolic plasticity was evaluated through within-group multivariate dispersion analyses to determine whether some species exhibit broader biochemical variability, reflecting potential adaptive flexibility. Understanding these patterns provides insight into evolutionary diversification under salinity stress and offers valuable perspectives for saline ecosystem conservation and the development of salt-resilient crops under global change.

More of the same? Changes in alpha and beta plant diversity on Europe's mountain tops

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Climate warming drives elevational upward shifts of mountain plants. On summits newly arriving relatively warmth-demanding, widespread species from lower elevations are added to the already established cold-adapted narrow-ranged species leading to an increase in alpha diversity. However, an increase of widespread species and a concurrent loss of narrow-ranged ones also lead to plant communities on mountain summits becoming increasingly similar, thereby promoting thermophilization and biotic homogenization. Using linear mixed-effects models and structural equation modelling we disentangle the influence of temperature and precipitation changes, nitrogen deposition, measures of disturbance, as well as topographic variability on changes in both the taxonomic and functional diversity of alpine plant species on 134 European GLORIA (Global Observation Research Initiative in Alpine Environments) summits monitored in 34 mountain regions over the past two decades. We show that increases in taxonomic alpha diversity were most prominent in the temperate ecozone and accompanied by a small but significant decrease of within-region beta diversity. On boreal summits, beta diversity was also decreasing while alpha diversity was stable. On the more isolated mediterranean summits, alpha decreased significantly, and beta diversity showed a (not significant) increase. We conclude that changes in alpha and beta diversity are not driven by warming alone. Changes in precipitation patterns, airborne nitrogen deposition and land-use changes are additional global change elements that need to be considered, while elevation, (bio)geographic and topographic factors modulate plant diversity responses.

Thriving at the extremes: ecology and evolution of clonality and belowground growth forms across aridity gradients

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Clonal reproduction is often considered advantageous in stressful environments. While considerable research has explored how clonality supports plant survival in wet and cold conditions, its role in arid and semi-arid conditions remains underexplored. To address this gap, this study examines the distribution and diversity of clonality as a key component of belowground growth form (BGF) along aridity gradients across SW and Central Asia using the species-rich Lamiaceae family as a model. Data were collected from 281 species with a variety of BGFs occurring in a broad range of habitats. Data on BGFs were collected primarily in the field, with additional data from herbarium records and digital databases. BGFs were categorized into hypogeogenous rhizomes, epigeogenous rhizomes, stolons, and non-clonal types. Species distribution data were obtained from regional floras and the Global Biodiversity Information Facility (GBIF) and analyzed using precipitation-related bioclimatic variables. Clonal species of the Lamiaceae family, particularly those with hypogeogenous and epigeogenous rhizomes, were more prevalent in extreme environments, both water-limited and moisture-rich, highlighting their adaptation to stressful conditions. They thrived in arid habitats like deserts and semi-deserts as well as wet habitats such as forests or wetlands. Non-clonal species were concentrated in the center of the gradient, dominating montane steppe shrublands where water availability was moderate and seasonally variable. These findings highlight how climate change may differentially affect species based on their BGFs.

A novel method for quantifying the short- and long-term effects of environmental impacts on vegetation community assembly

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Community assembly: Theory and methods in vegetation science*

There is a pressing need for better tools to assess the long-term impact of ecological restoration efforts and other environmental impacts on the assembly and of plant communities. Ideally, these tools should be both flexible and robust – being able to accommodate a wide variety of data types and sampling designs, as well as predictive and grounded in ecological theory; enabling researchers to make meaningful forecasts about community change based on current knowledge about succession processes. Current methods of impact assessment on the vegetation community level, often based on using distance-based methods such as NMDS, typically fall short of most of these ideals. Instead, we present here a new approach to model community successional trajectories using Generalised Latent Variable Models, in which we explicitly parametrize the impact of a treatment (such as a restoration intervention) on both the long- and short composition of the community. Specifically, our model allows researchers to estimate both 1) the initial impact of an event (i.e. restoration) on a plant community, 2) the rate of (non-linear) community change following disturbance, and 3) the community's convergence to a long-term compositional intercept, which can be compared to the intercept of natural reference sites or non-impacted sites. The flexibility of the GLVM modelling framework also makes it simple to relate changes in individual species to changes in the broader community, as well as relating the impact of environmental factors such as soil conditions to the assembly process.

