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Plenary talks

Beyond trees: the multi-taxonomic diversity of European forests

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The implementation of silviculture has a significant impact on forest biodiversity. Despite the promotion of sustainable forest management, in Europe, sustainability indicators rarely directly account for the diversity of multiple taxonomic groups. The sampling and analysis of multi-taxonomic biodiversity rely on exhaustive censuses of species belonging to different taxonomic groups and require a certain amount of financial and time resources, as well as a broad range of expertise. The challenges posed by such sampling efforts have been repeatedly addressed at local or regional scales to assess the effects of forest structure and management on multi-taxonomic diversity. Nevertheless, these scattered and heterogeneous information have never allowed broad scale syntheses. This presentation starts from a recent European project, i.e., Bottoms-Up, focused on multi-taxonomic forest biodiversity to discuss the challenges ahead of us in terms of methodological standardization (1), definition of sustainable management indicators and thresholds (2), analysis of the forest management effect on ecosystem biodiversity and functioning (3). The Bottoms-Up project has: i) collected and harmonized existing information on multi-taxonomic forest biodiversity associated with structure and management; ii) identified knowledge gaps in forest biodiversity research; and iii) assessed the sustainability of forest management for biodiversity using different approaches. The project started from a European research network that harmonized 34 datasets containing data on species presence/absence and abundance, the dimensions of standing trees, and deadwood on the ground, with metadata including spatial coordinates, applied management, and references to conservation value habitats at the single sampling unit level. To date, information is available for 3,591 sampling units (4), surveyed on average for 4.6 taxonomic groups. The available data cover all 14 compositional categories defined by the European Environmental Agency, although not uniformly, with beech forests overrepresented compared to thermophilous and boreal forests. The platform developed so far has great potential to guide the development of conservation strategies and sustainable forest management in Europe by supporting: i) methodological harmonization and coordinated monitoring; ii) the definition and testing of sustainable forest management indicators and thresholds; iii) the assessment of the effects of environmental and management factors on the biological and functional diversity of forests.

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Cities as a human contribution to the diversity of nature

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Cities are the fastest growing ecosystem globally. Urban environment is created and altered by humans, which leads to the loss of natural habitats. In contrast, cities are areas where the emergence of new human-made habitats is coupled with high rates of introduction of non-native species. This results in novel plant communities with new species combinations. Plant species in urban environments are influenced by multiple factors, such as land-use types and their spatial distribution, climatic, edaphic, and socioeconomic conditions, disturbance, and other stochastic processes. Cities are also transportation hubs, facilitating species dispersal from one city to another and spreading urban-tolerant species across the globe. In my talk, I will present a new global dataset of urban flora which was built as an initiative of the GUBIC consortium. This dataset contains data from 553 cities across 61 countries and includes 66,362 species. Using this source and additional data, I will detect centres of urban biodiversity and identify the determinants of the patterns. Further, I will show that native and non-native species use different functional strategies in urban environments.

Zonobiome System for Europe

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Building on the Biodiversity of Encyclopedia (2024) chapter on Ecosystem of Europe (ref. 1), I present a new zonobiome scheme for Europe. A zonobiome is the highest-level biome (zonal functional biotic community and its environment). Zonality of the zonobiomes rests in the nature of the drivers of functional patterns and processes, including the global-scale cosmic (sun) forcings underpinning the thermic patterns (hence re-distribution of energy), which, in turn, shape the patterns of re-distribution of water (precipitation – amount and seasonality) on our planet. The global ecological templet based on temperature and water is also known as the Schimperian World. Europe is situated on the land-dominated Northern Hemisphere and spreads over 47 degrees of latitude (81 to 47 deg. N), including the cold, polar and warm-temperate mediterranean realms. It borders on two major ocean and spans regions of maritime and deep continental realms. The well-established (and paradigm-reigning) zonobiome system of H. Walter (ref. 2) recognizes 5 zonobiomes. It makes provisions for recognition of zonoecotones (regions of transition between the zones), however those have never been properly mapped. The new zonobiome system for Europe, part of the Global Biomes System as defined by Mucina (2023, ref. 3), recognizes most of the H. Walter's zonobiomes, under different names and codes, incl. A1 Arctic Zone (= Walter's ZB IX), B1 Boreal Zone (= ZB VIII), T1 Nemoral Zone (= ZB VI), S1 Ethesial Zone (= ZB IV), and G1 Northern Steppe Zone (= ZB VII). It splits, however, the maritime regions of the ZB VIII and ZB VII as a zonobiome in its own right – B2 Oceanic Boreal Biome and T3 Oceanic Temperate Zone, respectively. These new zonobiomes have been recognized on both hemispheres already (ref. 3). Further, the most continental, semi-desertic ecosystems of the European part of the Caspian Sea Basin has been assign to a new zonobiome G2 Continental Cold Zone (ref. 3). The hot/warm deserts (S2 Hot Arid Zone) and warm-temperate forests (T4 Warm-Temperate Forest Zone) occur in Europe (defined politically) only in Macaronesia. The ecosystems of the alpine zone (above the timberline) in Europe are considered extrazonal of the A1 Arctic Zone; the position of the oromediterranean vegetation in the global biome system remains contentious. Southern Spain is home to a small, yet bioclimatically and vegetation-wise significant ecotonal patch (Almeria coastal semi-desert) classified as ZE S1–S2. Some zonoecotones, for instance ZE B1–T1 (hemi-boreal forest zone) and perhaps also ZE T1–S1 (submediterranean forest zone) and ZE T1–G1 (forest-steppe zone) are pretty well defined in bioclimatic terms and are also easily mappable. Other zonoecotones are awaiting further enquiry and proper definition and they might included ZE B1–B2, T3–S1 and perhaps the most difficult one – ZE T1–T3. Europe is home to very variable and in places (especially in the higher latitudes) also extensive azonal biomes. Because of their occasional link to the zonobiomes (the case of intrazonality), for comparative purposes, these will also be briefly featured.

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Ten years of plant functional biogeography: what are we gaining?

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A decade ago, Violle and colleagues proposed and conceptually formulated functional biogeography, which is defined as the study of the spatial distribution of organisms' forms and functions (1). It emerges from the integration of several fields, spanning from population biology to Earth science. The main goal of functional biogeography is to examine the geographic distribution of trait diversity across organizational levels – synthesized in its three tenets "describe, explain, predict". Traits therefore constitute the key conceptual and analytical tools of this integrated discipline, which has been applied in different contexts and at different scales. Studies range, for instance, from examining intra- and interspecific persistence trait patterns of specialist species of distinct habitat patches embedded in a dissimilar landscape matrix at local scales (2) up to continental or global analyses of entire species assemblages/floras, e.g. with the aim to better understand the latitudinal gradient of diversity (3). In this talk, I will make an overview of advances, developments and implementations of functional biogeographic approaches made in the past 10 years, focusing on plants – presenting some findings from my own collaborative research on insular systems, bioregionalization, conservation and fire ecology. I will also discuss the importance of: i) a sound trait selection, which should be justified from a biological, functional and evolutionary standpoint and tailored to tackle the specific questions of each research, ii) considering the multidimensionality of plant functioning [hence taking into account that traits can co-vary forming coordinated syndromes], which plays out both aboveground and belowground and can interact to shape plant forms, functions and distribution. I will conclude by identifying open challenges and gaps in plant functional biogeography that I consider most pressing and that, at the same time, constitute exciting avenues for future exploration to address fundamental eco-evolutionary questions.

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Community Phylogenetics in Vegetation Science: Past, Present, and Future

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Community phylogenetics (CP) has emerged as a powerful framework for understanding plant community assembly, ecosystem functioning, and biodiversity responses to global change. By integrating evolutionary relationships into vegetation studies, CP provides insights into the ecological and historical processes shaping species coexistence. Initially, CP focused on distinguishing between environmental filtering and competition, but the field has since expanded to address broader questions in vegetation science. This keynote will explore the evolution of CP, highlighting its contributions to understanding plant community structure across environmental gradients, its integration with functional traits, and its application in conservation planning. A growing body of research has demonstrated that CP can reveal patterns of phylogenetic homogenization, shifts in evolutionary distinctiveness, and the resilience of plant communities under anthropogenic pressures. I will present examples to illustrate how CP can be applied in long-term vegetation studies, particularly in resurveyed plots across diverse habitats. By examining how plant communities have changed over time, we can assess whether species loss is eroding evolutionary diversity, whether global change is favoring particular evolutionary lineages, and how phylogenetic metrics can complement traditional biodiversity assessments. These approaches are particularly relevant for understanding vegetation dynamics in ecosystems at their biogeographical and ecological limits. Looking ahead, the future of CP in vegetation science will likely involve increased integration with functional trait databases, remote sensing, and macroecological datasets. New analytical tools allow researchers to explore the interplay between evolutionary history and ecosystem functioning at multiple spatial and temporal scales. However, challenges remain, including the need for more resolved plant phylogenies, better linking of phylogenetic and functional diversity, and refining CP methodologies for long-term monitoring. By synthesizing past advances, current applications, and future directions, this talk will provide a critical perspective on the role of community phylogenetics in vegetation science. As global change continues to reshape plant communities, evolutionary perspectives will be essential for predicting biodiversity responses and informing conservation strategies

Aftermath

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In traditionally-managed meadows in the UK, the aftermath (from Anglo-Saxon *maeð* = to mow) refers to the regrowth of herbage after the hay crop has been taken. After the splendour of the meadow flowers, the grassy aftermath looks dull but holds some prospect of future fertility. As an end-of-season ecologist myself, I will review some past rich harvests in my long career, some crop failures, how best to manure the ground, some happy collaborations in the harvesting, and how to pass on our experience to newcomers working in the field. At a time of threatening environmental and political change, the EVS will be increasingly important as a forum for Europe-wide sharing not only of projects and data but also of such past experience and hopes for the future in the field of vegetation science and beyond.

Talk Sessions

Overview of dune vegetation in the Gulf of Lion (France)

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Coastal dunes are highly dynamic ecosystems that provide significant benefits to people but face intense pressure such as coastal erosion, mass tourism, climate change, etc. As a result, they are frequently prioritized for conservation. Several ongoing conservation programs in France require the precise identification of dunes vegetation types. As coastal dunes are home to a very specific vegetation, it is essential to produce dedicated tools such as identification keys. To achieve this, clearly delineated vegetation units and well-defined distinguishing criteria are needed. This talk will focus on the vegetation of the Gulf of Lion which hosts a large proportion of France's Mediterranean coastal dunes. The study begins with an extensive bibliographical review of dune vegetation relevés, followed by their digitization. The validity of previously published names is then assessed in accordance with the latest edition of the International Code of Phytosociological Nomenclature. More than one thousand dune vegetation relevés – both published and unpublished – have been analyzed using k-means clustering, based on a hierarchical classification performed with Wards method. Dissimilarity was computed using the Bray-Curtis index. The resulting clusters are compared with previously published syntaxa to see if they fit concept-wise or if they contain a nomenclatural type. The distinctive floristic features of each syntaxon are identified and structured into a determination key inspired by the hierarchical classification. Most classical syntaxa in use are confirmed, sometimes with slightly different diagnostic species or characteristic species combinations. Additionally, previously undescribed plant communities have emerged, some of which require further field investigation before formal description. The syntaxonomic position of certain units is also questioned. *Loci classici* of the different syntaxa are identified adding scientific value to already remarkable natural sites. The final step, set to begin this field season, involves testing the identification tools *in situ* to assess their accuracy and ease of use. Beyond its immediate application on the field, the determination tools could serve as a reference for ecological monitoring, natural areas management and new conservation programs.

Not just aliens: Why we need to worry about native expansive plants

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Alien plant invasions have been systematically studied for more than half a century and we already have extensive scientific evidence of their negative role in the current biodiversity decline. Here we aim to draw attention to expansive plants (also called native invaders, super-abundant natives), i.e. native plant species that exhibit similar ecological behaviour to invasive alien plants, being promoted by recent environmental changes. Some of them can also have negative impacts on native plant communities. However, they have been much less studied than alien species. Our goal was to create an up-to-date catalogue of expansive species (including aggregates or subspecies where needed) in the Czech Republic, compare their functional traits and ecological strategies with non-expansive native species and provide a list of regions and habitats where they spread. We conducted a questionnaire survey, asking local experts to evaluate the expansive character of preselected species in 17 regions and 27 broadly defined habitat types (66 regional assessments). We critically revised these data and verified the distribution patterns. In total, we identified 126 expansive taxa (116 species, 8 species aggregates and 2 subspecies, for simplicity referred to as species) from 43 families. The most represented were *Poaceae* (27 species, i.e. 21%, while only 7% in the native flora), *Asteraceae* (10 species; 8%) and *Rosaceae* (10; 8%). Our list comprises a heterogeneous group of plants, which tend to be taller and are more frequently polycarpic perennials than the non-expansive native species of the Czech flora. The highest numbers of expansive species were reported at middle elevations. Thirteen species were considered expansive in all regions: *Aegopodium podagraria*, *Alopecurus pratensis*, *Anthriscus sylvestris*, *Artemisia vulgaris*, *Betula pendula*, *Calamagrostis epigejos*, *Dactylis glomerata*, *Elymus repens*, *Phalaris arundinacea*, *Poa trivialis*, *Rumex obtusifolius*, *Trifolium pratense* and *Urtica dioica*. Expansive species were most frequently found in anthropogenic habitats, both non-forest (99 species) and woodlands (including plantations and clearings; 73), as well as in mesophilic meadows and pastures (64) and wet meadows (60). We hope that the presented list of expansive plants will trigger further research on them and their potential impacts on plant communities and other biota.

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The role of plant traits in shaping fire-prone communities

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Across fire-prone ecosystems, different fire regimes can be found, reflecting a combination of climatic factors and of different plant species characteristics. Ecosystem flammability and fuel load are the most evident and well-studied plant aspects influencing fire regimes, which are also used in modelling predictions of fire occurrence probabilities and of fire regimes under future scenarios. Here we will focus on how other plant traits, and especially fire responses, shape the fire regime and the overall ecosystem resilience in different ecosystems and for various climates around the globe, with a focus on the European Mediterranean biome. Based on a combination of statistical and mathematical modelling, this research showed that plant trait syndromes were fundamental in determining fire regimes and the occurrence of different plant communities under the same climatic and environmental conditions. Specifically, when the strongest competitor had a very strong fire response, only one ecological state could be achieved. Conversely, when the strongest competitor was poorly fire adapted, alternative ecological states emerged—for example, between tropical humid savannas and forests or between different types of boreal forests. In the Mediterranean basin, projected increases in aridity, by limiting post-fire recovery, may reduce the resilience of the forests against fires and potentially drive post-fire ecosystem dynamics to tip into open shrublands. These findings underline the importance of including the plant fire response when modeling fire ecosystems, for example, to predict the vegetation response to invasive species or to climate change.

A country-level assessment of long-term habitat changes in Hungary since the 18th century

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The importance of historical changes and long-term processes is increasingly recognized in ecology. As the number of habitats and species in Europe continues to decline despite the growing conservation efforts, it is essential to understand the interacting direct and indirect drivers that influence ecological processes and biodiversity in different contexts. Despite being a key driver of biodiversity decline, habitat loss is mainly assessed over short-term and in aggregate vegetation categories or biome level (e.g. grasslands or tropical forests). Our aim was to estimate long-term habitat-level changes: loss, trajectories, and drivers of Natura 2000 habitats since the 18th century. We also assessed country-level grassland and forest cover loss with continuity analysis using a 200 years long time-series database. We built a country-wide geoinformatical database that contains habitat-level site histories in 5000 randomly selected localities for seven time periods since the 18th century. Habitat estimation was carried out using iterative information transfer between historical and recent sources, for which we developed a point-based method that helped overcome problems caused by the large size of the studied area, the topographical inaccuracies, and data inequalities. To ensure a more accurate habitat level interpretation for the 18th century, we reconstructed the exact locations of over 2400 species lists from Kitaibel's botanical travel diaries. In Hungary, seven habitat types lost more than 90% of their area since 1783 which corresponds to the IUCN 'long-term critically endangered' status. The highest losses (98% each) were experienced by two grassland habitats (Pannonic loess and sand steppes). Over the last 200 years, the loss of semi-natural wetlands has been over 70% and of semi-natural forests had exceeded 60%. We estimated a 25% total forest cover for the 18th century, and now it is again approx. 24%, but two-third of this is already secondary forest (planted and spontaneous). The forest cover reached its minimum of 13% in the first half of the 20th century, and the grassland area approx. 20% – in the 1980s. 33% of forests is semi-natural continuous forest since 1783. Cultivated land had the maximum cover in the mid-20th century. The main direct driver of the forest and grassland loss has been conversion to arable land, and the most significant indirect driver behind this was population growth with an increased demand for grain in the 19th century. Despite the methodological challenges, this long-term time-series analysis proved to be very useful for interpreting recent habitat changes. Given the increasing availability of digitised historical data, we believe that our method is suitable for regional or country-level assessments and can be effectively used to extend the time scale of shorter-term large data series on habitat area change.

Dry grasslands in the steppe zone of Ukraine: findings from a 200 km transect survey case study of Campobasso Functional Urban Area

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The Ukrainian steppes, formerly abundant grasslands occupying vast territories, are known for their high ecological, biodiversity, and cultural significance. While steppe grasslands in Ukraine are highly threatened nowadays, their typology and biodiversity still remain understudied. The European typology of vegetation and habitats was primarily developed using data from Central, Western, and Northern Europe, where various Braun-Blanquet studies have been conducted over the past century. As a result, steppe vegetation surveys began outside its main distribution range, with steppe-zone data integrated later. Recent systematic studies, however, provide new insights into both widespread steppe vegetation and previously overlooked endemic types. Using the data from a 200 km transect across the steppe zone, I analyzed the main dry grassland vegetation and habitat types, their distribution, diversity patterns, and ecological drivers. The dataset included 350 vegetation plots of dry grassland vegetation, collected in 2018–2020 in the western part of the Ukrainian steppe zone, specifically in the Southern Buh River Basin. I used R 4.3, JUICE 7.0, and QGIS 3.4 for the data analysis and visualizations. The dry grasslands were classified into communities of the classes *Festuco-Brometea*, *Koelerio-Corynephoretea*, and *Sedo-Scleranthatea*. The main vegetation types included true forb-bunchgrass steppes (all. *Stipo lessingianae-Salvion nutantis*), forb-rich meadow steppes (all. *Cirsio-Brachypodion pinnati*), and narrow-leaved fescue steppes (all. *Festucion valesiacae*, all. *Tanaceto millefolii-Galatellion villosae*). Extrazonal communities occurred on specific substrates, such as petrophytic steppe communities on siliceous (all. *Poo bulbosae-Stipion graniticolae*) and limestone (all. *Potentillo arenariae-Linion czernjajevii*) outcrops, as well as Pontic sandy grasslands on alluvial sands (all. *Festucion beckeri*). Wormwood semi-desert steppes, found on the steep loess slopes at the southernmost edge of the transect, were preliminarily classified as the alliance *Agropyrion pectinatae*. Hemipsammophytic steppe grasslands were closely related to rocky grasslands on siliceous outcrops and represented a vicariant Pontic type of the Central European alliance *Koelerio-Phleion phleoidis*. Using the EUNIS-ESy expert system, I identified five habitat types from EUNIS group R1 (R11, R12, R1A, R1B, R1C), while perennial rocky grasslands on both calcareous and siliceous substrates had no direct equivalents using the definitions of existing classification system and were preliminarily placed into type R16 Perennial rocky grassland of Central and South-Eastern Europe. I also examined the influence of bioclimatic variables, substrate type, soil properties, microrelief, and land use on the differentiation of studied grassland communities. Biodiversity patterns varied among vegetation types, with both macroclimatic variables and local environmental conditions playing a crucial role in shaping the distribution and species richness of these communities.

Can stess-tolerant strategy be defined by three leaf traits: leaf dry matter content, specific leaf are, and leaf size?

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Grime's plant strategy scheme is widely used in the vegetation science. He assumed that the three main strategies are adaptations to three habitat types: competitors (C-strategy) are adapted to high productivity and low disturbance, ruderals (R-strategy) are adapted to high productivity and high disturbance and stress-tolerants (S-strategy) are adapted to low productivity and low disturbance. Grime stated that irrespectively to reason of low habitat productivity (e.g. scarcity of soil nutrients, dry conditions, acidic or salty soil, shading by tree layer) it is advantageous to conserve the produced biomass, and the low leaf turnover is a key characteristic of stress tolerant species. To makes classification of species Pierce et al. (1) developed an algorithm to determine plants strategy based on three leaf traits: leaf dry matter content (LDMC), specific leaf area (SLA) and leaf size. In this algorithm the key feature of stress-tolerant's is the high LDMC, because it results in higher mechanical resistance and lower palatability which is in line with Grime's idea of low turnover. The algorithm results in percentage of C-, S- and R-strategy for each species. Since percentages sum up to 100%, species can be located in a ternary plot where three corners of the triangle are the "pure" C-, S- and R-strategies. European level of indicator values (2) allow to select species adapted of unproductive habitats. They should be situated in the right corner of the strategy triangle, but they spread over the whole strategy space. Thus, there is a strong discrepancy between strategies defined by habitat preference and defined by leaf traits. Looking for its reason we face that LDMC of species adapted to low light conditions is lower than species adapted to open habitats. Its reason is that high SLA is advantageous in shade, and it is generally correlated with low LDMC. LDMC of species living in poor or dry soils in average higher, but there is a huge overlap. There are several species adapted to these unproductive habitats whose LDMC is low. Its reason is that the high LDMC is only one way to increase leaf longevity, and leaf longevity is only one – however very important – aspect of adaptation to low productivity. Therefore, simplified strategy estimations from three leaf traits should be used with caution.

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Local conditions modulate the forest habitats response to rising temperature with climate change

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Climate change is one of the main global drivers of biodiversity shifts, posing significant threats to forest ecosystems. However, its effects are often examined independently of environmental factors such as topography and soil, which can modulate climate-driven changes. Additionally, biome-scale studies frequently group diverse forest habitat types together, disregarding differences in leaf phenology (e.g., evergreen vs. deciduous) and leaf type (e.g., broadleaved vs. needle-like). This broad categorization can obscure critical differences in diversity responses to climate change. To address this, we assessed how rising temperatures in the course of climate change influence taxonomic and functional diversity in tree and shrub guilds while accounting for the regulatory roles of topography and soil across distinct forest habitat types.
Using a national database of forest vegetation plots from Italy enriched with functional trait data, we analyzed four key forest habitat types within the Temperate biome. We modelled the direct effects of temperature, solar radiation, and soil water capacity on taxonomic and functional diversity while also examining how solar radiation and soil water capacity mediate temperature-driven diversity changes. Our findings indicate that warming affects taxonomic and functional diversity in both tree and shrub guilds, albeit with varying magnitudes. In warm forest habitats, diversity declined due to increased summer drought stress, whereas in cold-temperate forests, diversity increased as reduced winter frost stress facilitated species establishment and persistence. These responses were stronger regarding trees than in shrubs, highlighting different sensitivities between growth forms. Furthermore, regional factors such as topography and soil exerted a stronger regulatory influence on temperature-driven shifts in tree diversity than in shrub diversity, with these effects being more pronounced in cold forests. This underscores the importance of considering fine-scale environmental variability when assessing climate change impacts on forest biodiversity. Our results highlight that while climate remains a dominant driver of biodiversity change, future projections must integrate regional regulatory mechanisms to improve accuracy. Grouping different forest habitat types into broad categories can mask critical diversity responses, leading to oversimplified conclusions. Recognizing the distinct responses of forest habitat types to climate and environmental gradients underscores the need for targeted, habitat-specific adaptive management forest restoration strategies to enhance forest resilience in a changing climate.

The Role of Dolines as Climate Refugia: Linking Geodiversity and Biodiversity Across Diverse Biomes

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This research/project investigates the biodiversity and geomorphology of dolines (karst depressions) in two contrasting biomes: the Mediterranean (Slovenia, Kras) and the temperate (Slovakia, Slovenský Kras National Park – Plešivská planina). The Mediterranean biome is characterised by more humid air and higher average temperatures compared to the temperate continental climate of Slovakia. Dolines, regarded as climate refugia, provide a distinctive setting for studying vegetation diversity and species adaptation to abiotic factors such as geodiversity and pronounced microclimatic variations.Within the relatively confined space of dolines, significant microclimatic transitions occur – with the upper regions experiencing warmer conditions. In contrast, the lower regions are cooler, more humid, and demonstrate more stable temperatures. A total of 20 dolines were analysed, with 10 located in each region and an average depth of approximately 15 metres. Geomorphological data, encompassing parameters such as slope, openness, and eccentricity, were obtained through terrestrial LiDAR scanning, thereby creating high-resolution digital terrain models (DTMs). Botanical surveys were conducted along continuous transects (2 m × 2 m plots), during which species composition, functional traits, and diversity patterns were recorded. Additionally, terrestrial gastropods were sampled from the top, slope, and bottom of two dolines per each region, serving as bioindicators of microclimatic and moisture conditions and changes. The project integrates detailed geomorphological data, vegetation diversity surveys, and snail community analysis to reveal the internal links between biodiversity and abiotic factors. The results will contribute to a better understanding of dolines as refugia in the context of climate change and support habitat conservation strategies across different biomes.

Woodwardia radicans (L.) Sm. (Blechnaceae) in the Mediterranean area: phytosociological remarks and conservation issues

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The shady wet cliffs of the Mediterranean area host a chasmo-chomophytic vegetation referred to the *Adiantetea capilli-veneris* class. In particular, this class includes pterido-bryophytic rich communities featured by a remarkable phytogeographic value dominated by Woodwardia radicans, endangered species included in Annex II of Habitats Directive, that grow on siliceous dripping cliffs (*Conocephalo conici-Woodwardietum radicantis*). This vegetation is characterized by the occurrence of ferns (*Adiantum capillus-veneris*, *Struthiopteris spicant*, *Pteris vittata*, *P. cretica*, *Osmunda regalis*, *Phyllitis scolopendrium*, *Dryopteris* sp. pl., *Polystichum setiferum* and *Athyrium filix-femina*), bryophytes (*Conocephalum conicum*, *Eucladium verticillatum*, *Apopellia endiviifolia*, *Pohlia wahlenbergii* var. *calcarea*, *Plagiomnium undulatum*, etc.), and vascular plants (*Hypericum hircinum*, *Samolus valerandi*, *Lysimachia nemorum*, *Pinguicula* sp., etc.). Despite the negative effects of climate change, in the Mediterranean area the Woodwardia-dominated communities survive in northern Corsica, southern Italy, Sicily, and Crete. While in Algeria, it has not been found again. Our study is aiming at (1) comparing the Woodwardia radicans populations in the central Mediterranean area, (2) analysing the structure and composition of the surveyed plant communities, (3) evaluating demographic trends, (4) providing more insights on the ecology of Woodwardia radicans in order to improve protection and management policies, (5) finally, designing a translocation project to bring it back both to Algeria and Mt. Etna (NE Sicily).

The EVMac initiative: update and harmonization of syntaxonomy of European Macaronesia with the EuroVegChecklist and the International Vegetation Classification

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The syntaxonomy of the vegetation of Macaronesia, according to Braun-Blanquet principles, have been used for long in Macaronesia. Several partial propositions, either for the whole, or part of archipelagos are available (e.g. 1,7,9). Moreover, some comprehensive syntheses have also been proposed at national level (Portugal and Spain) (2,10). On the scope of 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 (8) and its updates (3) as 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 (5,6). For the later, we rely on phytosociological characterization and other alternative floristical-physiognomical-ecological systems locally available (e.g. 4). We present some paradigmatic examples for the main Macaronesian endemic classes where novel syntaxonomical changes is greater (e.g. *Kleinio-Euphorbietea canariensis*, *Oleo-Rhamnetea crenulatae*, *Aeonio-Greenovietea*, *Pruno hixae-Lauretea novocanariensis*, *Lauro azoricae-Juniperetea brevifoliae*). The group EVMac will maintain the initiative, enlarging it to other experts, and actively propose changes to the European Vegetation Classification Committee (EVCC).

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EVA-MAP: An online application for visualization of European vegetation survey and resurvey data

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The IAVS Working Group European Vegetation Survey manages the world's largest continental database of vegetation plots, the European Vegetation Archive (EVA), which contains more than 2 million plots. In addition, more than 450,000 observations from repeatedly sampled plots were recently assembled in the database ReSurveyEurope. The Biodiversa+ project MOTIVATE (2024-2026), focused on the development and analysis of the ReSurveyEurope database, supports European vegetation scientists to conduct studies of vegetation change by resurveying historical vegetation plots. For the coordination of these activities, it is essential that everybody can access and inspect the locations of historical plots and get information on whether or not each of them has already been resurveyed. To address this issue, we developed an online map application called EVA-MAP. The application allows exploring and searching the locations of plots from the European Vegetation Archive and ReSurveyEurope in the form of an interactive map-centric dashboard. The map component presents the density of plots in different areas and, when zoomed in, the locations of individual plots. The application enables filtering of locations by EUNIS habitat type, country, bioregion, user-drawn polygon on the map, altitude, year of sampling, time range between the first and last sampling of the same plot, plot area, location uncertainty, author, project and source dataset. Besides identifying historical plots suitable for resurveying, this application can also facilitate the selection of plots from EVA and ReSurveyEurope for specific studies, allowing the user to define selection criteria and see the relevant plot locations on the map or export them into a table. The application is built in the Remix full-stack framework, using SQLite database to store data and Prisma for schema management, data migration, and further data manipulation. The map component is built with MapLibre, while the rest of the user interface uses Mantine and Tailwind libraries. The application is available at https://evamap.eu.

Can we trust resurvey studies?

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The recent global environmental and socio-economic changes have negative impacts on biological diversity. However, while the associated biodiversity loss is evidenced at the global scale, surveys of local plant communities often show mixed responses with no clear overall trend. This can be attributed to the fact that plant communities react to short-term weather fluctuations that mask the long-term changes. To assess the long-term biodiversity change, plant ecologists often resurvey old vegetation plots. Such campaigns are, however, often conducted during a single resurvey year, which puts surveyors at risk of capturing peculiar conditions occurring at the time of both the original survey and resurvey rather than the long-term environmental change. To test the reliability of resurvey studies to detect the long-term trends in species richness and community turnover, we used 21 datasets of permanent-plot time series spanning a time window of at least 14 years between the first and last survey. We then decomposed those time series to simulate individual resurvey studies, with the first year referring always to the first year of the time series and the second year referring to the sixth to last year of the time series. We fitted a Bayesian multilevel model for each simulated resurvey study and quantified the overlap of estimated regression parameters with those from a model spanning over the whole time-series period. We found that species composition turnover estimated from simulated resurvey studies usually agreed with the long-term trend. However, species richness assessments varied greatly, with approximately half of the simulated resurveys diverging from the long-term trend. Our results highlight that while community turnover can be well-estimated even based on two visits of the same plot, conclusions about long-term changes in species richness might be strongly biased and would likely require at least one additional survey.

Trait based similarity among sandy grasslands and old-fields: effect of time and surrounding landscape are different for each trait

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By the spontaneous regeneration on abandoned agricultural fields can develop a species-rich plant communities. However, these areas mostly differ from the primary habitats in functional composition not only at the beginning of their establishment, but also even several decades. In our study, we made a resurvey of a regional grassland and old-field monitoring in Central-Hungary after a decade. We investigate whether the similarity in composition of selected traits (e.g. SLA – specific leaf area, height, seed mass) of old-fields to the primary grassland depends on the (1) age of abandonment, (2) on the time of survey – first or second and on the (1) surrounding landscape. The vegetation of open and closed primary (never ploughed) dry sandy grasslands and old-fields in Kiskunság, Hungary was surveyed with 20 m x 20 m stratified randomly selected plots. Three groups of old-fields were classified according to the time of abandonment in 2007: young (1-7 years), middle-aged (8-20 years) and old (21-57 years) old-fields. The first survey was conducted between 2007-2009, the second between 2019-2021. We measured the trait similarity of old-fields to the grasslands using the effect size approach. The surrounding landscape was described by the amount of main land use types in 500m around the plots. Based on these data we classified into two groups: dominated by agricultural habitats and the mixed landscape with more grassland fragments. With linear mixed models we studied the effect of surrounding landscape, the age of abandonment and the survey. We found that each factors have an effect on the similarity. As it can be expected, in case of the most traits (e.g. SLA, LDMC, height, seed mass) elder age groups were more similar to grasslands. However in case of seed mass and dispersal type there was no difference between either the old-fields of different age-groups or between the two surveys. The type of surrounding landscape had a significant effect on the similarity of old fields when considering the SLA, the seed mass or dispersal type. Our result confirm that with the time the old-fields could became similar to the reference grasslands however also refine this finding. On one site there is a difference among the traits, suggesting that the vegetation developing on old-fields remain different from primary grassland considering selected functional traits. On the other side our results show the importance of surrounding landscape: the mosaic landscape with more fragments of grassland enhance the spontaneous regeneration of old-fields indicated by the trait similarity.

Global patterns of plant communities and functional traits in fire-prone ecosystems

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Fire is a critical ecological disturbance with both ecological benefits and socio-economic implications. Fire regimes across the globe are jointly shaped by climate and vegetation characteristics. While the role of plant characteristics such as fuel load and flammability has long been recognized, recent studies have emphasized how the composition of other plant traits linked to fire responses, but also to growth and competitive ability can dramatically impact the fire regime. Here we aimed to test this idea by analyzing plant communities and fire history in different ecosystems across the world.To address this aim we combined global datasets on plant traits (e.g., TRY, AusTraits, Flamits), community composition (from sPlot open), climate data, and remote sensing fire data (from MODIS/VIIRS). We first assessed global patterns of plant trait co-variation in fire-prone ecosystems. We then fit models to test how plant trait syndromes and community composition are related to different fire regimes under similar climatic conditions globally. Preliminary results confirm that in areas historically affected by fire, communities tend to have higher overall flammability. Additionally, the presence and/or abundance of species with favorable post-fire adaptations increases within plant communities, suggesting the presence of a positive feedback mechanism. However, our models also suggest that these relationships between fire-related traits and wildfires globally are indeed modulated by plant traits associated with growth and competition. Our findings provide valuable insights for fire management, ecosystem restoration, and reforestation efforts by highlighting the complex influence of community functional composition on fire dynamics.

Biogeographic issues related to the syntaxonomy of *Quercus cerris* and *Q. frainetto* forests in Italy

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Mixed woods of *Quercus cerris* and *Quercus frainetto* are a common forest landscape in the Balkan Peninsula and the central-southern Apennines of Italy. The distribution of these oak species on the Italian Peninsula is quite different. *Quercus cerris* is the most widespread oak species in the entire Apennines, with an ecological amplitude that allows it to dominate in forest communities from sea level to the montane belt. *Q. frainetto*, on the other hand, has a much more patchy distribution, concentrated mainly in the lower colline belt of the Tyrrhenian side of the Italian peninsula, although it can also be found in the montane belt in southern Italy. The northernmost limit of *Quercus frainetto* in Italy runs along the southern border of the administrative regions of Tuscany and Umbrian, excluding the northern Apennines and about a half of the central Apennines. In (1) and (2) the *Quercus cerris* and Q. *frainetto* forests of central Italy were included in the Italian endemic alliance *Teucrio siculi-Quercion cerridis,* while those of southern Italy were included in the trans-Adriatic alliance *Melittio-Quercion frainetto*. Both the EuroVegChecklist (3) and the Prodrome of the Italian vegetation (4) opted for a single Italian endemic alliance (*Crataego laevigatae-Quercion cerridis* Arrigoni 1997) on the basis of previous studies (5) (6). A recent paper (7) has analysed the nomenclatural issues associated with the names *'Melittio-Quercion frainetto'* and *'Melittio-Quercion confertae'* [*Quercus conferta* Kit. is a later synonym of *Q. frainetto* Ten.] and found that the former name should be assigned to an alliance endemic to the Italian peninsula (In the Balkan peninsula and southern Greece, the later name *'Melittio-Quercion confertae'* was replaced by the new name *Geranio asphodeloidis-Quercion frainetto* Di Pietro et al. 2020). Accordingly, the name *Melittio albidae-Quercion frainetto* Barbero et al. 1976 has the nomenclatural priority over the name *Crataego laevigatae-Quercion cerridis* Arrigoni 1997. However, as already expressed in (7), the existence of only one alliance for the Italian peninsula does not sufficiently take into account the biogeographical differences between the oak forests of the central-northern Apennines and those of the southern Apennines. Therefore, we have compiled a data set of 2900 relevés of *Q. cerris* forests and treated it with multivariate analysis procedures. Although the results of the cluster analysis only partially reflect the current major syntaxonomic frameworks, the oak forests of southern Italy show a clear floristic identity and autonomy. This evidence is consistent with the proposal to divide the subacidophilous oak forests of the Italian peninsula into two geographically vicariant alliances, similar to what has already been reported in the EVC for the Balkan Peninsula, with a “northern” *Quercion frainetto* and a “southern” *Geranio-Quercion frainetto*.

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Are mean indicator values robust to incomplete plant census data?

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Mean plant species indicator values are important tools in applied ecology for assessing vegetation quality and change. These values integrate the ecological preferences of co-occurring plant species. However, consistent recording of plant composition within a plot is challenging. High pseudo-turnover rates between observers and due to phenology are reported across plot sizes and habitat types, yet the implications for mean species indicator values remain unclear. In this study, we tested the robustness of mean indicator values and their different types of weighting to incomplete species lists. We used a stratified random sample of plant censuses from a nationwide conservation monitoring programme in Switzerland. Incompleteness of plot species lists was simulated by stepwise omission of an increasing proportion of species from each plant census. Different scenarios of species omission were applied to mimic different types of incompleteness. In addition, data from plots surveyed independently by two different observers were used to estimate the true extent and type of incompleteness. Our results showed minimal effects of incomplete species lists on mean indicator values when simulations were applied to pooled habitat types. However, within specific habitat types (dry grasslands, fens, and bogs), the incompleteness of species lists significantly affected most of the indicator values analysed. The effect increased with increasing incompleteness. Incomplete species lists erroneously indicated more extreme conditions: fens and bogs appeared wetter and less productive, while dry grasslands appeared drier and again less productive. The effect was most pronounced when using mean indicator values based on presence/absence data and in simulation scenarios where the least abundant species were removed. Our findings underscore the importance of minimising observer bias in monitoring programs, even when focusing on relatively robust measures such as mean indicator values.

Long-term dynamics of forest-steppes in Eastern Europe

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A considerable proportion of the Earth's terrestrial surface is covered by mixed woody/herbaceous ecosystems. The dynamic processes of these systems are of crucial importance, as they have a profound influence on stability, diversity, and ecosystem services. While the long-term balance of woody versus herbaceous patches has received ample scientific attention in tropical savannas and in the North American prairie-forest ecotone, Eurasian forest-steppes have been severely understudied from this respect. In this work we studied protected Eastern European forest-steppes, where patches of xeric forests are embedded in a matrix of mostly dry grasslands. Our main goal was to find out how two variables, (1) the area covered by forests, and (2) the number of forest patches changed in these landscapes at a decadal time-scale. In randomly selected 1-ha units scattered across four sites, we delineated all forest patches on old and recent aerial photographs. We found that the area covered by forest patches significantly increased at all study sites during the last few decades. This is surprising, given the ongoing aridification in the region. We think that observed forest encroachment can be explained in the following two ways. First, it is possible that increasing temperature and CO_2 concentration disproportionately favour woody vegetation, at least until either the thermal optimum of the trees is surpassed, or the water requirement of the trees is not satisfied. Second, the spread of forest vegetation may be a result of past changes in land-use. Forest-steppes of the region evolved under constant grazing/browsing pressure of native mammals, which were able to limit woody vegetation. After the agricultural revolution, domesticated animals played a similar role for thousands of years. However, land-use changed during the 20th century, when grazing/browsing pressure decreased. Current forest encroachment may simply reflect that woody vegetation is responding to these changes. Our analysis showed that the number of forest patches may show significant increase or decrease, depending on site. This indicates that forest spread occurs via two mechanisms: new forest patches can form within grasslands (resulting in increasing forest patch number), and already existing forest patches can expand and merge (resulting in decreasing forest patch number).