Beyond trees: phylogenetic diversity of climbing plants in the Atlantic Forest

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

The Atlantic Forest Domain is a remarkable biodiversity hotspot in South America, encompassing contrasting forest phytophysiognomies, including sandy, nebular, coniferous, seasonal, and dense rainforests. Most macroecological studies in this domain focused on trees, neglecting other life forms such as climbing plants. Lianas and vines are important forest components, contributing to biomass, forest structure, and food resources. This study investigates patterns and drivers of climbing plant phylogenetic diversity along the Atlantic Forest latitudinal gradient. A species presence-absence dataset was compiled for 215 sites, mostly validated by voucher material. Alpha phylodiversity was assessed using the Net Relatedness Index, and differences among phytophysiognomies were tested by Analysis of Variance. Phylobetadiversity was evaluated through Principal Components of Phylogenetic Structure (PCPS), and its relationships with climatic gradients and phytophysiognomies were examined using model selection. Null models were applied to determine whether these relationships were mediated by phylogenetic and/or taxonomic composition. The dataset comprised 2,047 species, from 364 genera and 74 families. Alpha phylodiversity showed that nebular forests differed from all other phytophysiognomies, exhibiting a clustering pattern, whereas dense rainforests exhibited phylogenetic overdispersion relative to semideciduous and coniferous forests. Regarding phylobetadiversity, the first PCPS was associated with mean temperature and phytophysiognomies, distinguishing coniferous and nebular forests at low temperatures with contrasting taxonomic and phylogenetic composition. The second PCPS was mainly explained by phytophysiognomies, with sandy forests differing in taxonomic composition. These results provide a glimpse into understanding the phylogenetic diversity across the Atlantic Forest. Future steps will explore patterns of phylogenetic regionalization across the domain.

Belowground persistence strategies of native plants found in pastures in the Brazilian savanna

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Tropical ecosystems: Vegetation from the tropics and the subtropics*

The Brazilian Cerrado is a disturbance-prone ecosystem in which species exhibit a wide range of ecological strategies to survive recurrent disturbances. Pastures are highly modified systems created through the replacement of native vegetation, soil disturbance, and the introduction of African grasses. In the Cerrado, pastures already occupy more than 40% of the region and are a major driver of biodiversity loss. Understanding how some native species survive in pastures is essential for improving management and conservation practices. We surveyed woody and herbaceous plants across 266 active pastures in the Brazilian savanna (Cerrado). To classify regeneration and belowground persistence strategies, we combined functional trait data from a literature review with field assessments of 500 specimens representing around 100 native species, excavated to examine their belowground structures. Species were classified as seeders, clonal resprouters, and non-clonal resprouters based on belowground morphology and ecological function. We then evaluated how biophysical conditions, management practices, and pasture history affect species with different strategies. Clonal resprouters were the predominant persistence type in Cerrado pastures, enabling survival under recurrent grazing. Non-clonal resprouters also persisted through specialized structures (e.g., xylopodia, root crowns, and taproots) but were less common in communities, suggesting greater population-level vulnerability. Intensified pasture management significantly altered community composition, favouring woody resprouting species and herbaceous seeders. Examining belowground structures improves our understanding of how native species persist under intensive pasture management, and this knowledge can guide more effective regenerative agricultural practices in this global biodiversity hotspot.

Patchwork legacies: Cattle dung and biocrust shape seed banks in the Dry Mixedgrass Prairie

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Seed regeneration of plant communities*

The soil seed bank is a key demographic stage for many plant species and a major reservoir that structures plant community resilience. While the importance of the soil seed bank is well known, there is little understanding of its spatial variability and the filtering effects that aboveground microstructures provide. We tested how biological soil crusts (BSCs) and cattle dung influence seed bank structure at the microsite level, using the Dry Mixedgrass prairie, in Alberta, Canada, as a study system (n=20 sites). During May 2025, we sampled soil underneath cattle dung, BSCs and bare ground (control). Specifically, soil was sampled across two soil depths (0-5 cm, 5-10 cm) and aboveground, i.e. directly in dung and BSCs, using a soil corer. Inaddition, we assessed the BSC, plant communities, bare ground, and litter. In the next step, weidentified germinable seed bank composition through a germination experiment, which ran forseven months. Our preliminary results show that dung creates micro-hotspots of high seeddensity, likely due to a compacting effect of seeds during cattle consumption and digestion. Bycomparison, BSCs appear to impair the seed bank below them, for example due to mechanicalexclusion or suppression of germination. Our study shows that soil seed banks are spatiallyvariable at the microsite scale and that aboveground microstructure, like BSCs and dung, canhave strong effects on their composition and diversity.