Intraspecific functional trait responses to experimental warming depend on precipitation

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Alpine plant communities are particularly vulnerable to rising ambient air temperatures. To avoid local extinction, species may have to migrate or functionally adapt to future climate warming. Experimental studies simulating warmer growing conditions help to predict the extent and direction of those functional adaptations. We hypothesize that intraspecific responses are contextually dependent and vary according to local environmental conditions, such as precipitation, or species characteristics like habitat range or functional group. To test this, we measured the warming response in 10 leaf, growth and chemical traits for 17 perennial herbs, dwarf shrubs and graminoids. The species were subjected to an experimental warming regime using open-top chambers (OTCs) since 2018. To calculate the effect size of warming, we compared the traits of warmed plants with those growing in nearby control areas. The three alpine sites used in our study are spread across a precipitation gradient of 1315–3601 mm/yr in western Norway. The effect of warming on each trait, overall and for each site and species, was determined using Cohen's d. We compared effect sizes with respect to species' habitat ranges (alpine vs. generalist) and functional groups (graminoid vs. forb). Besides an overall increase in plant height, functional responses were highly context and species dependent. In the intermediate precipitation site, plant height, leaf area and leaf dry matter content increased while specific leaf area and leaf nitrogen content decreased, a sign that plants grew bigger and developed more conservative leaves. Additionally, the ratio of heavier 15N and 13C isotopes increased, potentially reflecting a move towards improved water-use efficiency and enhanced microbial activity in the soil. We found that the increase in plant height and leaf area could be mostly attributed to graminoids, while forbs reacted inconsistently. Contrary to our initial hypothesis, alpine specialist species did not significantly differ in their functional responses from generalist species. Instead, we found stronger differences between functional groups, with forbs reacting stronger but also less coordinated and directionally to warming than graminoids. In summary, we found that functional trait responses in alpine communities differ in strength and direction depending on the precipitation context, functional group and species identity. Studies of intraspecific trait responses to warming across a wider range of contexts will enable better predictions of how species will shift their traits in response to future warming.

Comparison of large-scale and habitat-specific approaches to assess long-term vegetation dynamics in alpine grasslands

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The Alps are a biodiversity hotspot particularly affected by ongoing climate and land use changes. In this context it is important to monitor the responses of species and ecosystems by exploiting the data collected during past studies to better direct conservation efforts. We executed a vegetation plot resurvey in the Gran Paradiso National Park to investigate the changes and the related ecological processes that have occurred, over four decades, in the alpine and subalpine grasslands of the western Italian Alps. In this area no vegetation resurveys have yet been done, we thus aimed to investigate: (1) how varied the species diversity and composition (2) how changed the vegetation structure (3) how are grasslands responding to changed environmental conditions. Previous resurvey studies conducted in the Alps have either considered general alpine vegetation or categorized different vegetation types based on research objectives. To assess where these approaches lead to similar or different results in addressing the same research questions, we analyzed the studied grasslands both as a whole and considering the different vegetation types. A challenge in resurvey studies is the lack of precise location data for historical plots, which can affect the accuracy of new surveys. To address this point, we developed a method integrating historical field data (elevation, aspect, and slope) with digital terrain models to identify suitable survey locations. This was complemented with field navigation apps for optimal plot positioning. Vegetation data from past surveys were classified into four habitats based on the EUNIS system: mountain hay meadow (R23), snow-bed vegetation (R41), temperate acidophilous alpine grasslands (R43), and arctic-alpine calcareous grasslands (R44). Our analysis identified snow-bed vegetation as the most affected by species composition, vegetation structure and environmental changes which led to their invasion by the surrounding grasslands species. At the same time, mountain hay meadows and acidophilous alpine grasslands are experiencing encroachment by woody plants, respectively dominated by trees and shrubs. On the contrary, calcareous alpine grasslands emerge as the most stable habitat among those studied. The overall analysis of the studied grasslands provides a general perspective on occurred changes in species composition, vegetation structure and environmental drivers but lacks the resolution to fully capture within-habitat dynamics, except regarding species diversity. This highlights the importance of combining broad-scale assessments with habitat-specific analyses to better understand ongoing ecological transformations.

Changes of the flora in the alpine grasslands of Gran Sasso 1962-2009

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In times of increasing threats to ecosystems and biodiversity, resurveying historical vegetation plots represents a great opportunity to document environmental changes over time. Detecting the vegetational changes and identifying the drivers of these trends become fundamental tools to suggest and implement appropriate conservation strategies to preserve the integrity and diversity of fragile and threatened ecosystems and to address global biodiversity trends. Hosting up to 20% of the native flora and a high percentage of endemic plants, mountain ecosystems are considered hotspots of plant diversity. These ecosystems worldwide are facing unprecedented threats from climate change which is driving significant shifts in high mountain vegetation, including species composition, biodiversity, and ecosystem functioning, with potential cascading effects on ecological processes and services. In this study, we examine long-term vegetation dynamics in the Gran Sasso and Monti della Laga National Park by analyzing 25 historical vegetation quasi-permanent plots sampled in 1962 and in 2009, spanning a 47-year period. Using a phytosociological approach, we assessed changes in species composition, diversity, and ecological indicators. The communities studied are three typical high-altitude communities dominated respectively by *Brachypodium genuense*, *Festuca violacea* subsp. *italica* and *Sesleria italica*. Our results show a clear successional trend, with relevés from 1962 indicating a more open grassland sward, that closed in recent year with a decrease in S strategists species and an increase in the H/Ch ratio. These changes are presumably due to the cessation of grazing. That was very intense formerly at high altitudes. Our data suggest also an increase in nutrients and an increase in thermophilic species, the former due probably to the process of succession, the latter to global change. Our results suggest that when address the impact of global change such as global warming it is important to take into account local confounding factors such as changes in management and socio-economic structure that can modify or even offset the global trends.

Classification and ordination of vegetation types by co-occurrence matrices

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Vegetation types can be compared in several ways, generally the syntaxonomical comparison is done by considering the species and their constancy in the tables of the association level. In Syntaxonomy the vectors given by the frequency of the species at association level are compared to define vegetation types at different hierarchical levels (alliances, orders, classes). In community ecology vegetation types are compared to discover relationships between species combinations and environmental factors, this leads to define the mutual position of the ecological niches of the vegetation types in the ecological space. To have a consistent description of the vegetation types by environmental variables (factors) to look for direct gradient analysis is very difficult exercise owing to the restriction of funds for research in this field to obtain a reasonable completeness in the data set, so we have to fall back to the use of indicator ecological values of specie as found by the experience of research. In this paper we present a way to find the correlation between the vegetation types and environmental factors by the use of matrices of co-occurrence between species and the indicator ecological values and we show that the matrices of co-occurrence, besides giving rise to new parameters of diversity related to the association pattern of the species, would offer a more predictive tool in analysing the vegetation environmental relationships. Examples are given with vegetation types dominated by Picea abies and *Alnus glutinosa* in Northern Italy.

Ecological niches and biogeography of European mycoheterotropic plants

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Mycoheterotrophy is a specialized nutritional strategy in plants that allows them to obtain not only mineral nutrients and water through mycorrhizal symbiosis with fungi but also organic carbon. The organic carbon acquisition at least partly releases the plants from dependence on their own photosynthesis. This unique adaptation may limit the occurrence of mycoheterotrophic plants to certain environmental conditions. This study explores the ecological niches and distribution patterns of mycoheterotrophic plants across Europe. Using vegetation-plot data from the European Vegetation Archive (EVA), we studied spatial and ecological patterns of mycoheterotrophic plants on both the species- and community-level. We identified all species that use mycoheterotrophic nutrition for at least part of their life-cycle, i.e. taxa of Ophioglossaceae, Lycopodiaceae, Orchidaceae, Pyrolaceae and Monotropaceae and classified them into functional types according to their mycorrhizal associates (arbuscular, ectomycorrhizal, or saprotrophic). We investigated their spatial distribution, the environmental drivers of their distribution and the ecological niches of the most common mycoheterotrophic species in Europe. We used a Boosted Regression Tree (BRT) model to predict the ecological responses of mycoheterotrophic plants to key environmental factors. We used climatic and topographic variables from online sources and habitat variables created based on the vegetation-plot data, along with mycoheterotrophic species occurrence data, to identify the main determinants of their distribution. Additionally, we analysed their response to Ecological indicator values derived from community composition. The occurrence of most mycoheterotrophic plants is positively correlated with summer precipitation. Coverage of the mycoheterotrophs associated with ectomycorrhizal and arbuscular mycorrhizal fungi also shows a positive relationship with temperature seasonality and a positive response to increased terrain heterogeneity, as indicated by the terrain ruggedness index. This suggests their preference for more continental regions and mountainous areas. On the other hand, mycoheterotrophs associated with saprotrophic fungi predominantly thrive in areas with low temperature seasonality, having their hotspot in the Mediterranean. Mycoheterotrophs associated with ectomycorrhizal fungi are less commonly found in open habitats, as indicated by their response to EIVE light. EIVE N indicates that all studied taxa prefer nutrient-poor conditions. Given the ongoing climate change, land-use shifts, and increasing habitat eutrophication leading to the loss of suitable environments, mycoheterotrophic plants are facing a growing risk of endangerment.

The influence of small canopy gaps on vegetation dynamics and functionality in karst landscapes

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Karst areas are topographically complex landscapes that provide 'safe havens' for biodiversity across the globe. Topographic complexity creates fine-scale variability in microclimatic conditions and soil properties due to cold-air pooling, topographic shading, water retention, and nutrient accumulation in the soil. Consequently, steep environmental gradients can be found along the slopes of local depressions and valleys, where many species that are adapted to different environmental conditions can occur in relatively close proximity. However, in forests, various natural and anthropogenic disturbances (e.g. heavy storms and forest management activities) also influence the environmental conditions, thus certain biodiversity components at different topographic positions. Here we studied the effects of small changes in canopy structure (canopy gaps) on several environmental factors, functional trait composition, as well as taxonomic and functional diversity of understory plant communities in 20 topographic depressions (dolines) and on the surrounding plateaus in the Mecsek Mountains, Hungary. We compared four habitat types based on their canopy structure and topographic position: 1) plateaus with closed canopy, 2) plateaus with small canopy gap (50–200 m^2), 3) doline bottoms with closed canopy, and 4) doline bottoms with small canopy gap (50–200 m^2). We found that the doline habitats were significantly cooler and had higher air humidity and soil moisture levels than the plateau habitats. All four habitat types were characterized by markedly different plant functional trait values and functional composition. For instance, plants in doline bottoms with small canopy gap had larger leaf area, smaller seeds, longer duration of flowering, and higher proportion of insect-pollinated species and hemicryptophytes. The relatively subtle differences in environmental conditions combined with altered light conditions in doline bottoms with small canopy gap may enhance the refugial capacity of this habitat type and enable the survival of plant species with functional traits that are less frequent in the surrounding habitats. We also found that the plateaus with small canopy gap were species-poor and dominated by *Fagus sylvatica* saplings (a climate change vulnerable tree species). This habitat may contribute to the development of a more complex stand structure and the maintenance of biodiversity within these forests. Therefore, by creating small canopy gaps in topographically complex karst landscapes, we may increase their refugial capacity and support the survival of climate change vulnerable species during periods of anthropogenic climate change (i.e. warmer and drier conditions).

Functional and Biological Diversity of Wild Edible Plants in Italy: Preliminary results from the FuD WE PIC Project

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Wild edible plants (WEP) have been vital resources for humans since the Paleolithic, and they still play a key role today in the context of sustainability and food security. While most scientific literature has focused on the nutraceutical and ethnobotanical aspects of WEP, ecological studies utilizing big data to analyse WEP on broader scales are still lacking. In this study, we used the Italian WEP checklist AlimurgITA (1), including data from the most comprehensive ethnobotanical literature of Italy. We combined the AlimurgITA dataset with Italian vegetation plots from the European Vegetation Archive (2) to explore the relationships between WEP richness and habitat types. The preliminary results show that vegetated man-made habitats have highest values for both total WEP richness and WEP relative frequency, followed by grasslands and scrublands for total WEP richness, and by forests and scrublands for WEP relative frequency.

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Ground Truth: insights from the first nationally coordinated Annex I habitat monitoring project in Italian National Parks

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Habitats are essential components of biodiversity, shaped by complex interactions of biotic and abiotic factors. They play a key role in assessing nature conservation status. Under the Habitats Directive (92/43/EEC), EU Member States must monitor Annex I habitats (Art. 11) to evaluate conservation trends and the effectiveness of biodiversity conservation policies. Despite efforts, standardized monitoring protocols remain a work in progress, whilst biodiversity loss continues to escalate globally. With funding from the National Recovery and Resilience Plan (NRRP), national-scale monitoring programs in Protected Areas are being implemented in Italy to provide a coherent conservation outlook in the frame of the DigitAP project, promoted by the Italian Ministry of the Environment and Energy Security (MASE) and coordinated by the Italian Institute for Environmental Protection and Research (ISPRA). One of the main objectives of the DigitAP project is to monitor Annex I habitats in Italian National Parks through vegetation surveys, aiming to establish a permanent network to support medium- and long-term monitoring (1). A team of vegetation operators, coordinated by a Temporary Grouping of Companies and supervised by the Italian Botanical Society (SBI), was hired to conduct annual vegetation surveys over two years. The project targets 98 Annex I habitats across 1,857 stratified-randomly located 100×100 m^2 cells. Data collection follows national guidelines (2), with rigorous validation processes involving habitat- and territory-specific experts to ensure high-quality, accurate, and comparable data. Photos and videos further support data assessment. The sampling design is based on Annex I habitat maps for each National Park: sampling cells are assigned proportionally to habitat surface, and activities are scheduled according to habitat types (3) and vegetation phenology. Standard habitat-specific sampling areas have been defined. Ground validation, a critical phase, involves close collaboration between surveyors, validators, and coordinators. Custom GIS-based applications facilitate data collection and management. A server-based system enables real-time data storage, visualization, periodic backups, and interactive dashboards for quality control. The platform also archives photographic and video material to support remote validation. As the first survey year concludes, initial efforts focused on defining permanent monitoring plots and recording key structural species. The 2025 campaign will gather comprehensive floristic-vegetation data, establishing a baseline for long-term monitoring. Monitoring data will be integrated into the Italian National Biodiversity Network (NNB). This represents the first nationally coordinated habitat monitoring effort focused on Annex I habitats in protected areas. It marks a significant step toward building an effective conservation monitoring system, harmonizing national data, and enhancing territorial knowledge. The initiative contributes to implementing the 92/43/EEC "Habitats" Directive in Italy and Europe, fostering long-term biodiversity preservation. While addressing longstanding challenges in Annex I habitat monitoring, the initiative underscores the continued importance of classical field methods.

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Differential effect of environmental filtering and dispersal limitation on vascular plant assemblages across forest types in temperate Europe

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Plant communities are the result of both abiotic and biotic drivers and filters. However, their relative importance is likely to differ across different European forest types. We expect that geographical distance might play a greater role in determining floristic dissimilarities in southern European forests, isolated for more time than when compared to more northern forest types, more connected since the last glacial period. We compiled forest plots from the European Vegetation Archive (EVA) and performed General Dissimilarity Models (GDMs) to test if the compositional differences within eight different forests were more due to the current climate, the past climate, the soil, the topography or the geographical distance (as a proxy of the dispersal limitation). We also fitted Community Distribution Models (CDMs) to delimit the visualization of spatial patters in floristic composition for each forest. We found that the floristic dissimilarities within forests were more related to current climate only for the deciduous forests, while past climate was the main driver for coniferous forests but, as expected, geographical distance was for Mediterranean, but also mountain, forests. The connectivity of the different forests in different periods might have played a critical role in their species composition. Thus, forests isolated for more time (i.e., Mediterranean and mountain) are more restricted by the capability of their species to disperse, while forests with greater connectivity, either past or present, are more restricted by other environmental drivers.

Vital rates measurements indicate a strong disequilibrium between climate and the distribution of high mountain plant species in the Austrian Alps

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Mountain ecosystems are particularly vulnerable to climate change and experience temperature increases that are above the global average. The recent warming has already led to an upward shift in plant species' elevational ranges, but these shifts are much slower than expected based on elevational temperature lapse rates. It is unclear, however, whether the lag times indicate the inability of species to track the changing climate, and hence an accumulating extinction debt and colonization credit, or whether they hide micro-scale adaptation, with species shifting to nearby cooler microhabitats that buffer them against warming. In this study, we analysed performance data from more than 7,000 individuals of 42 high-mountain plant species, combined with microclimatic measurements at 1 m spatial resolution. Using this data, we built population growth models, which we then projected onto 853 1 m-vegetation plots spanning a 1,700 m elevational gradient in an alpine landscape of the Austrian Alps. Comparing projected population growth rates with current species distributions, we found that species perform best on sites that are, on average, 1.3 °C cooler and 16 days less snow covered than at their current centre of occurrence. This discrepancy suggests that there has been very limited adaptation of species' distributions to climatic changes of the past decades even when microclimatic variability of alpine terrain is appropriately accounted for. Therefore, even if temperature increase would cease immediately, we would see considerable species turn-over in the long run, with most sampling sites experiencing a potential species turnover of more than 50 % until the end of the century. Predicted lag times to local extinctions vary considerably among species and sites and can extend over several centuries. Our findings highlight that a strong disequilibrium between current climatic conditions and fine-scale distribution of species has emerged in this alpine model landscape over the last decades, even at a very fine spatial resolution. Microclimatic variation has hence hardly helped alpine species to cope with climate warming so far.

The development of dune slack vegetation (*Caricion davalianae*) in former estuarine areas in the southwest of the Netherlands

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We studied the development of species-rich dune slack communities in coastal areas that have been embanked in the 1960s and 1970s. These areas showed quick desalination and slow soil development since the sea influence was stopped. Specifically on former sand flats where grassland management is applied (grazing, mowing), saline plant communities developed into species-rich dune slack communities, which belong to the alliance *Caricion davallianae* according to the Dutch overview of plant communities (1) or the alliance *Caricion viridulo-trinervis* in the EuroVeg Checklist (2). By combining data from permanent plots and other relevés with soil measurements and hydrological conditions, we distinguish four different succession directions under different conditions. In areas with strongly fluctuating water tables *Salix repens* ssp. *arenaria* becomes dominant. In relatively drier sites species of the *Molinio-Arrhenatheretea* increase, indicating a development into the association *Rhinantho-Orchidietum morionis*. Long-term conservation of calcareous dune slack communities may be achieved in sites with stable water tables due to seepage. In the most wet sites however, we found dominance of *Sphagnum subnitens*, a species of relatively basic soil conditions. This community may be described as a new association within the *Caricion davallianae*. The significance of the insights for the Natura 2000 goals, which aim at conservation of the dune slack habitat type 2190, is discussed.

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Fire regime change threatens the future of black pine (*Pinus nigra* J.F. Arnold) forests

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Fires are important ecological drivers of Mediterranean ecosystems. However, ecosystem – fire relationship have been negatively affected by human activities. Effects of the changing fire regime caused by humans have been intensively investigated in Aleppo pine and Red pine forests, which are fire adapted and frequently exposed to fires. But the knowledge on the effects of changing fire regime on black pine forests which are supra-Mediterranean ecosystems and exposed to low severity ground fires is not sufficient. For this goal, we established permanent plot design in order to determine the effect of fire severity (ground fire x crown fire) on black pine forest vegetation after the 2021 mega fire areas in Türkiye. We determined the cover-abundance of species by using the Braun-Blanquet scale for three years after the fire, and tried to understand the change in vegetation dynamics. As a result, black pine trees did not die in the areas exposed to ground fire and survived. This is the result of the thick bark adaptation of black pine to ground fires. The herbaceous layer after fire in these plots were quite weak in terms of species richness. However, all trees in the crown fire sites were died. Since the black pine does not have a crown seed bank and seeds lost their viability due to the heat during fire, black pine could not germinate after fire. Therefore black pine-dominated forests in crown fire sites have turned into a vegetation dominated by other species such as Quercus cerris, Cistus laurifolius, Pteridium aquilinum and Verbascum spp. It was observed that the number of species in these areas was much higher in the first year than surface fire sites. This indicates that black pine forests also have a soil seed bank like Aleppo pine and red pine forests. The change in the fire regime in black pine forests threatens the future of these forests. Compared to the past, fires in these forests now occur in larger areas as crown fires. Therefore, silvicultural approaches should be put forward to ensure that fires in black pine forests occur in ground fires. For this goal, silviculture should aim the extension of harvesting periods ensuring single layered old-growth stands with high crown coverage preventing laddering

Long-term vegetation changes of primeval beech-dominated forests in Slovenia

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Multidecadal vegetation studies in primeval forests are used to investigate how these valuable, pristine ecosystems with high naturalness are changing in terms of self-regulating stand dynamics. Temporal trends may be indicative of various global environmental drivers while the influence of forest management is nullified. We studied the long-term vegetation changes in three primeval beech-dominated forest reserves in Slovenia. The selected forest reserves are Donačka gora – DG (in Sub-Pannonian region), Krokar – KR and Bukov vrh – BV (both in Dinaric region). The DG reserve is located on a steep, north-facing slope whereas KR and BV exhibit highly diverse topography. All three reserves are characterized by long-term natural development without direct human impact. The KR reserve has a special protection status as it has been declared as UNESCO World Heritage site, being located in remote karst landscape and strictly unmanaged since 1885. Baseline surveys were conducted in the late 1970s and early 1980s. In 2024, we resurveyed 16 semi-permanent plots in DG, 50 plots in KR and 14 plots in BV. We followed the original sampling protocols, i.e. Piskernik phytosociological method (1). The aim of this study is to analyze changes in vegetation diversity and composition for different vegetation layers. The total cover of *Fagus sylvatica* in the overstory increased in all reserves, particularly in the subcanopy layer. *Abies alba*, a common co-dominant species in KR and BV, has declined. On plots in DG reserve, where *A. alba* is not present, we observed an ingrowth of broadleaves (*Acer* sp.). The results showed significant floristic impoverishment for DG and enrichment for BV. Plot-level species richness in the herb layer remained relatively stable in KR. Gamma diversity decreased by 30% in DG and increased by 11% and 23% in KR and BV, respectively. Using model-based analysis of beta diversity, we found evidence for both taxonomic homogenization (DG) and taxonomic differentiation (KR and BV). Herb-layer cumulative cover decreased in all three reserves, on average by 13%. Overall shifts in multivariate ordination space were more pronounced for DG and BV, while higher degree of compositional stability was detected for KR. Comparison of ecological indicator values (2) between winner and loser species indicated some contrasting results. In DG, a shift towards shadier and nutrient-rich conditions occurred. In KR, however, winners were more light-demanding species with preference for higher soil reaction but lower soil moisture. The BV reserve also experienced colonization of heliophilous plants, but the signal of soil acidification was more prevalent. Observed patterns can be mainly interpreted with respect to local stand developmental cycles controlling light availability at the forest floor and may as well be attributed to the effect of other abiotic factors (e.g. air pollution, climate warming) or biotic disturbances (e.g. ungulate browsing).

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Half a century of temperate non-forest vegetation changes: no net loss in species richness, but considerable shifts in taxonomic and functional composition

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In recent decades, global change and local anthropogenic pressures have severely affected natural ecosystems and their biodiversity. While disentangling the effects of these factors is difficult, they are reflected in changes in the functional composition of plant communities. We present a comprehensive, large-scale analysis of long-term changes in plant communities of various non-forest habitat types in the Czech Republic based on 1 154 vegetation-plot time series from 53 resurvey studies comprising 3 909 vegetation-plot records. We focused not only on the taxonomic diversity but also on the functional characteristics of communities. Species richness of most habitat types increased over time, and taxonomic and functional community composition shifted significantly. Habitat specialists and threatened species became less represented in plant communities, indicating a decline in habitat quality. The spread of trees, shrubs, tall herbaceous plants, strong competitors, and nutrient-demanding species in all non-forest habitats, coupled with the decline of light-demanding species, suggests an effect of eutrophication and natural succession following the abandonment of traditional management. Moreover, we identified specific trends in certain habitats. In wetlands, springs and mires, moisture-demanding species decreased, probably due to drainage, river regulations, and increasing drought resulting from climate change. Dry grasslands, ruderal, weed, sand and shallow-soil vegetation became more mesic and successional processes were most pronounced in these communities, suggesting a stronger effect of abandonment of traditional management and eutrophication. In alpine and subalpine vegetation, meadows and mesic pastures, and heathlands, insect-pollinated species declined, and the proportion of grasses increased. Overall, these functional changes provide deep insights into the underlying drivers and help conservationists take appropriate countermeasures.

Environmental factors, past and current land use drive diversity of different plant species groups in dry grasslands of Southern Moravia (Czech Republic)

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The basiphilous dry grasslands in the Pannonian region of South Moravia, Czech Republic, host a high diversity of vascular plants, and are threatened by factors such as the absence of management and intensive cultivation of surrounding land. We aimed to explore how the diversity of selected species groups within patches of these grasslands relates to landscape parameters and abiotic conditions, focusing on whether this diversity reflects current and historical land use. We used 695 vegetation plots of narrow-leaved and broad-leaved dry grasslands, primarily sourced from the Czech National Phytosociological Database (Chytrý & Rafajová 2003), and supplemented with 32 newly sampled plots. These plots were linked to patches of dry grasslands as delimited within the national habitat mapping scheme. Through this linkage, we obtained a set of 182 sites to examine the effects of environmental and landscape factors (e.g. habitat patch size, continuity and isolation) on various diversity metrics using the Random Forests algorithm. Our findings indicate that larger grassland patches are associated with higher alpha diversity but also a higher proportion of problematic species (i.e. invasive, expansive or ruderal). Past land use appears to be crucial for endangered species, as they benefit from longer continuity and stable management of the habitat patches. Additionally, the proportion of dry grassland specialists is particularly influenced by environmental factors, including climate, heat load and topographic heterogeneity.

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Studying the sensitivity of Annex I habitats to pressures on biodiversity and understanding of state-pressure links to answer the needs of the EU Nature restoration law in France

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Following the adoption of the Nature restoration Law in 2024, EU Member States have committed to prevent deterioration, to restore and to re-establish Annex I habitats over their territories. To implement the adapted restoration measures necessary to improve to good condition areas of those habitat types, it is necessary to understand the factors contributing to their degradation. The Driver-Pressure-State-Impact-Response (DPSIR) model (1) has been developed to describe environmental responses to anthropogenic pressures. Following this framework, it is theoretically possible to map habitats condition by overlaying habitat distribution data with standardized and spatialized data available on pressures. However, it is important to ensure that the pressure in question is indeed the cause of the degradation of the considered habitat. This is the goal of studying of the sensitivity of habitats to pressures. Sensitivity is described as the combination of resistance (the ability to tolerate external pressure) and resilience (the time required to recover from the degradation faced) (2). The national centre of expertise on biodiversity, "PatriNat", supports the French ministry in charge of the environment in the implementation of the EU restoration law by mapping restoration priorities and providing recommendations on restoration measures. This presentation will therefore detail the ongoing work to evaluate the sensitivity of Annex I habitats to every pressure they may face, based on literature and expert consultation. We will first address resistance, aiming to prevent degradation, before focusing on recuperation. We will first study the 5th group of habitat types from the restoration law: Steppe, heath and scrub habitats. Our plan is to increase knowledge of the ecology of each habitat, in order to identify the threatening pressures. For example, analyses of plant functional traits composing habitats could help us understand their sensitivity to certain pressures. The study of the links between state and pressure at the habitat group level should also help to better understand the causes of ecosystem degradation on land. In the end, it will help to recommend relevant pressure reduction measures and strategies. Indeed, the restoration of degraded habitats will necessarily require actions and measures aiming to prevent current pressures, before applying potential interventionist restoration measures.

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Six decades of losses and gains in European plant alpha diversity

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Quantifying temporal changes in biodiversity is crucial given the ongoing anthropogenic pressures on ecosystems. However, long-term time series data with broad spatial and temporal coverage remain scarce. To address this gap, we applied a novel machine learning method to interpolate species richness changes across space and time, leveraging sites surveyed only once instead of relying on traditional time series. Using data from 698,692 vegetation plots across Europe, we quantified changes in vascular plant alpha diversity (i.e., plot–level species richness) in four major habitat types (forest, grassland, scrub, and wetland) over six decades (1960–2020). Our approach produced reliable predictions when tested against independent time series data, unlocking an unprecedented amount of vegetation plot data for estimating species richness dynamics. We found an overall near-zero mean net change in species richness between 1960 and 2020. However, species richness generally declined from 1960 to 1980 across habitats, followed by an increase from 2000 to 2020. Declines were more pronounced in forests, but trends varied significantly across habitats and European regions, with overall increases at higher latitudes and in mountains, and declines or stable trends elsewhere. While the "biodiversity conservation paradox" – the previously reported average of zero net local diversity change – holds true overall, our findings reveal distinct regional, habitat-specific, and temporal variations in local biodiversity change, emphasizing the need for context-dependent conservation policies and targeted local actions.

Traditional ecological knowledge of Eurasian herders about patterns and dynamics of vegetation

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Traditional herders feel themselves part of local nature, and have an internalized responsibility to manage pastures and livestock well (Sharifian et al. 2023). Herders can distinguish between 100 and 200 wild plant species on their pastures, and they are knowledgeable about the ecological preferences of these plants, and whether their animals prefer or avoid these species (Molnár 2017). Herders use at least 35 indicators to describe the forage quality of these species (Sharifian et al. 2023). They partition their home landscapes into 60-100 (even upto 140) different types of habitats at multiple scales (micro, meso and macro), many of them are equivalent with phytosociological associations or higher taxa (Molnár 2013, Gantuya et al. 2019). Herders use 30-40 different indicators when they report recent and ongoing changes of their landscapes (e.g. vegetation, hydrology, climate; Gantuya et al. 2021, Sharifian unpubl.). Traditional herders' rich ecological knowledge is based on the reciprocal learning between the livestock and the herder (and in some cultures by nature itself; Gantuya et al. 2021). Using multiple livestock types and feeding skills, and flexible herd composition herders optimize the use of various forage plant resources. They strive to manage their pastures optimally, avoiding forage wasting, and overgrazing through understanding the relative and changing palatabilities of forage plant species and pasture types (*If we came here in the morning, they would not eat. Half-satiated they eat, even like it.*). They monitor closely and predict forage quantity and quality using a set of locally relevant indicators (Molnár 2017, Sharifian et al. 2023). Herders's decisions have multiple impacts on vegetation pattern and dynamics. Through motivating the utilization of less preferred parts of their pastures, they can increase local species diversity, avoid overgrazing, improve forage quality, prevent the accumulation of herbaceous litter, and suppress competitive bushes and tall plants (like *Phragmites, Typha, Calamagrostis*). *They graze where I want them to graze* – they keep argue. Herders can also decrease trampling by controling their livestock in the perpetual search for the best forage (*We slowed them to eat mixed.*). We acknowledge that overgrazing is still an issue in some parts of Europe but undergrazing and abandonment of grazing is a much bigger and increasing problem across Europe. Experience shows that herders can be valuable partners of conservationists, especially the so-called conservation herders. The challenge is the reconsideration of their long-tested management knowledge and practices along the recently (since the mid 20th century) developed objectives and values of nature conservation.

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Vegetation Monitoring and Mapping. Ecological classification of land based on Potential Natural Vegetation: a new quantitative & multivariate approach to map ecosystems. The

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Nature and biodiversity make life possible, provide health and social benefits and support our economy. In Europe and many other countries worldwide, ecosystems and services they provide are under pressure from urban sprawl, intensive agriculture, pollution, invasive species and climate change, resulting in widespread degradation since more than 80% of habitats are in poor condition (1). The Nature Restoration Law aims to put Europe's biodiversity on the path to recovery by 2030 to benefit people, climate and the planet. It is acknowledged that protecting biodiversity is essential to reforming ecosystems that host it. Restoring wetlands, rivers, forests, grasslands, marine ecosystems, and the species they host is imperative. Effective land management and biodiversity conservation rely on a thorough comprehension of ecosystems, which makes it necessary to describe, characterise, and spatially locate them (2). The ecological classification of land can help delineating ecosystems through a hierarchical approach that defines homogeneous portions of territory, or Land Units (LU), based on their homogeneity according to physical and biological features at various scales (3,4). A valid approach to classify LU is associating the physical factors with the corresponding Potential Natural Vegetation, a mature vegetation stable in time, developing in sites under undisturbed conditions. Vegetation-based landscape classifications thus reflect combinations of different vegetation types, promote understanding of landscape patterns and support ecological restoration (5). Potential vegetation approaches also enable the classification of currently transformed landscapes, representing a fundamental tool for selecting species suited for these environments in ecosystem restoration actions or as a guide for nature-oriented agricultural and silvicultural management (6). To provide a standard methodology useful for fine-scale research on urban and peri-urban areas, we propose an updated ecological classification of land based on PNV-LU relationships that has been tested for the Functional Urban Areas (FUA) of Campobasso (Italy, Molise Region). We applied a deductive process, dissecting wholes into parts based on environmental discontinuities (concerning climate, lithology and geomorphology features), and leading to the hierarchical delineation of LU within which phytosociological surveys were homogeneously stratified in woodland patches, followed by vegetation analyses based on clustering and Indicator Species Analyses. Therefore, relationships between recognised vegetation typologies and environmental variables were investigated through multivariate analyses, leading to the estimation of threshold values for each diagnostic feature. In conclusion, a detailed PNV/Environmental Land Unit map of the study area was obtained, improving the cartographic products already available at the regional/national level. This tool enriches the basic knowledge on mature forest ecosystems and may support effective restoration actions for the specific case study, but can be also transferred and generalised for wide-scale research on urban biodiversity (such as that on the overall Italian FUAs promoted by the National Biodiversity Future Center).

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Unlocking the potential of biodiversity data stored in vegetation databases

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Openly sharing species composition data from vegetation plots is crucial for advancing biodiversity research and strengthening global conservation efforts. Large-scale vegetation databases play a vital role in synthesizing and harmonizing plot-based biodiversity data, facilitating ecological research across regions and time. Publishing vegetation plot data via GBIF.org further enhances the accessibility and impact of such data by ensuring compliance with global biodiversity data standards and integrating it into a broader, open-access framework. By making biodiversity data freely available, GBIF contributes to international conservation initiatives, including the Convention on Biological Diversity (CBD), the International Union for Conservation of Nature (IUCN), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). These efforts support data-driven decision-making for biodiversity protection, ecosystem management, and sustainable land-use planning. This presentation will highlight the benefits of open data sharing for vegetation scientists and society, including fostering scientific innovation, ensuring effective citation tracking, supporting conservation efforts, and informing policy. Practical steps for publishing vegetation plot data on GBIF.org will also be covered, including becoming a publisher, applying open licenses, selecting appropriate standards like Darwin Core, and exploring hosting options and publishing tools. These guidelines will be illustrated with examples of published vegetation datasets, demonstrating their contributions to biodiversity science and global conservation policies.

The role of soil ion composition for plants in saline habitats

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In salt-affected environments, salinity shapes ecosystem function. However, little is known about specific soil ions, most of which contribute to salinity, as possible edaphic drivers of plant species occurrence, composition, or richness patterns. Our studies (1,2) asked whether soil ions explain species composition and whether they are important for species occurrence. In addition, we hypothesized that soil ions co-determine plant species niche differentiation and are related to variance in species richness. For analyses of ion importance and species richness, we also explored whether we would see differences if we looked at halophytes and associated species separately. We assembled high-resolution data on plant occurrence and chemical topsoil characteristics, including pH, electrical conductivity (EC), sodium adsorption ratio (SAR), and concentrations of Ca2+, K+, Mg2+, Na+, SO42-, Cl-, CO32- and mineral nitrogen in 433 plots within the Carpatho-Pannonian region (Central and Eastern Europe). To investigate the effects of ions on species composition, we compared unconstrained and constrained ordinations. We used random forests (RF) to analyse the importance of ions for individual species, and tested for significant differences in ion importance between halophytes and associated species using Friedman or Wilcoxon tests based on the sum-normalised mean decrease in RF model accuracy. To calculate realised plant niches, we fitted response curves with Huisman-Olff-Fresco (HOF) models and constructed two-dimensional species niche plots for key ions. We explored the relationship between soil chemistry and plant species richness by calculating commonality analyses and, in a separate attempt that anticipated recurrent patterns in soil chemistry, classified topsoils using k-means clustering and compared differences in species richness across clusters (topsoil types) using negative binomial, generalised linear and beta regression models. Ions explained a considerable proportion of species compositional variation. Na+, followed by SO42−, Cl−, CO32−, Ca2+, Mg2+, and mN, was most important for the occurrence of individual species, but their importance differed for associated species and halophytes. Ion concentration niches varied among species and did not necessarily correspond to soil salinity or alkalinity. Shared effects contributed most to the relationship between soil chemical factors and the variance in total species richness and richness of associated species. The most saline or alkaline topsoil types had significantly lower species richness than all others. However, the variation in halophyte richness could not be explained by topsoil chemical features nor differed between topsoil types. We show that ion composition is an important edaphic variable that helps us understand the functioning of saline environments, co-determines niche differentiation, and partly relates to species richness.

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Vegetation of inland salt marshes in temperate Europe

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The natural inland salt marsh habitats have been legally protected in Europe for years but are still declining. They are listed in the European Red List of Habitats as endangered. The principles of their protection are related to the species and vegetation syntaxonomic units, defined by the characteristic combination of diagnostic species. We aimed at the classification of vegetation and validation in terms of vegetation units' relation to the environment and then their functioning based on functional traits. We also assessed the role of diagnostic species in vegetation functioning. In our work, we focused on the vegetation from the northern part of temperate salt marshes to limit confusion related to species' geographical ranges. We collected the database of over 1000 vegetation plots from different European countries and applied the Cocktail method to analyse the data. To identify functional traits distinctive to individual vegetation units, we considered a set of traits from the CLO-PLA and LEDA databases responsible for the persistence, regeneration, and dispersability of approximately 400 species recorded. For diagnostic species role assessment, we chose three typical inland associations. We included biochemical traits not considered up to now in vegetation ecology. Classification results revealed nine classes, including two typical for salt-marsh vegetation – the *Therosalicornietea* and *Festuco-Puccinellietea*. Within these two classes, we distinguished two alliances and five associations. The classes differ the most regarding species preferences for salinity, soil moisture, light availability and soil nitrogen content. In addition, salt marsh associations differ also by soil reaction and soil organic matter content (1). Based on functional traits analysis, we found that the syntaxonomic vegetation units are also functional. The functional traits responsible for plant persistence are the most important factors separating vegetation classes and salt marsh plant associations. Traits related to regeneration, such as seed number and seed number per shoot, also play essential roles in grouping species into individual associations (2). Diagnostic species' role assessments demonstrated that diagnostic species play a crucial role not only in distinguishing phytosociological units but also in their functioning (3). Among the analysed associations, *Salicornietum ramosissimae* was the most adapted to the osmotic and oxidative stress under soil salinity. *Triglochino maritimae-Glaucetum maritimae* showed the highest values of most measured morphological parameters related to biomass production but the lowest salt resistance expressed by the highest level of osmotic and oxidative stress markers. The *Puccinellio-Spergularietum salinae* association had the lower biomass production. This association is similar to *Triglochino maritimae-Glaucetum maritimae* in managing osmotic stress but is more adapted to oxidative stress. Our results demonstrated a close relationship between the syntaxonomic and functional concepts of vegetation. These findings may bring practical application in new approaches and protection strategies for salt marsh habitats.

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Integrating Drone Truthing and Supervised Classification of Remote Sensing Time Series for Enhanced Vegetation Mapping and Monitoring

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Phytosociological maps are essential for biodiversity monitoring and conservation. Supervised classification of multispectral satellite time series using machine learning can achieve high accuracy, even when mapping numerous vegetation categories or habitats (1). However, the effectiveness of this approach depends on the availability of large and high-quality reference data, which cannot be fully provided by field surveys alone. Therefore, the main limitation in vegetation mapping is not satellite image processing, but rather the collection of reference data needed to train the machine learning classifier (2). To address this challenge, this study presents an approach to collecting vegetation data using drones equipped with optical zoom cameras. Well-designed procedures were implemented to capture ultra-high resolution imagery, allowing phytosociologists to identify and estimate species abundance within plots and assign them to specific vegetation categories. The drone truthing data were then used to train machine learning models to recognise different vegetation types in Sentinel-2 multispectral time series. This method was applied to several Natura 2000 sites in the Marche region (central Italy), covering a range of forest, shrub and grassland types in a temperate sub-Mediterranean bioclimatic context. For each Natura 2000 site, between 700 and 1000 plots were verified and assigned to the target vegetation categories. These reference datasets were then used both to train the machine learning classifier and to validate the resulting maps, which achieved overall accuracies (OA) of between 89% and 92% across all study areas. This highlights the effectiveness of the approach in producing highly accurate maps. The results further emphasise the value of drone truthing, as it enables the creation of large, spatially balanced reference datasets, which are essential for the production of reliable vegetation maps. By capturing the spectral variability of vegetation, these datasets facilitate the identification of key phenological patterns that differentiate vegetation types. In addition, the integration of drone truthing with supervised classification of Sentinel-2 time series allows for continuous updates of vegetation and habitat maps. Drone-based imagery creates a high-resolution photographic archive, including for small or scattered habitats, complementing phytosociological maps as a valuable tool for long-term monitoring. This approach supports habitat assessment and restoration efforts in line with the requirements of the Habitats Directive and EU Restoration Law. Finally, drone-based ground truthing serves as a complementary tool to traditional methods such as the Braun-Blanquet approach. In the same way that a botanist uses a hand lens or a small hoe, drones serve as an additional tool that could enable species identification and plot assignment to a pre-defined vegetation type in inaccessible or complex landscapes.