Fire frequency shapes belowground bud bank size and bud-bearing organ abundance in Cerrado

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: Fire-prone ecosystems: Vegetation responses to frequent or periodic fires

The belowground bud bank is an important trait driving the regeneration capacity of savanna vegetation, as resprouting from belowground organs is the main post-fire regeneration strategy in the herbaceous layer. In fire-prone ecosystems such as the Cerrado, understanding how different fire regimes shape the belowground bud bank can support future actions related to savanna management and restoration. Therefore, we quantified the belowground bud bank size and the composition of bud-bearing organs across nine Cerrado sites with different fire frequencies and time since last fire. We hypothesized that the higher the frequency and the lower the time since last fire, the higher the bud bank would be in density and diversity of belowground structures. Areas subjected to higher fire frequency exhibited larger bud banks, mainly due to the forb bud bank. Variations in bud bank size were accompanied by shifts in belowground organ composition: both xylopodia and bud-bearing roots of forbs increased in abundance under frequent fires. Surprisingly, time since the last fire showed no clear relationship with neither bud bank size nor type of organ. These findings indicate that fire frequency, rather than recent fire history, is the main driver of belowground bud bank dynamics in Cerrado. By promoting the maintenance of the regeneration capacity and belowground bud-bearing organ diversity, recurrent fires play a crucial role in preserving the resilience of this ecosystem. Our findings reinforce the idea that decreasing fire frequency would affect savanna resilience and thus, frequent burning is necessary for the conservation of the Cerrado vegetation.

Disentangling elevation-dependent drivers of plant diversity across spatial scales on the Qinghai-Tibet Plateau

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Type: *Poster*

Subject: *Special Sessions*

Session: *Plant biogeography and macroecology in a changing world*

Despite intensive research, it remains poorly understood how multiple factors shape plant diversity across spatial scales in alpine ecosystems where plant diversity often exhibits regular patterns along elevational gradients. To fill this gap, we used data of 758 plots from 338 sites across the Qinghai-Tibet Plateau to explore how climatic, topographic and anthropogenic variables drive alpha, beta and gamma diversity at different elevations by applying multivariate models and structural equation modelling. We tested whether the effects on gamma diversity are through alpha or beta diversity, and whether the results are elevation-dependent to explain maximized plant diversity at the medium elevation. Gamma diversity emerged as an emergent property of alpha and beta diversity. The aridity index was the strongest positive driver, increasing gamma diversity through simultaneous enhancement of alpha and beta diversity. Elevation influenced gamma diversity via both pathways, while inclination contributed primarily through alpha diversity. Driver impacts shifted systematically with elevation: at low elevations (< 3000 m), topographic factors influenced gamma diversity primarily through alpha diversity, reflecting local habitat heterogeneity; at high elevations (> 4500 m), climatic factors dominated, influencing gamma diversity through both alpha and beta pathways. This elevational shift explains the maximized diversity at medium elevations (3000-4500 m), where neither climatic harshness nor topographic constraints are extreme, allowing both local richness and species turnover to contribute optimally. Grazing intensity showed weak effects overall. These findings deepen our understanding of plant diversity drivers across spatial scales in mountain ecosystems and highlight the need for elevation-explicit approaches in biodiversity conservation.