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Vegetation plot data on Mediterranean islands capture a limited subset of the local plant species diversity

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Large-scale vegetation plot databases have enabled unprecedented advances in plant research, by making biodiversity data widely accessible in standardised formats. This has prompted new opportunities of plant community analyses, both at continental and global scales, providing insights on how species diversity is geographically distributed. Given that vegetation plots have a strong focus on the study of plant communities, the species lists obtained by aggregating them usually underestimate the overall diversity. However, the extent of this phenomenon has not been assessed yet on a wide regional area. The Mediterranean Basin is one of the World biodiversity hotspots, with thousands of vegetation plot data collected in the last century, recently included in the European Vegetation Archive (EVA). Moreover, the recent release of the MEDIS database (1), a spatial database providing spatial and environmental data for the 2,217 Mediterranean islands larger than 0.01 km2, enables a straightforward data categorisation at the island level, making such an assessment possible. With this study, we aimed to evaluate the availability of vegetation plot data for Mediterranean islands and their ability in capturing the island species diversity, by comparing them with single species occurrences and checklist data. We obtained plot data from EVA, species occurrence data from the Global Biodiversity Information Facility (GBIF), and species checklists from the Global Inventory of Flora and Traits (GIFT). We harmonised taxonomy in accordance with the World Checklist of Vascular Plants and aggregated data at island level. GIFT checklists are available for 269 islands (12.1%), a distinctively lower number than EVA (450; 20.3%), and GBIF (504; 22.7%); however, GIFT provides data for a considerably larger number of species (7,741), with respects to EVA (3,782) and GBIF (4,732). Moreover, the 50 most frequent species in GIFT have significantly higher frequencies than those in EVA (27 to 45 islands), and GBIF (28 to 49 islands). These patterns confirm that systematically collected floras are preferable than different data sources, to capture the island plant diversity. However, vegetation plots provide data for several areas not covered by GIFT (e.g., many French and Italian islands, or several islands along the North African coastline), making them a good source to retrieve tentative checklists when an official island flora is lacking. Our study highlights the necessity to include already available island floras in public databases and encourages field data collection in under-sampled areas.

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Can information about land cover continuity provide useful insights for habitat monitoring and restoration?

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Habitat loss and fragmentation have been seen as major causes of biodiversity decline (1). There have been several attempts to halt this decline by implementing different policies, especially in Europe, like the EU's biodiversity strategy for 2030 and most recently the Nature Restoration Law. Information about past landscape structure and presence of (semi)natural habitats can help in identifying localities and regions where some habitats can be restored to some success. Moreover, it has been shown that present-day species richness can be to some extent explained by past landscape pattern (2, 3). The European landscape has changed significantly over the last 200 years with intensification on one hand and abandonment on the other. Yet, there are still localities where the land cover did not change. These localities could be seen as a backbone for halting biodiversity loss and stepping stones for further restoration efforts if they at the same time consist of the habitats with good ecological quality. In this contribution, we combine information about localities with 180-year continuity based on the TopoLandUse database and information about habitats and their ecological quality based on the habitat mapping covering the whole territory of the Czech Republic. The TopoLandUse database contains information about land cover from five periods (1840s, 1870s, 1950s, 1990s, 2000s) while the habitat mapping layer contains information about the spread of natural habitats mapped during the 2000s and their ecological quality based on their representativeness and preservation. We focused on three (semi)natural land cover classes – forests, grasslands and water bodies. Results show that the most widespread land cover classes with 180-year continuity were represented by forests (24% of the country's area), followed by grasslands (2%) and water bodies (less than 0.5%). Patches with these land cover classes contain different types of habitats or their mosaics that not always represent the land cover class, e.g. continuous grasslands can also have forests or wetlands. For continuous forests, only about 1/3 of their area is covered by natural habitats with good ecological quality. In case of continuous grasslands, nearly half of their area is covered by natural habitats with good quality. Continuous water bodies are the best covered by natural habitats (2/3) but their quality is rather poor. To conclude, both continuous grasslands and water bodies do indeed host more natural habitats but with various quality and can be seen as stepping stones for restoration activities. However, their significance is hindered by their small spatial extent.

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PhytoS: an online nomenclatural database of plant community names

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For a number of years, there has been a growing need for a tool that compiles all published names of the Braun-Blanquet school at the rank of association and above, in order to know if a given name already exists, where it has been published and what its type element is. The development of PhytoS, an online nomenclatural database of plant community names, aims to fill this gap. Furthermore, PhytoS goes beyond specific schools and the name of any plant community at any other rank (e.g. subassociation, variant) or without a rank (e.g. plant community type) from any school can be registered too. The ultimate goal of PhytoS is therefore to enable the registration of described plant communities on a worldwide basis, in order to provide as a free resource to the wider scientific community working on this topic, and to the public, a tool to search for both specific published names and any published denomination of plant communities according to criteria such as syntaxonomy, geography, author, year. Overall, PhytoS is intended to play the same role in the study of vegetation as the IPNI does in the study of plants. In particular, PhytoS will be an important tool for the regular updating of the European Vegetation Checklist, which is an important task of the European Vegetation Survey.
With the financial support of IAVS (1), the development of PhytoS, which started in 2023, will be presented in its current state.

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Monitoring habitat deterioration in small temperate mires using aerial and satellite imagery: verification using ground-based vegetation data

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Mires in agricultural landscapes are highly sensitive, endangered ecosystems of immense ecological significance. Their deterioration caused by eutrophication or desiccation leads to biodiversity loss and a shift from carbon dioxide sink to source. This change is commonly manifested by increasing vegetation productivity. The large-scale, in-time monitoring of vegetation productivity and site wetness in mires might help adopt conservation management to reverse or slow down undesired changes. Ground-based measurements are inherently time-consuming and spatially inefficient. Here, we tested the utility of remote sensing techniques, such as aerial and satellite imagery, to detect deterioration of mire habitats associated with enhanced productivity. We focused on the initial phases of deterioration of small, diverse island-like mires in the Central European agricultural landscape. We analyzed aerial imagery and satellite data from freely available sources, such as regular aerial surveys of Czechia and the Copernicus Sentinel program managed by the European Space Agency. We confronted them with directly collected vegetation data in the plots that differed in productivity and deterioration levels. While RGB imagery and the long intervals between aerial sampling limited our ability to capture extensive metrics, we could measure the NGDRI index with high spatial detail. Conversely, Sentinel-2 data enabled the collection of tens of datasets over the past seven years, suitable for temporal averaging, though constrained by limited resolution. We demonstrate that the deterioration of mires can be effectively indicated by both methods, opening an opportunity for extensive monitoring and calibration of vegetation databases. However, this methodology cannot be fully effective without ground-based calibrations.

Predicted climate change and land-use intensification likely speed up C4 grass invasions in Europe

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In Europe, alien C4 grass species have the potential to take benefit of a changing climate, being better adapted to higher temperatures and heat stress. Our aim was to compile an up-to-date inventory of alien C4 grass species in Europe, to find information about their distribution and country- and region-wise statuses, to identify the most widespread and high-risk species, and the most invaded habitat types, and to draw the temporal trends of their European establishment. We used the standard systematic literature review methodology to identify relevant publications and online plant distribution databases to get an up-to-date list of alien C4 grass species in Europe. We aimed also to gather information on (1) their current country- and region-wise distribution; (2) alien status in each country (casual, naturalised, invasive); (3) the most widespread and high-risk species; (4) native climatic zones and habitat preferences of each species in European countries; and (5) temporal distribution patterns of the identified species. We detected 133 alien C4 grass species across Europe, with the highest number of species in Western European countries (103 species), and the lowest in Northern Europe (69 species), with considerable overlap among regions. Southern Europe stands out with the highest number of naturalised (55) and invasive (21) species compared to other regions, while Northern Europe has the highest number of casual species (53). We identified the most widespread and high-risk species, including those from tropical and subtropical climatic zones, which pose the highest invasion risks. These species predominantly occur in ruderal and anthropogenic habitat types, but also in natural habitat types, especially in grasslands. Regarding temporal trends, we detected an alarming increase in the establishment of tropical C4 grasses in Europe in recent decades.

High mountain grassland and shrub vegetation of Central Balkan Mts. (Central Stara Planina Mts.), Bulgaria

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The syntaxonomy, ecology and successional patterns of the high mountain vegetation in Bulgaria are relatively understudied. Certain vegetation types, particularly in the subalpine and alpine belts, have been largely unexplored. The present research is a first attempt to present a comprehensive classification of the grassland and shrub vegetation of the Central Balkan Mts. (Central Stara Planina Mts.) above the tree line, according to the classical Braun-Blanquet's approach. In total, 157 unpublished relevés, collected in the period 2002-2023, were subjected to hierarchical cluster analysis. A detrended correspondence analysis was performed to delineate main gradients in floristic composition. As a result, ten associations, one community and ten alliances, belonging to eight orders and six vegetation classes (*Juncetea trifidi, Salicetea herbaceae, Elyno-Seslerietea, Nardetea strictae, Loiseleurio-Vaccinietea, Calluno-Ulicetea*) have been identified and described. Most of the alpine and subalpine vegetation types grow on silicate base rocks and exhibit phytogeographical relationships with the Rila and Pirin Mts. in the south, as well as the Carpathians in the north. The current state of the vegetation above the tree line is characterized by complex successional dynamics, resulting in an unstable balance between the upper forest boundary, low shrub and grassland communities.

Rapid response of multi-taxa understorey diversity and composition to experimental interventions in subcontinental oak forests.

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Decline of species-rich grass-dominated communities of nemoral oak woods were observed across the temperate Europe in the last decades. To reveal the causes of these changes and to test the potential for restoration, we established a field experiment in subcontinental forests dominated by *Quercus petraea* (*Sorbo torminalis-Quercetum*) on andesite bedrock of the Western Carpathians. After baseline vegetation sampling (eight plots in five replications/localities), combinations of three treatments were applied: canopy cover reduction in autumn 2017 (primarily high shade casting trees as hornbeam were excluded), litter raking and annual N fertilization until 2024. Significant shifts in species composition, richness and diversity were observed over seven years of resampling. Canopy reduction had a positive effect on understory diversity, however, the most rapid increase in species richness was found in the raked plots with the reduced canopy closure in the first two years after canopy reduction. Richness culminated in the 6th year (about 60 compared to original 20 species of vascular plants per 100m^2). Fertilization (50 kg of N/ha/year) did not lead to the expected eutrophication effect and did not cause a reduction in diversity. The greatest changes in species composition were also observed in the raked plots with the reduced canopy cover. Instead of the expected thermophilic effect after canopy reduction (where air temperature increased by 2 °C), a xerification was observed and the communities gradually shifted towards target subcontinental communities dominated by heliophilous grasses (especially *Poa nemoralis*) and xerotolerant forbs (as *Ajuga genevensis*, *Astragalus glycyphyllos, Clinopodium vulgare*, *Euphorbia cyparissias, Hypericum perforatum*, *Trifolium alpestre* and *Torilis japonica*). Perennials finally displaced annual ruderals (such as *Erechtites hieraciifolius, Galeopsis* spec. div., *Senecio sylvaticus*, *Sonchus* spec. div.), which spread over disturbed sites in the early years. Along with the vascular plants, bryophytes and macromycetes were also sampled in the same plots (in two years; after treatment application). While species richness of the bryophytes was higher in raked plots and plots with reduced canopy, the macromycetes responded in the opposite way, and their highest richness was recorded in unmanaged control plots. To conclude, mesophication and diversity decrease in the oak woodlands is a consequence of high canopy closure increased by hornbeam and other high shade-casting species in an interaction with a litter accumulation. On the other hand, effective and rapid restoration is possible after the exclusion of highly shading trees (up to 30 % of canopy cover) and 2-5 years of the litter raking.

Vegetation of low-elevation calcareous petrifying springs (*Lycopodo europaei-Cratoneurion commutati*) in Western Ukraine in the broader geographical context of the central and southeastern parts of Europe

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Low-elevation calcareous petrifying springs with tufa formation dominated by calcium-demanding vascular plants and bryophytes of the *Lycopodo europaei-Cratoneurion commutati* (2) alliance are endangered and highly important for biodiversity protection. This study aims to revise previous syntaxonomic concepts and provide a unified classification of the *Lycopodo europaei-Cratoneurion commutati* communities in eastern part of Central Europe and Southeastern Europe, emphasizing the classification of Ukrainian communities. We assembled an initial dataset of 196 relevés of calcareous petrifying spring vegetation from Central (Czech Republic, Slovakia, Poland) and Southeastern Europe (Romania, Bulgaria, Montenegro, Serbia, Greece) and Ukraine, resulting in 139 relevés after the HCR resampling (1). The non-hierarchical classification (ISOPAM) (3) resulted in four clusters which could be interpreted, according to the presence or absence of own diagnostic taxa, as the associations or subassociations: (i) *Eucladietum verticillati*, (ii) *Brachythecio rivularis-Cratoneuretum commutati typicum*, (iii) *Brachythecio rivularis-Cratoneuretum commutati rhynchostegietosum riparioidis*, (iv) *Tussilago farfareae-Cratoneuretum commutati typicum* and *Tussilago farfarae-Cratoneuretum commutati pinguiculetosum hirtiflorae*. The latter three syntaxa had to be formally described. All these syntaxa, except for the last one, are reported from Ukraine. Individual communities are differentiated regarding nutrient availability, temperature and light availability. This cross-regional synthesis provides the first unified classification at the association level within the *Lycopodo europaei-Cratoneurion commutati* alliance for the central and southeastern part of Europe.

1) A. Lengyel, M. Chytrý, L. Tichý (2011) Heterogeneity-constrained random resampling of phytosociological databases. Journal of Vegetation Science, 22 (1): 175–183.
2) T. Peterka, P. Hájková, M. Jiroušek et al. (2023) Formalized classification of the class Montio-Cardaminetea in Europe: towards a consistent typology of spring vegetation. Preslia, 95: 345–383.
3) S. Schmidtlein, L. Tichý, H. Feilhauer & U. Faude (2010) A brute-force approach to vegetation classification. Journal of Vegetation Science, 21: 1162–1171.

Vegetation Classification of Europe: Current knowledge of the vegetation diversity of Bulgaria

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The territory of Bulgaria is characterized by a significant diversity of abiotic conditions (topography, climate, soils, etc.), which has led to the formation of diverse flora and vegetation. During a long period (1945-1995), vegetation studies followed the Dominant Approach, which is in contrast with the widespread application of the Braun-Blanquet method in neighbouring countries and Europe. Another major problem is that a significant part of the phytosociological literature presents only descriptive vegetation data without complementary phytosociological relevés. Over the last 25 years, phytosociological studies have gradually increased significantly and followed the Braun-Blanquet method. Currently, 33 781 phytosociological relevés are available in the Balkan Vegetation Database and Balkan Dry Grassland Database, which combine digitized data from the literature and personal data of the authors. A significant proportion of the relevés are unpublished (77.7%) and were collected between 2010 and 2024 (67.8% of all relevés). After statistical processing of the data, the vegetation diversity of Bulgaria is currently represented by 53 classes (98.2% of all plots), 71 orders (38.5%), 103 alliances (38.3%), and 136 associations (28%). The richest in syntaxa classes are *Festuco-Brometea, Carpino-Fagetea sylvaticae* and *Molinio-Arrhenatheretea*. Significant data were collected during the period 2017-2023 for the classes *Papaveretea rhoeadis, Phragmito-Magnocaricetea, Digitario sanguinalis-Eragrostietea minoris, Artemisietea vulgaris, Crataego-Prunetea, Helianthemetea guttati, Sisymbrietea, Epilobietea angustifolii, Lemnetea, Bidentetea* and *Potamogetonetea*. The classes *Carici rupestris-Kobresietea bellardii, Thero-Salicornietea strictae, Charetea intermediae, Littorelletea uniflorae, Juncetea maritimi, Cakiletea maritimae, Adiantetea, Cymbalario-Parietarietea diffusae, Oxycocco-Sphagnetea* are still largely unexplored. In recent years, as a result of targeted research, vegetation diversity has been well studied in the southern and western parts of the country, while in Northern and Eastern Bulgaria, studies are still insufficient. Investigations need to continue and to cover all existing vegetation types systematically on the whole territory of the country.

Uncovering Alpine Refugia: Factors Beyond Temperature

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As climate change accelerates, alpine species face increasing habitat loss, potentially leading to local extirpation. It has been argued that fine-scale microclimatic variability in alpine terrain may create (micro)refugia that may provide strongholds for diversity of alpine plant species in a warming world. The long-term viability of such microrefugia remains uncertain due to constraints not only related to temperature but also to snow cover and substrate conditions. To assess their impact on alpine plants, we investigated how temperature, snow, and substrate conditions control the current vascular plant species composition of 824 vegetation plots sampled on the Schrankogel (3,497 m a. s. l.), a mountain in central Alps, Austria. Specifically, we fitted a Generalized Dissimilarity Model (GDM) to the sampled species turnover and used the fitted model to project the dissimilarity of the entire alpine landscape to each of these 824 plots on a 1 m²-resolution. Based on the projections, we identified plant assemblages predicted to be more similar in species composition to vegetation 400 m above their elevation than to the one predominating at the elevation where they grow. We interpret these assemblages as current microrefugia as they are low-elevation outposts of higher elevation vegetation. We subsequently matched these low-elevation-outposts with sites characterized by temperature, snow and substrate conditions that are more likely to be found 400 m higher to identify the factor that drives their occurrence. Our results showed that microrefugia are not uniquely attributable to unusually cold temperature; instead, the vast majority appears to be controlled by snow cover duration and soil properties. As a corollary, those species that dominate the surrounding vegetation today will only be able to use these sites as microrefugia in the future if they are adapted to cope with their peculiar snow and substrate conditions. By distinguishing microrefugia maintained strictly by cold temperatures from those requiring species' tolerance of atypical snow and soil conditions, we provide a more nuanced perspective on in-situ survival of alpine plant species under climate change. Our findings emphasize the need for integrative approaches that account for multiple environmental factors rather than focusing solely on temperature, offering valuable insights into the mechanisms governing species persistence in alpine landscapes.

WorldVegChecklist – inventory and revision of the world's syntaxonomic classes

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Low-elevation calcareous petrifying springs with tufa formation dominated by calcium-demanding vascular plants and bryophytes of the *Lycopodo europaei-Cratoneurion commutati* (2) alliance are endangered and highly important for biodiversity protection. This study aims to revise previous syntaxonomic concepts and provide a unified classification of the *Lycopodo europaei-Cratoneurion commutati* communities in eastern part of Central Europe and Southeastern Europe, emphasizing the classification of Ukrainian communities. We assembled an initial dataset of 196 relevés of calcareous petrifying spring vegetation from Central (Czech Republic, Slovakia, Poland) and Southeastern Europe (Romania, Bulgaria, Montenegro, Serbia, Greece) and Ukraine, resulting in 139 relevés after the HCR resampling (1). The non-hierarchical classification (ISOPAM) (3) resulted in four clusters which could be interpreted, according to the presence or absence of own diagnostic taxa, as the associations or subassociations: (i) *Eucladietum verticillati*, (ii) *Brachythecio rivularis-Cratoneuretum commutati typicum*, (iii) *Brachythecio rivularis-Cratoneuretum commutati rhynchostegietosum riparioidis*, (iv) *Tussilago farfareae-Cratoneuretum commutati typicum* and *Tussilago farfarae-Cratoneuretum commutati pinguiculetosum hirtiflorae*. The latter three syntaxa had to be formally described. All these syntaxa, except for the last one, are reported from Ukraine. Individual communities are differentiated regarding nutrient availability, temperature and light availability. This cross-regional synthesis provides the first unified classification at the association level within the *Lycopodo europaei-Cratoneurion commutati* alliance for the central and southeastern part of Europe.