Effect of management on clonal traits and rhizome biomass in wet meadows

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Type: *Poster*

Subject: *Special Sessions*

Session: *The Hidden Half: emerging questions in belowground functional ecology*

Management practices strongly influence wet grassland vegetation and ecosystem functioning, yet their long-term effects on clonal traits and soil carbon dynamics remain insufficiently understood. We assessed the impacts of mowing, fertilization, and their combination on plant community composition, clonal functional traits, and soil carbon in wet grasslands across Central Europe. Using data from a 15-year field experiment at ten wet meadow sites, we compared three management regimes with an unmanaged control. We analyzed plant species composition, clonal traits related to rhizome lateral spread and longevity, belowground biomass, root carbon content, and soil organic carbon. Mowing or fertilization applied individually did not significantly alter species composition; however, both treatments favoured species with greater rhizome lateral spread and higher root carbon content, while reducing species with short-lived rhizomes. In contrast, the combined mowing and fertilization treatment induced opposite trait responses, characterized by reduced rhizome spread and increased persistence. Despite these trait shifts, intensive management had an insignificant effect on total rhizome biomass, indicating high resilience of belowground biomass to long-term management. Site identity explained most of the variation in soil organic carbon and several root traits, highlighting the importance of spatial heterogeneity and microclimatic conditions. Our results emphasize that grassland management primarily affects belowground functional strategies rather than species composition, with implications for long-term carbon storage in wet grasslands.

Fire imprint on Taiwan's subalpine vegetation: how fire regimes override climatic controls at forest–grassland boundaries

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Fire-prone ecosystems: Vegetation responses to frequent or periodic fires*

Alpine forestline are widely attributed to thermal constraints, yet this paradigm often fails at regional scales. In the subtropical mountains of Taiwan, the subalpine zone exhibits a sharp boundary between Taiwan fir (*Abies kawakamii*) forests and Yushan cane (*Yushania niitakayamensis*) grassland-like scrubs. This mosaic vegetation structure cannot be adequately explained by low-temperature limitation alone, suggesting the involvement of non-climatic processes in shaping forest–grassland boundaries. To quantify the extent and establish the theoretical climatic treeline, we employed the species distribution model (SDM). Using SDM, we show that large areas currently occupied by dwarf bamboo vegetation remain climatically suitable for Taiwan fir, indicating a pronounced mismatch between the observed forest limit and the theoretical climatic treeline. Previous studies have proposed several mechanisms to explain this discrepancy, among which fire disturbance is most frequently mentioned. We hypothesize that fire regimes, rather than temperature, are the primary drivers maintaining this boundary. To evaluate this mechanism, we developed a system dynamics model integrating vegetation growth, interspecific competition, and fire disturbance to simulate successional dynamics. Model simulations identify a critical fire threshold that governs vegetation trajectories. Frequent or high-intensity fires promote the persistence of bamboo grasslands and inhibit forest establishment, whereas low-frequency or low-intensity fires create transient recruitment windows that allow fir seedlings to establish and expand. These results demonstrate that fire regimes can override climatic suitability and act as the dominant regulator of long-term succession in Taiwan's subalpine ecotones, highlighting disturbance history as a key factor shaping alpine vegetation dynamics under climate change.

Morphological and chemical traits show contrasting turnover and intraspecific responses to environmental gradients in Caatinga dry forest

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Type: *Poster*

Subject: *Special Sessions*

Session: *Integrating intraspecific trait variability into vegetation science for improved ecological predictions*

In Caatinga dry forests, characterized by strong seasonality and low and highly variable rainfall, the precipitation, chronic anthropogenic disturbance (CAD; integrating human pressure, livestock, and timber extraction), and soil fertility (linked to organic matter content) can be key drivers of plant community formation, but little is known about their role in inter- and intraspecific trait variation. Here, we investigate how species turnover and intra- and interspecific trait variation mediate the morphological and chemical responses of woody plant communities to gradients of precipitation, soil, and anthropogenic disturbance. The study was conducted in 19 plots, partitioning total functional trait variation into three components: (I) turnover (species replacement along environmental gradients), (II) intraspecific variation (ITV; phenotypic variability within populations), and (III) covariation (interaction between these strategies shaping community responses). Our results indicate that precipitation is the main driver of functional variation in the woody community, acting primarily through species turnover in structural traits such as wood density (WD) and plant height (H), while intraspecific variation (ITV) was more pronounced for chemical traits, such as branch carbon concentration. Soil mainly influenced specific leaf area (SLA) via turnover, whereas chronic anthropogenic disturbance (CAD) showed no effect, suggesting the influence of other unmeasured environmental factors. Overall, these findings show that turnover and ITV act complementarily in shaping community functional structure and regulating ecosystem in Caatinga dry forests.