1) A. Lengyel, M. Chytrý, L. Tichý (2011) Heterogeneity-constrained random resampling of phytosociological databases. Journal of Vegetation Science, 22 (1): 175–183.
2) T. Peterka, P. Hájková, M. Jiroušek et al. (2023) Formalized classification of the class Montio-Cardaminetea in Europe: towards a consistent typology of spring vegetation. Preslia, 95: 345–383.
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Are Braun-Blanquet's associations still valid? The example of the inneralpine dry grasslands

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In his seminal work on the vegetation of the dry inner valleys of the Alps, J. Braun-Blanquet (1) distinguished a huge number of grassland associations based on regional character species. Each valley system had its own set of regional associations, mostly reflecting different site conditions within each region. Later authors often criticised Braun-Blanquet's association concepts or had problems to apply it to their own data. In a phytosociological revision of the dry and semi-dry grasslands of the Eastern Alps (2), we evaluated Braun-Blanquet's associations using a data set of 2924 relevés. We used TWINSPAN to analyse the floristic patterns and test previous association concepts. A unit was accepted as association if it could be given an unambiguous floristic definition and, at the same time, had a clear biogeographical and/or ecological individuality. The main selection criterion for diagnostic species was their suitability for discriminating the vegetation units along the chosen (ecological and/or geographical) gradient to be reflected in the classification, without following a strict fidelity threshold. Of the 18 associations described by Braun-Blanquet, 11 could be confirmed and accepted, five had to be rejected, while two associations were preliminary accepted but need further confirmation by additional data. Moreover, one subassociation of Braun-Blanquet had to be raised to association rank. Of the rejected associations, four were merged with ecologically analogous associations of other regions due to insufficient floristic differences. Only in one case, two sympatric associations were merged because both their ecological and floristic difference was rather weak. We also confirmed a few additional associations that were described after Braun-Blanquet from areas not visited by him. In conclusion, the majority of Braun-Blanquet's associations could be confirmed even though we applied a markedly different association concept (differential species versus regional character species). This shows that Braun-Blanquet's association concept is quite robust, and different phytosociological approaches lead to similar units. However, it must be emphasised that none of these associations have absolute (i.e., supra-regional) character species. Thus, an association concept relying on supra-regional character species would probably result in a much lower number of associations. We suggest that a concept using a combination of differential species and external criteria (clear ecological and/or geographical differences between the units) is more similar to Braun-Blanquet's approach and also more useful in practical applications such as nature conservation.

1) J. Braun-Blanquet (1961) Die inneralpine Trockenvegetation von der Provence bis zur Steiermark. Gustav Fischer, Stuttgart, Germany
2) W. Willner, G. Kadlec, W. R. Franz, T. Ellmauer, D. Moser (2024) The Stipo-Poion puzzle: syntaxonomic revision of the dry and semi-dry grasslands of the Eastern Alps. Tuexenia, 44: 297–332.

Effects of Post-Fire Silvicultural Treatments on Vegetation Dynamics of *Pinus brutia* Ten. Forests

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The *Pinus brutia* forests exhibit strong fire adaptation through serotinous cones, allowing natural regeneration after wildfires. However, successful regeneration depends on the presence of a sufficient canopy seed bank that remains viable despite the heat generated during the fire. In cases where natural regeneration is insufficient, artificial regeneration techniques, such as seeding and planting, become necessary to ensure forest continuity. Additionally, post-fire soil conservation measures are critical for preventing land degradation. Depending on the fire severity, different silvicultural approaches can be applied. While some studies have examined natural post-fire vegetation dynamics, the effects of silvicultural treatments on vegetation remain unclear. This study aims to evaluate the effects of various post-fire silvicultural treatments (natural regeneration, seed sowing, planting with mechanization, and soil conservation measures through post-fire management) on vegetation dynamics. For this purpose, permanent experimental plots were established in an area affected by wildfire in Antalya, Türkiye, and vegetation surveys were conducted. Plant cover and abundance were assessed using the Braun-Blanquet scale, and field data were analyzed using numerical analysis techniques. The results revealed significant floristic differences among treatments. Species richness was significantly lower in planted areas than in others. Although, colonization of ruderals occurred across all sites by the second post-fire year, it was more pronounced in planted areas. In natural regeneration, seed sowing, and soil conservation sites, pre-fire species successfully recolonized, indicating that mature *Pinus brutia* forests regenerate through an autosuccession process after fire. In summary, mature *Pinus brutia* forests naturally regenerate after wildfires. In cases where the seed bank is insufficient, seeding can support regeneration. Soil conservation measures facilitate vegetation recovery. However, planting with soil mechanization negatively impacts biodiversity. Therefore, when planting is necessary, soil mechanization should be applied in strips rather than uniformly across the entire area to mitigate its negative impacts on biodiversity.

Poster Sessions

Extinction risk assessment of diagnostic species of mire classes – a case of Latvia

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For the first time, the extinction risk assessment according to the IUCN criteria and categories has been carried out in Latvia (2021-2024). We studied 345 vascular plant taxa: legally protected, included in the previous Red Data Book of Latvia (2003), species discovered after 1999 in Latvia, and other species considered rare and endangered in the Baltic Sea region. Diagnostic species are important in mire vegetation classification, but many of them are becoming rare and endangered due to different past and ongoing threats. Here we present extinction risk assessment results of 40 rare vascular plant species diagnostic for mire and spring classes - *Scheuchzerio palustris-Caricetea nigrae* (33 species), *Oxycocco-Sphagnetea* (4), and *Montio-Cardaminetea* (4). The majority of the taxons met the criteria for EN (26), less for VU (6), CR (3), LC (3), NT (1), and RE (1). There are still 64 diagnostic vascular plant species of mire classes present in Latvia that were not assessed. We expect that at least ten of them might also meet the criteria of threatened species. That makes about half of the diagnostic vascular plant species to be threatened in Latvia. We think that the protection of intact mires is the most cost-effective and the most important action to maintain mire species diversity in Latvia, followed by fen management and restoration of mire hydrology. Rare mire species are occasionally recorded in human-made habitats, such as ditch banks, abandoned dolomite and gravel quarries, fire breaks in forests, and abandoned peat extraction sites. Sometimes, they form large subpopulations in these habitats. Nevertheless, these secondary habitats shouldn't be considered as priority sites for mire species protection.

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Approaching the V Report on the Habitats listed in Annex I of Directive 92/43/EEC in Italy: methods, state of the art and challenges

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Under Article 17 of the Habitats Directive (HD), EU Member States must report on the conservation status of habitat types listed in Annex I. The report requires comprehensive information on the progress towards achieving a favourable conservation status and the measures taken to protect these habitats. This process helps evaluate the effectiveness of the HD's implementation and informs the development of future conservation strategies. The V report, covering 2019-2024, is currently being prepared. The institutional referent for the process, on behalf of the Italian Ministry of the Environment and Energy Security (MASE), is the Italian Institute for Environmental Protection and Research (ISPRA), with scientific support from the University of Sassari and the Italian Society of Vegetation Science (SISV). A working group of thematic and territorial experts is analyzing, and validating the data about area, pressures and threats, and conservation measures provided by the Administrative Italian Regions and Autonomous Provinces to ISPRA. The data were arranged in a database developed by ISPRA according to the EU reporting format. National habitat distribution maps based on the European grid ETRS89-LAEA5210 with a 10x10 km² mesh have been collected in a dedicated WebGis system, facilitating access, compilation, and management. Additional sources of information includes the Natura 2000 database released by the MASE in December 2024. Data on 124 types of terrestrial and inland water habitats in Italy are being processed to assess their overall conservation status in the biogeographic regions of occurrence (Mediterranean, Continental and Alpine) and to highlight any inconsistencies. The work includes a critical analysis of data and a broad scientific discussion aimed at finding methodologically robust solutions to address the many gaps that, unfortunately, still exist. The process is designed to ensure the traceability of information and facilitate the collection of scientific articles, phytosociological surveys, and unpublished specialist material, composing a substantial pool of data that supports a long-term approach for future reporting cycles. Cartographic outcomes, associated databases and additional data used for the assessments will be available online on the official website created by ISPRA to facilitate access to national data on the HD as soon as the European Commission will complete the validation process. A freely accessible online archive of phytosociological surveys representative of the various Annex I Habitats in Italy is being set up within the national "VegItaly" database, owned by the SISV. Such a long-term vision oriented to storing and enhancing knowledge represents significant progress towards constructing an effective monitoring system for preserving Annex I Habitats in Italy.

Re-survey forest vegetation across climate and land-use change scenarios in the hemiboreal region: an introduction to study

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The Lithuanian territory is characterised by two types of forests − broadleaved and mixed forests and boreal forests, whose boundary is roughly marked by the edge of the *Carpinus betulus* distribution. Lithuania's geographical position thus means that the vegetation of the region is characterised by transitional features, with combinations of different species that are not always clearly ecologically or phytogeographically related. In addition, the diversity of forest communities is particularly shaped by human activities. Traditionally, vegetation data have been collected in so-called representative communities, bypassing damaged and disturbed communities. Therefore, the aggregation of data collected in this way does not always reflect the actual state of the vegetation. This study would aim to reassess the state of forest vegetation and how it has changed over the last few decades: to identify which changes in communities may have been caused by (1) geographical factors, (2) human activities related to forest use, and which have been caused by (3) a changing climate. Data are collected on transects reflecting use, biogeographical and climatic gradients. Vegetation-plot sites will be selected based on historical data stored in the Lithuania vegetation database (EU-LT-001). The projected vegetation cover and the abundance of individual species are assessed within the 400 m² study plot. The results of the survey will provide an important contribution to the European resurvey of vegetation, which aims to distinguish between long-term and random patterns in vegetation dynamics, and to provide a scientific basis for the practical aspects of a nature restoration strategy.

Preliminary results from an analysis of Italian upland peatland vegetation: syntaxonomical scheme

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Italian upland peatlands brings high-relevant biogeographical values, hosting several vascular plants and briophytes with a N-European ad Circumboreal typically-centered distribution, many of which reach in peninsular Italy, Sardinia and Sicily their southermost limit of distribution (1,2,3,4,5). Peatland sites are distributed mainly in the Alps and in the Northern Apennines, becoming rare and extremely fragmented in Southern Italy and Sicily. However, the physionomic and floristic features of Italian peatland vegetation differ in the Alps from Apennines and Sicily (6). In fact, Alpine peatlands are mostly bogs characterized by *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946 communities wich are absent in the Apennines, S-Italy and Sicily where transitional mires, fen, fen grassland are instead the most widespread biotopes. We summarize here all the phytosociological associations and groupments of Italian upland peatlands distributed along Apennines, south Italian and Sicilian mountain ranges. The syntaxonomical nomenclature of class, orders and alliances follows Mucina et al. (7). A total of 38 associations, 19 sub-associations and variants, 54 groupments ("Aggruppamento", "Community" etc.) belonging to 6 class were recognized. The *Scheuchzerio palustris-Caricetea fuscae* Tx. 1937 includes most of associations and groupments (65%), followed by *Molinio-Arrhenatheretea* Tx. 1937 (16%), *Phragmito-Magnocaricetea* Klika in Klika et Novak 1941 (11%), *Montio-Cardaminetea* Br.-Bl. et Tx. ex Klika et Hadač 1945, *Littorelletea uniflorae* Br.-Bl. et Tx. ex Westhoff et al. 1946 and *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946. Higher *syntaxa* are summarized here: *Littorelletea uniflorae* class in Italy includes amphibious plant vegetation developed on peaty substrates permanently saturated by water (*Hyperico elodis-Sparganion* Br.-Bl. et Tx. ex Oberd. 1957, *Littorellion uniflorae* Koch ex Klika 1935 alliances); the *Molinio-Arrhenatheretea* includes the relict humid swards of the southern upland belts of the Italian peninsula and Sicily (*Dactylorhizo-Juncion striati* S. Brullo et Grillo 1978, *Calthion palustris* Tx. 1937), the mown meadows on prolungated wet peaty soils of siliceous Apennines highland (*Molinio-Holoschoenion* Br.-Bl. ex Tchou 1948, *Molinion caeruleae* Koch 1926) and the wet meadows of high-altitude karst poljes of the Central Apennines (*Ranunculion velutini* Pedrotti 1978); besides, the *Montio-Cardaminetea* class describes the oligothrophic vegetation of peaty springs in mountain clearings (*Cardamino-Montion* Br.-Bl. 1926) or in shady forest environments (*Caricion remotae* Kastner 1941) and also the vegetation of moss-rich calcareous water springs (*Cratoneurion commutati* Koch 1928); *Scheuchzerio-Caricetea* groups the sedge-moss calcareous mineral-rich fen vegatation (*Caricion davallianae* Klika 1934) or the transitional-mires's vegetation (*Caricion fuscae* Koch 1926) while only one association of Tuscan-Emilian Apennines (2) represents *Oxycocco-Sphagnetea* in Apennines context; *Phragmito-Magnocaricetea* includes the helophyte, sedge and rushes bed and herbland vegetation of the most advanced successional stages of mires lifting.

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Epiphytic and epixylic bryophyte and lichen assessment under forest biodiversity monitoring in Latvia

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Epiphytic bryophytes and lichens make up a large proportion of the biodiversity found in natural boreal and temperate forests (1, 2). Forest structure and the processes occurring in the forest ecosystem directly or indirectly affect the distribution and survival of bryophyte and lichen species (3, 4), therefore these organisms are good indicators of forest continuity and effects of management (5), as well as a good indicator of the condition of species associated with old forests (6, 7). To track changes over time, long-term monitoring of these species is essential (8, 9). Therefore, the assessment of bryophytes and lichens is also a part of biodiversity monitoring within the National Forest inventory in Latvia. The initial phase of monitoring, conducted from 2019 to 2023, involved surveying 1797 living trees and 251 logs across 441 monitoring plots. Each year, a different subset of these plots was surveyed to assess bryophyte and lichen species composition. In 2024, the sites surveyed in the first year of monitoring were revisited to evaluate the changes over a five-year period. Epiphytes were assessed on four living trees per plot (if possible) representing different tree species, focusing on larger-diameter trees to capture a greater variety of epiphyte species. Logs with at least 20 cm diameter were also surveyed to measure the richness of epixylic species. In total, 47 bryophyte and 88 lichen taxa were found on living trees. The most common bryophytes were *Hypnum cupressiforme* (39% of plots), *Dicranum montanum* (36%) and *Radula complanata* (30%). For lichens, *Lepraria* spp. (97% of plots), *Hypogymnia physodes* (71%) and *Cladonia* spp. (54%) were the most frequent. Sixteen of all recorded species were woodland key habitat indicator species and special biotope species according to the local species pool. On logs, 120 bryophyte and lichen taxa were recorded, with nine classified as woodland key habitat indicators. The comparison of bryophyte and lichen species richness and cover between 2019 and 2024 revealed no significant differences for most plots where all assessed trees remained alive. Longer-term monitoring is likely needed to detect changes if no significant disruption has occurred in the forest stand. General linear models were calculated to test which factors explain the composition of bryophyte and lichen species. Factors such as tree species, diameter, forest type, and stand age were significant in explaining the richness of epiphytes, while the stage of decomposition was important for epixylic species.

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A Habitat-template approach for Green Infrastructure Design in Mediterranean Urban Areas: Leveraging EVA data and plant functional traits.

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As part of the *Evolution* project, a collaboration between Teamdev, Latitudo 40 and the Universities of Palermo and Perugia, we developed an innovative method for designing green infrastructure in Mediterranean urban areas, with a particular focus on *urban forests* and *green roofs*. In response to the challenges posed by climate change and biodiversity loss, the project adopts the *Habitat Template Approach*[1], a method based on the idea that the design of artificial ecosystems should be inspired by spontaneous plant communities found in similar ecological conditions, in order to maximize the sustainability and effectiveness of interventions. The Municipality of Perugia was chosen as a model to test and validate the proposed methodology. The process involved a phytosociological and vegetation characterization of the study area, supported by the QGIS analysis of the Vegetation Series Map[2], to identify reference vegetation series, and the Natura 2000 Map[3], to determine the existing habitats. From these habitats, a preliminary species list was extracted and then validated by integrating data from vegetation plots available in the EVA[4] (European Vegetation Archive) database for the Province of Perugia. This step provided a representative list of the local species pool, which was further enriched with functional traits extracted from multiple sources: GIFT[5] (Global Inventory of Floras and Traits), Digital Italian Flora[6], and the TRY Database[7]. To ensure a dataset focused exclusively on native species, exotic species were excluded. The integration of these data resulted in 330 species related to our habitat templates, each annotated with the 41 most relevant functional traits. A cluster analysis was then applied to classify the species into eight functional groups, representing clusters of species with similar ecological and morphological characteristics. Finally, the *cocktail method*[8], implemented using the JUICE software, allowed us to analyse species co-occurrences, identifying the most suitable plant associations for green infrastructure design. The effectiveness of this methodology strongly depends on the size of the dataset: a larger dataset enables greater precision in species selection and functional analysis, enhancing the robustness of the proposed solutions. Additionally, this methodology, based on open-access databases and software, is replicable in various urban contexts, and the definition of functional groups can be adjusted to meet specific design needs, making the approach flexible and applicable to different ecological planning strategies. Despite the robustness of the method, one of the main critical issues encountered is the availability gap: many of the identified species may not be readily available in the nursery market, limiting the practical implementation of the proposed solutions. This issue highlights the need for greater integration between scientific research and plant nurseries, to promote the cultivation and distribution of native species suitable for urban re-naturalization projects.

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Barbary Thuja dominated forests of North-West Africa

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Understanding plant community ecology and distribution in regions of great biogeographical interest and rich in endemic species and genera such as the Mediterranean is crucial. Many Southern European vegetation types extend into North Africa, while others are primarily North African with limited occurrences in Southern Europe. The latter applies to *Tetraclinis articulata*-dominated communities. *Tetraclinis articulata* is a conifer species restricted to the southwestern Mediterranean region, mainly found in Morocco, Algeria, and Tunisia, with small populations in southeastern Spain and Malta. Our study aims to characterize the ecology of *Tetraclinis articulata*-dominated open forest communities in northwestern Africa. We compiled 1,873 vegetation plots from published and unpublished sources, including 18 journals, and six PhD theses, covering the species' full distribution range. We selected plots where *Tetraclinis articulata* had a cover of at least 15% (N = 695) and applied the EUNIS expert system, retaining only those classified as Mediterranean Cupressaceae Forests (T3D). This dataset included approximately 40 different syntaxonomic names referencing *Tetraclinis articulata*. Summary statistics of the 545 selected plots (plot sizes ranging from 50 to 250 m²) revealed an average species richness of 18.2 ± 5.7 SD. The mean Ellenberg indicator values for these communities were 7.8 ± 0.3 SD for light, 3.2 ± 0.3 SD for moisture, 6.3 ± 0.5 SD for reaction, 3.8 ± 0.5 SD for nutrients, and 8.9 ± 0.4 SD for temperature. This study will contribute to the understanding of the ecological requirements of *Tetraclinis articulata* dominated communities and contribute to their conservation in the Mediterranean region.

Invasive Species: Challenges and Impacts on European Vegetation Distribution and ecological pecularities of *Salicetum albae* Issler 1926 association in Ukraine

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Communities of the *Salicetea purpureae* class, especially coenoses of *Salicetum albae* association, are considered as widespread in all regions of Ukraine. It is assumed that they include many hidrophylous species, and their development seems to be conditioned by long flooding regime and geomorphological peculiarities of the floodplains. After regulation of all big rivers in Ukraine, their water regime underwent the drastical changes. The floodplain vegetation has changed a lot over last decades. Currently floodplain forests are one of the most-invaded types of vegetation in Ukraine due to decrease the water regime. The aim of our study was to investigate the diversity of communities with dominance of *Salix alba* in Ukraine. Our research based on personal geobotanical releves sampled across floodplains in all regions of Ukraine. Totally 210 releves have been sampled during field seasons since 2014. The main ecological parameters (altitude, aspect, inclination, microrelief, plant cover structure) are recorded for each plot. By means of numerical classification, we aimed to identify the main underlying ecological gradients driving the variation in species composition. As a result, 3 clusters were obtained: wet group with hydrophylous species, dry group with *Acer negundo* and dry group with *Fraxinus pennsylvanica*. Only communies with high presence of hydrophylous species are considered as typical of *Salicetum alba* association. Hovever, they present only 1/3 of all releves. They occupy only small areas in the Danube and Dnieper basin, especially in the Left-Bank Ukraine, which is caused by presence of extended floodplains. Most represented in Ukraine are communities with high coverage of *Acer negundo*. In general, *Acer negundo* occurs in 60% of all releves of *Salicion albae* alliance. They are distributed in all regions of Ukraine, but in the Steppe zone they are rare. They are most likely limited to floodplains that are rarely flooded, or as a result of floodplain regulation, are not flooded anymore. The big group of mesophilous species are diagnostic to this group. Communities of the third group are characterized by high presence of *Fraxinus pennsylvanica*, and another adventive species as *Amorpha fruticosa* and *Morus alba*. *Acer negundo* can also be present, but always with little coverage. Moisture regime is moderate. Hydrophylous and mesophilous species are present in this group. They occur mostly in the Steppe zone, but along the Dniepr river distribute to the north. *Fraxinus pennsylvanica* occurs in 30% of all releves of *Salicion albae* alliance. The first willow associations with diagnostic mesophylous species were described by V. Shevchyk in 1996 on the territory of Kaniv Nature reserve as *Poo nemoralis-Salicetum albae, Aristolochio-Salicetum albae* (1, 2, 3). There are no reports of coenoses of *Fraxinus pennsylvanica* in Ukraine, but the new association *Salici albae-Fraxienetum pennsylvanicae* was described from the nearby territory of Lower Volga.

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Impact of geomorphological and ecological gradients on phenological patterns in dolines of the northern Dinaric Alps

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Phenology is the study of natural phenomena that recur periodically in living organisms and their relationship to seasonal changes. The study took place on the Kras Plateau, a limestone karst plateau above the Bay of Trieste. The zonal vegetation is forests dominated *by Fraxinus ornus, Ostrya carpinifolia*, and *Quercus pubescens*. The object of research were dolines (depressions with a diameter of several hundred meters and a depth of several tens of meters), where the topographic complexity favors the preservation of a great diversity of microhabitats and different types of vegetation. We have studied the floristic gradient from the karst plateau to the bottom of the dolines. We used the transect method to sample the vegetation. We sampled 10 dolines of different depths. We took continuous line transects with 2m x 2m plots from the northern edge of the doline over the bottom to the southern edge. We estimated the percentage of bare rock in each plot and used LIDAR technology to determine the geomorphologic variables. We used K-means clustering to elaborate the sample plots and the φ-coefficient to determine the diagnostic species. We identified discrete groups with respect to this gradient and provided their diagnostic species. We determined the time of flowering onset and related it to geomorphologic variables (bare rock, sky view factor and parcel depth) and ecological conditions (light, temperature, nutrients, moisture and soil response) estimated by Ellenberg bioindicator values (EIV). We passively projected the geomorphologic variables, EIV, and month of flowering onset onto the DCA diagram. We also calculated the Spearman correlation coefficient between the first two DCA axes and these variables. We used canonical correspondence analysis to test the explanatory power of flowering onset in different months on floristic composition. The results suggest that the early onset of flowering in spring in the doline bottom and on the lower slope is stimulated by the high spring moisture and nutrient availability as well as by the open canopy of the mesophilic deciduous forests at this time. On the upper slope and on the karst plateau, flowering starts later, which is due to the precipitation peak in May/June, higher temperatures and the light availability of the open canopy of the thermophilic deciduous forests. The delayed onset of flowering in late summer on rocky sites and in crevices is due to a particular physiology stimulated by the harsh site conditions. Future climate scenarios with rising temperatures predict that the plants will migrate to refugia with lower temperatures. In our case, dolines represent the microrefugium. However, the question is how plants from thermophilic deciduous forests growing on shallow soils would react to the increased moisture and faster mineralization in the dolines.

Adaptive potential of *Calamagrostis epigejos* (L.) Roth. as a potential competitor for the invasive species *Solidago canadensis* L.

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Calamagrostis epigejos (L.) Roth. is an erect rhizomatous perennial plant 25−250 cm tall (average 150 cm) with annual above-ground shoots and persistent underground rhizomes. It is a psammophytic species that exhibits coenotic activity in various habitat types with different ecological conditions. It is primarily dedicated to natural and semi-natural grasslands, forest edges and anthropogenic sites. In recent years, high competitive ability of *Calamagrostis epigejos* has been recorded with the North American species *Solidago canadensis* L. (1), which is widespread in Eurasia and according to Moron et al. (2) together with the closely related species *Solidago gigantea* Aiton were among the most successful invasive species in Europe. Since the control of invasive species is one of the priority tasks of biodiversity conservation for the next decade (3), we set the goal of investigating the population status and ecological potential of *Calamagrostis epigejos* in the forest zone of Eastern Europe. For this purpues we sampled test plots (10 m^2) in different habitat types, with and witout participation of *Solidago* spp. The first plots series we sampled in Ukraine on the territory of the Chornobyl Radiation and Ecological Biosphere Reserve and in the Kyiv suburb in the most typical habitats for *Calamagrostis epigejos*: pine forests edges, meadow steppes and fallows. For all our sampled plots, we used standardised EDGG sampling methodology, developed by the Eurasian Dry Grassland Group (4). Within every plot we made a subplot (1x1 m) for collecting *Calamagrostis epigejos* biomass. Also, we estimated height, inflorescence length and leaf area for 10 ramets of *Calamagrostis epigejos* from each plot. According to preliminary analysis, the lowest species richness and highest biomass are observed for communities with domination of the Calamagrostis epigejos on fallow lands. The lowest biomass values are observed on psammophyte forest edges. The next stage is planned to increase the number of sampled plots, which will allow calculating species diversity and evenness, as well as conducting an ecological analysis using an Ecological Indicator Values System. Thus, we plan to assess the adaptive potential of *Calamagrostis epigejos*, taking into account its functional and ecological characteristics, which will allow establishing its competitive ability relative to *Solidago canadensis*.

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Ordination support for classification, through ecophysiological plant responses in halophytic environments from Southeast Spain.

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We performed an study in the halophytic areas in Guadalquivir River High Valley (Jaen province, Andalusia, SE Spain) to: a) Characterize environmental variables that determine plant species composition in these saline areas; b) Evaluate seasonal differences (spring-summer, autumn) in the edaphic gradients (physico-chemical properties and ionic concentrations in surface soil); c) Associate phytosociological communities and abundance of particular species to edaphic gradients; d) Corroborate the association between particular species and their optimum development conditions (edaphic characteristics, phytosociological communities), through the endogenic proline content, involved in cytoplasmic osmotic regulation under saline stress conditions, in seeds from these species at different positions along the gradients. In order to: A) Determine the possibility of using phytosociological communities and particular species abundance in the characterization of the underlying soil type; B) Clarify the phytosociological classification, especially in cases of doubt or transition between communities, obtaining results about the conditions in which a species or group of species find its optimum. Vegetation was inventoried (101 points) along the basin, in areas (seven lakes and ponds, eight rivers and creeks), separated by no more than 80 km. Four areas (Honda, Brujuelo and Quinta Lakes; Salado Creek), were selected for intensive edaphic and ecophysiologic study (43 points) in different seasons through the year. Soils were analyzed for physico-chemical properties and ionic composition of the soil solution. To assess the "position" of plant communities in relation to environmental gradients we determined: i) its sintaxonomic frame by phytosociological classification methods, and ii) the average DCA and CCA site scores of the group of inventories assigned to a particular community type. Species values were obtained in an analogous way. CCA was used to select the set of environmental variables that better explained the observed variation in species composition. To get a salinity-stress indicator (plant ecophysioĺogical response) we analyzed endogenic proline content (osmotic regulation by internal organic solutes) and germination success of seeds from selected species. DCA axes clearly separated typical halophylic species and phytosociological communities from the nitrophylic ones, the gypsophylic and the ones for intermediate conditions linked to more peripheral positions in the marshes. The directions of the gradients for the indirect analysis, and a relationship between the gradient in DCA axis II and CCA axis I for the direct analysis, are shown. We found differences between the two periods of soil sampling, shown by CCA for the two seasons, and by Variance Partitioning, that shows that the explained inertia by isolated edaphic data in summer is similar to the one for autumn and for the intersection. Relationships between ordination results found for taxa and sintaxa and their ecophysiological responses, are discussed in terms of the ecological signification of individual adaptation to patterns of vegetation heterogeneity.

DALIA database of trees, shrubs and lianas of urban in the forests in Campobasso (Italy)

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The urban environment is a complex structure in which human settlement, semi-natural, agricultural and natural areas, with different ecological values, strictly interact. Urban woods offer numerous benefits, such as climate moderation, improved air and water quality, reduced flooding, reduced energy use in buildings, carbon sequestration, and improved human health (1). However, urbanization significantly alter plant diversity and the functioning of ecosystems in and around cities, also favoring the introduction and spread of non-native species, some of which are invasive (2). In the context of the National Biodiversity Future Centre (NBFC) and the working group "Urban Biodiversity" (Spoke 5) we recorded the woody plant species of the urban forests into the Functional Urban Area (FUA) of a small inner Mediterranean city (Campobasso, Molise Region), located 70 km from the Adriatic coast. The FUA (i.e. cities with the respective commuting zone) of Campobasso covers 1,028 km2, with a population of approximately 100,000 inhabitants and a population density of 97.3 inhabitants/km2. According to the Map of Nature of Campobasso (3), the main forest types refer to six different EUNIS habitat types: Southern Italic Quercus cerris forests, Southern Italic Quercus frainetto forest, Italo-Sicilian Quercus pubescens forest, Southern Mediterranean riparian Populus alba forest, Deciduous self-sown forest of non-native trees, and Coniferous forest (4). Aim of our work was the implementation of a relational database of the woody flora of urban forests recorded in Campobasso thanks to the vegetation monitoring carried out in the context of the Spoke 5-Urban Biodiversity project and the data gathered from the urban greenery census of the Campobasso Municipality. The database contains 33 attributes which refer to taxonomy, scientific and common name, chorology, resident time, growth habit, bloom length and season, EUNIS habitat, conservation status for EU IUCN, EIVE's indicators, Disturbance Indices, Grime indicators, geo-localization. We recorded a total of 170 plant species and subspecies (trees, shrubs, lianas) belonging to 46 families; the most common is the Rosaceae family (20.0%), followed by Fabaceae, Pineaceae, Sapindaceae and Salicaceae. The 68.8% of total taxa is native, 25.5% is alien neophyte (with 14 invasive species), and 5.9% is alien archeophyte. As concerns leaf traits, 122 are winter deciduous and 48 evergreens; the principal dispersion mode is zoochory (122 species), followed by anemochory (44 species), and authocory (4 species). The analysis of EIVE's (5), disturbance indicators (6) and Grime indices has allowed us to identify the species that best adapt to the various environmental conditions occurring in the study area. Moreover, the analysis of the ecological features of the recorded trees, shrubs and lianas provided new insights into the potential adaptability of these species to global change such as their tolerance to high temperatures, long periods of drought, and disturbed soils.

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Distribution analysis of Illyrian mesophilous understory species

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Understanding the geographical patterns of mesophilous understory species is important, as these species play a crucial role in distinguishing geographically divided vegetation units that have the same or similar tree layer but are differentiated by their understory. Such cases include mesophilious Illyrian forests belonging to alliances *Aremonio-Fagion* and *Erythronio-Carpinion*, which are distinguished from other vegetation units largely by their understory flora. *Aremonio-Fagion* and *Erythronio-Carpinion* are characterized by a unique floristic composition rich in mesophilous endemic and sub-endemic forest species. While many species have been noted to be important for distinguishing Illyrian forests, their roles based on geographical distributions have not been systematically analyzed. To address this gap, we analyzed the distribution patterns of mesophilious species traditionally considered as important for Illyrian forests in the literature. Species distribution data were compiled from published sources, Turboveg databases, and online databases containing species occurrence records. The species were grouped using hierarchical classification based on the overlapping of their distribution areas. For the clusters of species defined by classification, spatial clustering analyses of species richness was conducted. Dataset was divided into three groups (wide-range, medium-range, and narrow-range), each containing species with similar distribution patterns in terms of position and size. Distinct distribution patterns began to emerge, and fine-scale geographical distinctions became visible as the dateset was divided into smaller clusters. The hot spot analysis results indicate that wide-range species, due to their extensive distributions, contribute minimally to the geographic delineation of Illyrian forests. Medium-range species form a hot spot which mostly overlap with traditional views on distribution of Illyrian floral province. In contrast, narrow-range species, concentrated around glacial refugium (Slovenia, Croatia), are important for western boundaries of the Illyrian floral province. Analyses at a fine scale revealed the importance of glacial refugium and species ecology in shaping species distributions. Future research should incorporate additional species and vegetation types to provide deeper insights into post-glacial vegetation dynamics, the significance of glacial refugia, and understory distribution patterns at the European scale.

Vegetation dynamics of the “Bagno” bog (Ukrainian Carpathians)

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The oligotrophic bogs of the Ukrainian Carpathians are characterized by dwarf-shrub and peat-moss vegetation, representing the climax stage of oligotrophic bog development (1,2,3). Over the past half-century, these ecosystems have undergone significant transformations, including fragmentation and insularization of bog vegetation, replacement by meadow vegtation, a decline in the coenotic role of oligotrophic and meso-oligotrophic plant species, their local losses, and the expansion of tree and shrub species (4,6). The Bagno Bog is located on the Vygorlat-Gutyn volcanic ridge in Ukrainian Carpathians at the levation of 850 m a.s.l. The the bog is characterized by the dominance of Calluna vulgaris (L.) Hull in the shrub layer, a species rarely found in the Ukrainian Carpathians. Early records from 1960–1969 documented a dense cover of oligotrophic bog vegetation across an area of 8 ha. However, vegetation surveys conducted at the same area in 2006–2008, revealed substantial changes. The vegetation dominated by oligotrophic species had become fragmented and meadow vegetation with Molinia caerulea (L.) Moench now occured in this area (5). At this time, vegetation of the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946 is primarily located in the upper part of the bog, where it formed small patches (10–20 m²). The vegetation of the class *Scheuchzerio palustris-Caricetea fuscae* Tx. 1937 is restricted to the peripheral areas and depressions, while the *Molinio-Arrhenatheretea* Tx. 1937 vegetation occupied the majority of the bog area. Approximately 30% of the total bog area is covered by oligtrophic stands. A 2022 resurvey confirmed that the shift of oligotrophic bog vegetation to meadow vegetation is ongoing. Data from four permanent monitoring plots (4×4 m) within the *Calluna vulgaris-Eriophorum vaginatum-Sphagnum capillifolium* community showed a decline in the projective cover of *Carex pauciflora* Lightf., *Eriophorum vaginatum* L., *Sphagnum magellanicum* Brid., and *Empetrum nigrum* Loefl. Meanwhile, Molinia caerulea coverage increased, and in some areas, *Rhynchospora alba* (L.) Vahl—an indicator of disturbed peatlands—appeared. In some locations, Calluna vulgaris expanded its coverage, potentially signaling the final stage of oligotrophic bog succession. Additionally, isolated individuals of tree species, including *Sorbus aucuparia* L., *Betula verrucosa* Roth, *Populus tremula* L., and *Alnus incana* (L.) Moench, were recorded. The primary driver of this transformation is the lowering of the water table, resulting from hydrological changes induced by human activities. The degradation of oligotrophic vegetation is further accelerated by climate change, particularly prolonged summer droughts and the absence of long-term snow cover in winter. These factors contribute to increased evapotranspiration and further shifts toward meadow and woodland vegetation, accelerating the decline of this oligotrophic bog ecosystem.

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The Ecological features of the distribution of *Solidago canadensis* in Ukraine

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Invasive plant species represent a significant threat to biodiversity and ecosystem stability. *Solidago canadensis* is one of the most aggressive invasive species, capable of altering plant community structures and forming monocultures. The species's native range is North America. Since 2004, *S. canadensis* has been listed by the European and Mediterranean Plant Protection Organization (EPPO) as invasive, recommending restrictions on its sale and distribution and raising awareness of its potential ecological threat. In Ukraine, systematic research on its distribution and ecological niche has been scarce despite its significant ecological threat. This study aims to define the ecological niche of *S. canadensis* within Ukrainian ecosystems using synphytoindication and analyze its current distribution. Releves were collected from the forest and forest-steppe zones of Ukraine between 2015 and 2024. An assessment was conducted based on ecological factors such as soil aeration, carbonate content, cryoregime, soil moisture, continentality, light availability, and soil acidity. Distribution maps were created using DIVA-GIS software, based on data from the author's project "*Solidago canadensis* in Ukrainian Ecosystems" and geobotanical studies from GBIF. The study revealed significant correlations between soil aeration, moisture, cryoregime, soil acidity, and other ecological factors.In modeling the ecological niche of *S. canadensis*, the amplitude of ecological factors was assessed, reflecting the conditions under which the species can exist within Ukraine. The results indicate a high degree of ecological plasticity, particularly with regard to soil moisture, nitrogen content, and light availability. To collect data on the species' distribution, a project was created on the iNaturalist platform, integrating user observations and author-generated records. As of November 2024, 1925 observations had been made, with 1423 of them confirmed. The highest number of observations was recorded in the Kyiv region, likely reflecting favorable conditions for the species. Based on this data, a distribution map of *S. canadensis* in Ukraine was created. Additionally, the GBIF database was utilized to construct a distribution model using DIVA-GIS software. The model indicated that the greatest number of observations were made in the forest-steppe zone, which is consistent with findings from other sources. This study confirms that *S. canadensis* exhibits high ecological plasticity, particularly in relation to variations in soil moisture, nitrogen content, and light availability. However, salt regime, cryoregime, and continentality are critical factors for the species's survival. Furthermore, the data from the project "*Solidago canadensis* in Ukrainian Ecosystems" serves as a foundation for assessing the ongoing invasion process. The findings of this study contribute to a better understanding of the species' ecological adaptation and can be used for predicting its spread, assessing invasion risks, and formulating appropriate conservation measures.

Using Community-Weighted Mean functional traits to identify the ecological niche of narrow endemics

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Ptilostemon greuteri is a very rare woody species of the Asteraceae family, known from only two populations located on the N-facing slopes of Monte Inici (1,064 m asl), in the Province of Trapani (W-Sicily), where it thrives in shady habitats within two deep valley furrows, characterized by thick layers of incoherent debris. These populations are part of the Natura 2000 site SAC ITA010015 "Complesso dei Monti di Castellammare del Golfo". In 2021, an international project on *P. greuteri* (1) was launched to expand scientific knowledge and improve its conservation status. The project aims to develop and implement an action plan for the species' long-term protection. Several studies have already been conducted, and its ecological niche is being assessed through vegetation surveys, microclimatic data collection, and detailed analysis of the structure of the two subpopulations (2). To define the ecological niche of the species, we measured key functional traits related to water stress and photosynthetic performance: Leaf area, Leaf Dry Mass, Specific Leaf Area, Leaf Wettability, average plant height, and survival strategy during adverse seasons (perennial vs. annual life forms; woody vs. non-woody stems) (3). These traits were assessed using standardized protocols, followed by statistical analyses to compare community weighted means (CWM) of functional traits between the two sites and evaluate trait variations along different exposures within transects. Among the functional traits, leaf wettability emerged as the most distinguishing factor along the transects. Its variation indicated that valley slopes support functionally distinct plant communities, influenced by orientation and associated environmental conditions. Correlation analyses between functional traits and environmental variables (climatic and edaphic) revealed that summer soil temperature and solar radiation are the most influential. These variables positively correlate with high leaf wettability and greater presence of annual plants, whereas plots falling within the niche of *Ptilostemon greuteri* show the opposite trend, being associated with higher soil moisture during warm months.The ecological niche of *Ptilostemon greuteri* is characterized by a relatively mesophilous plant community, with few annual species and a high frequency of species capable of foliar water absorbtion. This adaptation suggests moderate water stress, lower than in the surrounding environment, allowing the target species to persist in its unique habitat.

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Syntaxonomy and ecology of the *Phragmito-Magnocaricetea* class in Bulgaria

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This research aims to reveal the syntaxonomical and ecological diversity of the *Phragmito-Magnocaricetea* class in Bulgaria. We prepared a dataset of 2162 relevés of this class from the territory of the country. Two hundred and twenty of them came from 17 publications and 1942 were unpublished ones. The majority of the plots were sampled between 2017-2024 following the Braun-Blanquet approach. The plot size was 10-16 m^2. GPS coordinates and data on the water depth was also collected. The relevés were contributed to the Balkan Vegetation Database (EU-00-013). The species names were standardized according to the Euro+Med PlantBase. The hierarchical clustering was performed in the PC-ORD software package using the Bray-Curtis dissimilarity and the flexible beta clustering algorithm. The species cover values were square root transformed and clusters were standardized to equal size. The diagnostic species were determined by calculating the Phi-coefficient and only the statistically significant values evaluated by Fisher's exact test ($P<0.05$) were considered. Species with covera above 50% at least in 20% of the relevés in any cluster were considered as dominants, whereas constant species were those having at least 50% presence in a cluster. Detrended Correspondence Analysis was applied to reveal the major environmental gradients. We found that synatxonomical diversity of the phragmito-Magnocaricetea class in Bulgaria is represented by 4 orders (M*agnocaricetalia, Nasturtio-Glyceretalia, Oenanthetalia aquaticae, Phragmitetalia communis*), 5 alliances (*Carici-Rumicion hydrolapathi, Glycerio-Sparganion, Magnocaricion gracilis, Glycerio-Sparganion, Eleocharito palustris-Sagittarion sagittifoliae*) and 27 associations (*Beruletum erectae*, Bolboschoenetum maritimi, Butometum umbellati*, Caricetum acutiformi-paniculatae*, Caricetum acutiformis*, Caricetum buekii*, Caricetum hirtae*, Caricetum ripariae*, Caricetum vulpinae*, Cyperetum (Juncelletum) serotini*, Eleocharitetum palustris , Equiseto fluviatilis-Caricetum rostratae*, Glycerietum maximae, Glycerio-Sparganietum neglecti*, Iridetum pseudacori, Leersietum oryzoides, Nasturtietum officinalis*, Oenantho aquaticae-Rorippetum amphibiae*, Phalaridetum arundinaceae*, Phragmitetum australis, Sagittario sagittifoliae-Sparganietum emersi*, Schoenoplectetum lacustris*, Schoenoplectetum tabernaemontani*, Thelyopterido palustris-Phragmitetum australis, Typhetum angustifoliae, Typhetum latifoliae, Typhetum laxmanii*). Seventeen associations, marked with an asterisk are new for the territory of Bulgaria.