Biodiversity tipping points in traditional mountain pastures in South Tyrol

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Type: *Poster*

Subject: *Ecosystem-focused topics*

Session: *Cold-driven ecosystems: Alpine, arctic, and mountain vegetation*

Traditional alpine pastures are high nature value ecosystems shaped by extensive livestock grazing dating back to pre-roman times. However, recent changes in grazing management have altered biodiversity, soil properties, and ecosystem functions, threatening long-term sustainability. While intensification has occurred in lowland areas, less accessible pastures face abandonment, leading to shrub and tree encroachment and biodiversity loss. In sheep farming, management has shifted from flocking and accompanied grazing to mainly free-range grazing, creating a more heterogeneous impact on pasture habitats. To anticipate and mitigate these effects, it is crucial to identify potential ecological tipping points and their indicators. This study examines the impact of different grazing management types —(I) homogeneous rotation grazing, (II) heterogeneous free-range grazing, and (III) pasture abandonment— on vegetation and soil parameters in South Tyrol. We select three plots per management type across four sites, assessing plant indicator species of reduced management, vegetation composition, and soil physico-chemical soil properties. We hypothesize that reduced grazing management alters biodiversity in South Tyrol's pasture systems, leading to a stepwise shift in vegetation communities. We expect to identify threshold values connected to soil parameters and plant diversity that signal tipping points in pasture conditions. Our findings will contribute to sustainable management recommendations for mountain pasture ecosystems in South Tyrol and facilitate their application by sharing insights with farmers and stakeholders.

Reorganization of alpine communities in central Italy after 60-years resurvey due to climate change

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Long-term vegetation dynamics: Insights into the past*

Alpine and subalpine grasslands are sensitive indicators of global change. Monitoring how these communities respond to rising temperature, change in water regime and management is crucial for understanding the ongoing trends of biodiversity. In this study, we provide an assessment of vegetation changes on the Gran Sasso massif (Italy) over 62 years by resurveying in 2009 and 2024, a set of 25 phytosociological relevés of different alpine communities, originally sampled in 1962. We analyzed community-specific trends by fitting hierarchical models (GLMMs). Diversity indices and Ellenberg indicators (EIVs) were moreover tested across two elevation belts (low and high alpine), accounting for species' altitudinal preferences (i.e., alpine, subalpine, montane, euryecious). Our analyses reveal a significant increase in total, montane and euryecious species richness in the low alpine belt. At these same altitudes, despite some community-specific idiosyncrasies, we detected a general increase in the temperature EIV. This warming trend is accompanied by a decrease in the moisture indicator observed across multiple communities in both altitudinal belts. Plots from the high alpine belt maintained stable richness and showed a qualitative reorganization towards more balanced communities (increased Evenness). Our findings indicate that climate-driven warming and drought have triggered an ascent of species from lower altitude (montane and euryecious) into the alpine, with no significant rate of extinction of high-altitude species. Rather than an "escalator" effect, the observed changes suggest a reorganization of high-altitude communities.

Monitoring ecological restoration of Mediterranean alder forests in the international Tagus River Basin (Spain and Portugal) under the project LIFE Alnus Taejo

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Type: *Poster*

Subject: *Cross-cutting topics across ecosystems*

Session: *Vegetation restoration and management*

The LIFE ALNUS TAEJO project – "Conservation and restoration of Mediterranean alder forests, priority habitat 91E0*, in the International Tagus River Basin" – aims to conserve and restore riparian ecosystems dominated by alder (*Alnus glutinosa*), promoting their natural regeneration and ecological connectivity along 513 km of watercourses within the international Tagus River Basin (Spain and Portugal). Within the scope of the project, a detailed ecological characterization was carried out, including the assessment of the river habitat index, riparian woodland connectivity, environmental pressures, as well as phytosociological surveys and vegetation mapping. This mapping enabled the delimitation of areas invaded by exotic species, mainly *Acacia dealbata* and *Arundo donax*, which are considered among the main pressures affecting these ecosystems. Based on this diagnosis, ecological restoration actions were implemented, consisting mainly of invasive species control and the planting of native species characteristic of the riparian geoseries *Scrophulario scorodoniae-Alnetum glutinosae geosigmetum* and *Galio broteriani-Alneto glutinosae geosigmetum*. Permanent monitoring plots were established in the restored areas, where changes in floristic composition were recorded, including both native and invasive exotic species, using the Braun-Blanquet abundance scale. This study presents the results of monitoring these interventions, comparing biodiversity

trends with control plots established in reference alder stands close to the target ecological conditions. The survival and growth of planted individuals were also quantified. This work contributes to improving knowledge on the distribution and impact of invasive species, as well as to the definition of effective conservation measures for Mediterranean alder forests in the Tagus River Basin. It also highlights the importance of continuous monitoring to ensure the success of alder forest restoration.

Key-words: invasive alien species (IAS), riparian ecosystems, habitat 91E0, Tagus river basin, Vegetation monitoring, ecological restoration

Climate-driven vegetation shifts in Mediterranean evergreen forests under long-term experimental manipulation

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P208

Type: *Poster*

Subject: *Drought-driven ecosystems: Arid, semi-arid, and seasonally dry vegetation*

Mediterranean forests are expected to undergo profound compositional changes under future climate scenarios characterized by increasing aridity and altered nutrient availability. However, detecting early signals of vegetation reorganization remains challenging, particularly in long-lived woody communities. In this study, we examine whether long-term climatic manipulation can trigger a shift in species dominance in a Mediterranean evergreen forest traditionally dominated by Quercus ilex. The study is conducted in the Prades Mountains (NE Iberian Peninsula), within a long-term experimental site where climate change is simulated through partial rainfall exclusion and nitrogen fertilization, reproducing conditions projected for the coming decades. We focus on the relative performance of the dominant tree species Q. ilex and the drought-tolerant shrub species Phillyrea latifolia and Arbutus unedo, which coexist in this system and exhibit contrasting ecophysiological and demographic responses to reduced water availability. To assess vegetation shifts, we analysed individual mortality and growth rates of the dominant species, integrating these data with measurements of ecophysiological functional traits linked to climate-change responses. Functional changes at the community level were quantified using community-weighted means and functional diversity indices and related to experimental treatments and continuously monitored microclimatic variables. Our results indicate early signals of a shift from tree-dominated forest structures toward increased shrub dominance under drier and more nutrient-enriched conditions, suggesting that species-specific responses to climate change may drive a profound reorganization of Mediterranean forest communities. These findings highlight the value of long-term manipulative experiments for anticipating vegetation shifts and for understanding future trajectories of Mediterranean ecosystems under climate change.

Vegetation remains, specialist species fade: changes in Pannonian sand grasslands

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Inland sand grasslands are highly threatened habitats in central Europe and the Pannonian biogeographical region and harbour several specialized and threatened species adapted to dry, nutrient-poor sandy soils. The area of these grasslands decreased dramatically in the 19th and 20th centuries. Although many remaining patches have been included in protected areas, changes in these plant communities may have occurred due to environmental changes and altered management practices. To assess temporal vegetation changes in sand grasslands in the Vienna Basin (Czech Republic, Slovakia and Austria), we resurveyed 86 vegetation plots in 2023–2024 that were first sampled between 1952 and 2010. We compared changes in species composition, species richness of vascular plants, proportions of specialized, ruderal, threatened, alien and woody species and ecological indicator values among three main vegetation types of sand grasslands (pioneer, acidophilous and basiphilous). The results indicate that the main types of sand grasslands in the Vienna Basin have persisted over recent decades. However, specialized species of sand and dry grasslands and species adapted to grazing have declined. In contrast, species with higher nutrient and moisture requirements have increased. This indicates an effect of eutrophication and natural succession following the abandonment of previous management. The decline in sand specialists was most pronounced in the pioneer sand vegetation, where species with higher Ellenberg-type indicator values for temperature also decreased, indicating a transition to more closed sand grasslands. These results indicate that appropriate conservation management and future monitoring are needed to maintain the habitat quality of inland sand vegetation.

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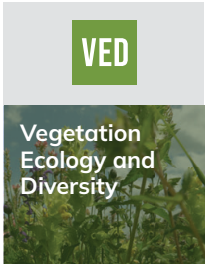
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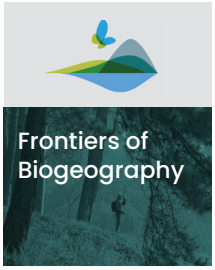
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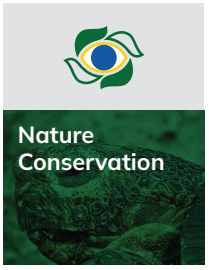
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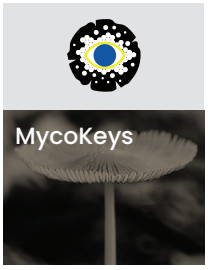
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