The impact of road characteristics on forest roadside vegetation diversity in Latvia.

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Forest roads, primarily constructed for forest operations, have direct and indirect ecological effects on ecosystems and landscapes, forming a separate and distinct ecosystem (1). Constructed forest roads modify element flows and availability of resources such as water, light, and nutrients, changing the dynamics of plant populations (2). As a result, forest roads can have several negative impacts on vegetation, such as creating corridors for alien and non-forest species. However, other studies show that roads can also facilitate the distribution of rare plant species (3). Our study aimed to characterize the effects of forest roads on plant species diversity depending on different road verge widths and distances from the adjacent forest stand. The survey included three different types of forest roads to distinguish between various levels of management impact. Two types were represented by gravel-surfaced roads: one type with verges less than 5 meters and the other - more than 5 meters wide. The third type consisted of vegetation-covered roads, representing more natural road conditions. Each type of road was represented by a 5 km section, and along each 1 km section, five 10-meter-long transects were established on both sides. The number of species and their cover were recorded on both sides of each transect in a 1×1 m plot. In total, 150 transects were established, and vegetation was recorded in 3000 plots. Over 330 taxa were recorded along all studied roads. The results showed significant differences in vegetation composition between all studied road types. The highest species diversity was observed along the wider roadsides, where species composition differed significantly at different distances from the adjacent forest stand. Closer to the roads, annual species were more represented, whereas closer to the forest stand, forest-related species were more abundant, mostly determined by lower light availability. Additionally, different road characteristics significantly impacted species diversity along studied roads. Roads with ditches supported a higher richness of moisture-demanding species. However, higher shrub levels, which indicate lower management intensity, maintain shadow-tolerant species richness, respectively. Forest road verges may be considered an ecotone where different ecological conditions determine the environment for distinct species composition, likely related to different management practices along the roadsides. The Latvia Council of Science supported the study "Forest Roads as Multifunctional Ecosystems: Biodiversity, Ecosystem Services, and Disservices", grant No. LZP-2023/1-0558.

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SALTISH: the new dataset of SALt-affected vegeTatIon from Tuscany coaStal Habitats, central Italy

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Surveying vegetation is essential for documenting plant diversity, especially for coastal vegetation that results among the most threatened ecosystems globally. To support conservation and management programs, we developed the SALt-affected vegeTatIon dataset of Tuscany coaStal Habitats (SALTISH). This dataset comprises 734 newly sampled vegetation plots of 4 m^2 (2 × 2 m) from the Tuscany region in central Italy, including 569 sand dune plots and 165 salt marsh plots, recorded between 2018 and 2023. In total, the dataset contains 4,541 occurrences of vascular plant taxa. Overall, comprehending 257 vascular plant taxa belonging to 165 genera and 56 families. The Poaceae family is the most diverse, represented by 50 taxa, while the genus *Juncus* is the most prominent, with seven species. Species richness within individual plots is ranging from one to 55 species, with 622 plots (84%) containing fewer than 10 species. *Juniperus macrocarpa* emerges as the most frequent and dominant species in the dataset. *Helichrysum stoechas*, *Festuca fasciculata*, and *Medicago littoralis* are present in over 20% of the plots, whereas 157 taxa are recorded in fewer than 1% of plots. The dataset includes noteworthy taxa: four Italian endemics (*Centaurea aplolepa* subsp. *subciliata, Limonium etruscum, L. multiforme*, and *Solidago virgaurea* subsp. *litoralis*), eight taxa listed as threatened in the Italian Red List, and 18 archaeophyte and neophyte alien species. *Xanthium orientale* with 61 occurrences in sand dunes and *Symphyotrichum squamatum* with 24 occurrences in salt marshes are the most frequent alien species in the dataset. The dominant life forms are Therophytes (40%) and Hemicryptophytes (27%) in sand dunes and conversely Hemicryptophytes (37%) and Therophytes (31%) in salt marshes. The phytogeographical distribution of taxa shows Mediterranean (44%) and Eurasian (18%) elements are the most common chorotypes in the dataset, as well as in sand dunes and salt marshes, separately. According to salinity relationship classification, plants adapted to growing in non-saline areas are the most common in both habitats. However, approximately 60% of the taxa in salt marshes are classified as those adapted to saline and slightly saline or brackish areas. The vegetation plots are mainly included in protected areas (549 protected vs 185 non-protected plots) including special protection area, special area for conservation, state nature reserve, regional nature reserve, and regional park. Moreover, 482 plots of 549 plots in protected areas, are protected by two (81 plots), three (398 plots), or four (3 plots) types of protection. The classification of habitat types for each vegetation plot identified 14 Natura 2000 habitat types and seven EUNIS habitat types. However, 27.4% of the plots could not be classified into any Natura 2000 habitat type, and 3% could not be assigned to any EUNIS habitat type. SALTISH provides critical data for monitoring and conserving threatened coastal habitats in Tuscany. This ongoing project will facilitate comparisons of biodiversity status and vegetation changes over time and aid in identifying habitats harboring rare and endangered plant species. Future efforts should be directed towards rush communities to assess the entire sea-inland gradient fully.

Classification of forest vegetation in Montenegro

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Montenegro is a country located on the western coast of the Balkan Peninsula. Diverse climatic conditions, together with the heterogeneous landscape, create an ideal environment for a high diversity of ecosystems and species. Although some local studies of forest vegetation already exist, a comprehensive classification of forest vegetation has not been done so far. In 2022 and 2023, we recorded 305 vegetation plots in all the main forest types across the country and combined our data with plots from the Vegetation Database of Montenegro. We used statistical methods to classify the final dataset containing more than 1000 vegetation plots and characterized the distinguished vegetation types through their physiognomy and ecology. Sclerophyllous oak forests of the class *Quercetea ilicis* with evergreen *Quercus ilex* occur in the coastal zone. Deciduous oak forests of the class *Quercetea pubescentis* are widely distributed throughout the country, becoming rare at higher altitudes above 1200 m a.s.l. They are dominated by thermophilous oak species *Q. cerris, Q. frainetto, Q. pubescens,* and in the southern part of Montenegro also *Q. trojana*. The understory of deciduous oak forests is often species-rich, especially in pasture forests, where more than 90 species in the herb layer can be found per 100 m² plot. Hornbeam forests with *Carpinus betulus* rarely occur at mesic sites within the area of oak forests. Forests with *Carpinus orientalis*, *Fraxinus ornus*, and *Ostrya carpinifolia* are common on rocky slopes and limestone screes. Riparian forests with willows (*Salix* spp.) and alders (*Alnus glutinosa* and *A. incana*) can be found along rivers and lakes. Beech forests (class *Carpino-Fagetea sylvaticae*) are concentrated in mountain regions, where also fir (*Abies alba*) co-occurs or prevails in some areas. Coniferous forests dominated by spruce (*Picea abies*), fir (*Abies alba*), or pines (*Pinus heldreichii, P. nigra, P. peuce*, and *P. sylvestris*) occur in high-mountain areas. We provide a delimitation of forest plant communities of Montenegro and their syntaxonomic interpretation.

Mapping and Assessing Annex I Habitats condition to Meet EU Restoration Law Requirements

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The EU Restoration Law requires EU member states to locate and quantify the areas of Annex I habitats that should be restored. To achieve this, France will use the CarHab project (Mapping of Natural and Semi-Natural Habitats) in addition to existing monitoring programs. CarHab combines field expertise from the National Botanical Conservatories (CBN) and machine learning to produce a habitat map based on ecological conditions and vegetation types. Experts then assign a probability of occurrence of Annex I habitats within CarHab polygons to each CarHab habitat. Although model accuracy indicators are available, Annex I habitat maps, being a byproduct of CarHab, have not yet been evaluated. Therefore, we are developing a countrywide sampling strategy to:

i. Assess the percentage of false presences of Annex I habitats in CarHab polygons, and

ii. Evaluate the degree of habitat degradation when present in the polygon.

In 2026, field tests will be conducted to determine the minimum number of polygons needed to ensure robust sampling for data interpolation of prediction errors and habitat degradation in a given region. When visiting a polygon, experts will be asked to note the possible reasons for habitat absence, if applicable: Is it due to an error in soil moisture, pH, or vegetation type? What is the extent of the differences between predicted and observed parameter values? Can these differences be explained by past or current disturbances? Additionally, when the habitat is present, the expert will evaluate its degree of degradation using a quick-assessment protocol. Since 2012, France has developed robust methods to evaluate the conservation status of each Annex I habitat. However, these methods require significant time and are not available for all habitats. Therefore, we will test a simplified protocol inspired by these methods, relying primarily on expert evaluation rather than direct measurements. Preliminary analyses suggest that disturbances are the main explanatory factors for false presences and habitat degradation. Consequently, the sampling strategy aims to cover various disturbance scenarios that the target habitats may encounter. We will present the different steps in the sampling strategy development and explore potential interpolation methods, using external data on pressures, for instance.

Alnetea glutinosae in Ukraine: classification and distribution patterns

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The class *Alnetea glutinosae* includes swamp forests on periodically flooded minerotrophic and organic soils. Vegetation of the class unites monospecific forest stands of black alder (*Alnus glutinosa*) and/or downy birch (*Betula pubescens*) with a specific combination of plants in the herb layer. We gathered 1826 vegetation plots for the class *Alnetea glutinosae* across all of Ukraine with the aims of (a) revising previous classification systems using a representative dataset; (b) defining vegetation types at the association level and outlining their geographical distribution and species composition; (c) describing the relationships of defined vegetation associations to the main environmental factors. We performed unsupervised classification using agglomerative clustering with beta flexible clustering ($\beta = -0.3$), Bray-Curtis index as a dissimilarity measure, and square-root data transformation. We distinguished three vegteation alliances (*Alnion glutinosae*, *Salici pentandrae-Betulion pubescentis*, *Betulion pubescentis*) and six associations within: mesotrophic regularly flooded alder carr (*Thelypterido palustris-Alnetum glutinosae*, *Carici elongatae-Alnetum glutinosae*, *Carici acutiformis-Alnetum glutinosae*), basiphilous birch forests on mesotrophic mires (*Salici pentandrae-Betuletum pubescentis*) and acidophilous wet birch forests (*Thelypterido palustris-Betuletum pubescentis*, *Eriophoro vaginati-Betuletum pubescentis*). Our study has critically revised the previous syntaxonomic structure for the class *Alnetea glutinosae* in Ukraine. The modifications we have proposed include the exclusion of two and the synonymization of seven vegetation associations. Using NMDS-ordination and Ellenberg-type indicator values we demonstated that the most significant effects on the species composition of defined vegetation associations have soil moisture, soil reaction, nutrients, and light regime. The class *Alnetea glutinosae* within Ukraine is distributed across all physical-geographic zones. The vegetation's distribution follows the distribution of the rivers in combination with local soil and climatic conditions. The main areas for alder carr in Ukraine are concentrated in the forest and the forest-steppe zones. In the south of Ukraine, alder swamps are localized in protected areas or floodplains of large rivers with a more or less preserved natural hydrological regime. The occurrence of birch swamp forests is limited to the forest zone of Ukraine.

Plant life in holes: interplay of macro- and micro- environmental factors driving the plant community differentiation in dolines

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Karst landscapes are defined by distinctive geomorphological features such as dolines, karst poljes, and caves, which play a crucial role in shaping biodiversity. The permeability of carbonate bedrock allows water to drain quickly, making water scarcity a key ecological challenge for plant life. However, variations in landforms and topography create diverse environmental conditions, including differences in soil depth and moisture levels. One of the diagnostic landform features of karst areas are dolines, enclosed depressions in the landscape. Such depressions significantly modify the environmental factors affecting plant species distribution in the landscape, as they often provide extreme conditions in the landscape; south-exposed northern edges of dolines are warmest and driest microhabitats while the lower parts of north-exposed southern slopes are the coldest and most humid. Additionally, dolines provide geomorphological diversity not present in the landscape, most often dolines form on plateaus, where dolines provide steep slopes, small cliffs and screes. These effects are most well-known and studied in large karst depressions, extending several hundred meters across, which are however few and far apart. Our research focuses on medium sized dolines up to hundred meters in diameter, which can reach high density and form an interconnected network of refugial habitat. Because of microhabitat modification, dolines can serve as microrefugia and can harbour relict plant species not present elsewhere in the landscape. It has been suggested dolines might mitigate some of the effects of climate change. We surveyed vegetation in 60 dolines across six regions within the Illyrian floral province using the transect method. We assessed the impact of micro-topography on ecological conditions within the dolines. We utilized hand-held terrestrial LiDAR. This allowed us to generate high-resolution 3D relief models, from which we extracted explanatory variables for vegetation patterns. The study areas were categorized into three groups: submediterranean, montane, and subpannonian. The results show that at this scale, water and light availability are often more significant factors driving differentiation of vegetation in the dolines, and not temperature. The effect of the doline on ecological conditions and vegetation pattern is most pronounced in the transition zones between macroclimate zones, in our case in the submediterranean region - transition between eumediterranean and more continental climates. An important takeaway is the fact that while there are common patterns revealed in the distribution of species according to their traits and ecological indicator values, for example, bottoms of dolines are always populated by more moisture-demanding plants than the surrounding slopes and plateaus, but the significance of particular environmental factors and indicator values varies across the six researched areas. This fact is something that needs to be considered when discussing the ability of dolines to act as (micro)refugia in the light of current climate change.

Shifts in Vegetation Diversity and Dominance Following Large-Scale Clear-Cutting: Evidence from Latvia

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Retention forestry is the dominant practice in Northern Europe, with large-scale clear-cuts following natural disturbances becoming more frequent as the climate changes. Despite its widespread use, clear-cutting remains a contentious practice due to its potential adverse effects on biodiversity, soil stability, and long-term ecosystem resilience. In particular, concerns have been raised about its impact on species diversity and the regeneration of understory vegetation, which plays a crucial role in maintaining forest structure, nutrient cycling, and habitat availability for various organisms. The removal of mature trees alters microclimatic conditions, increasing light availability and soil temperature while reducing moisture retention—factors that collectively influence plant species composition and dominance patterns. This study examines early vegetation dynamics following large-scale clear-cutting in Latvia's hemiboreal forests, focusing on changes in species diversity, abundance, and cover across different vegetation layers. To assess these impacts, systematic vegetation surveys were conducted in 2017 and 2020—three and six years post-harvest—using 210 evenly distributed 1 × 1 m plots. Data collection targeted three distinct vegetation layers: mosses and lichens, herbaceous plants, and shrubs/trees. By comparing species composition over time, the study aims to provide insights into post-clear-cutting successional trends. The findings indicate that species diversity initially increases following clear-cutting, likely due to the rapid colonization of open areas by pioneer and opportunistic species. However, this effect is short-lived, as diversity declines after six years, suggesting that competitive exclusion and environmental stressors gradually limit species establishment. The herbaceous layer is particularly affected, showing significant changes in species composition and dominance. While clear-cutting may create temporary opportunities for certain plant species, negative effects become evident over time. Moreover, the rate of succession appears to vary depending on site-specific factors, with wet areas exhibiting faster vegetation recovery compared to drier sites. Given these findings, continued long-term monitoring is essential to fully understand the lasting effects of large-scale clear-cutting on forest ecosystems. Such knowledge is crucial for developing sustainable forest management strategies that balance timber production with biodiversity conservation and ecosystem resilience

Mapping the Potential Occurrence of Endangered Plant Species for Nature Conservation Prioritization in the Czech Republic

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The implementation of the Nature Restoration Law presents a great opportunity for biodiversity conservation and restoration. However, a critical question arises: where should these efforts be focused to achieve the greatest impact? A similar dilemma occurs when parts of protected areas must be removed and compensated by other areas. Prioritizing areas at the national level for nature conservation can help guide such decisions. We conducted a prioritization using the Zonation software, overlaying four branches of input raster layers: 1. Abiotic factors (geodiversity, climate, soil map, geomorphology, and habitat diversity); 2. Cultural landscape heritage and anthropogenic land cover transformation; 3. Habitat suitability models for 199 animal species (balanced across various habitats and weighted by threat level of the Red List); and 4. Suitable vascular plants data. Since species richness does not always reflect the conservation value of vegetation, and plant models across diverse habitats are often imprecise, we used a proxy for vascular plants based on the potential occurrence of endangered species (Red List species). We sourced species records from two nationwide databases: PLADIAS (Database of the Czech Flora and Vegetation, www.pladias.cz; 1; 2) and NDOP (Species Occurrence Database of the Nature Conservation Agency of the Czech Republic; 3), taking records collected only after 2000. Using ArcGIS Pro software, species locations were intersected with national habitat inventory maps (NATURA 2000) and, for finer resolution of anthropogenic and mosaic biotopes, with the Consolidated Layer of Ecosystems (KVES 2022). For each Red List species (4), we created a separate occurrence map, evaluating habitat-based species pools according to (5). To create a layer of potential dispersal for endangered plant species, dispersal distance was defined for each species according to (6). This approach allowed us to account for unsurveyed areas with a high probability of species presence or areas where species can easily spread. In total, we generated potential occurrence maps for each of 1,458 taxa of endangered species of the Czech Republic (Red List species; 6). These maps can be overlaid and analyzed based on threat categories (C1–C4), habitat types, and other criteria. We used them as a proxy for vascular plants in our national nature conservation prioritization map, though they offer a wide range of potential applications for conservation planning and biodiversity management.

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European database of alien plants

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Alien plant species, especially those that are invasive, threaten European biodiversity, disrupt native ecosystem functions and adversely affect human well-being through their impacts on economy and health. Therefore, detailed knowledge about the composition and structure of alien floras at the regional level is essential for studying alien plants' ecology, distribution and negative impacts. Previous attempts to compile large-scale databases covering the European alien flora (e.g. DAISIE or GloNAF database) were affected by the lack of available national and regional inventories and/or their incompleteness. In our recent overview (1), we combined inventories of alien vascular plants with online databases and unpublished data from our collaborators (up to 2022) for 55 European territories (i.e, countries and other territories such as large islands). We identified the main data gaps for alien flora in Europe and found inconsistencies among individual territories regarding taxonomic concepts and categorization of species origin and invasion status. This motivated us to prepare an updated and revised database of European alien flora. We compiled all available sources for each territory and harmonized their taxonomy and status. These included (i) national and regional alien plant checklists and unpublished data, (ii) records from large-scale databases (GloNAF, Euro+Med PlantBase and Plants of the Word Online) and (iii) occurrence data from the European Vegetation Archive and GBIF to add taxa not yet included in previous sources. We also added native taxa from the Euro+Med PlantBase and Plants of the World Online for each territory to avoid the confusion of alien and native status for taxa missing in available alien data sources. To revise the status of each taxon, we produced a series of distribution maps showing how it was assessed in original sources for each territory. We assigned each taxon preliminary native or alien status in each territory, for the latter distinguishing the categories of residence time (archaeophyte, neophyte) and invasion status (casual, naturalised, invasive; based on the frequency and population dynamics) and asked regional experts for additional checks. For each alien taxon, we also assigned the region of origin using the TDWG continental scheme (e.g. North America, Europe, Asia temperate). We aim to develop a critically revised and comprehensive database that will be continuously updated and made publicly accessible online within the FloraVeg.EU database (2). This research was supported by the Czech Science Foundation (grant no. 25-16176S).

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The role of the forests of different origins and successional stages in maintaining biodiversity stability in agricultural landscapes: an introduction to study

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Natural vegetation in forests, grasslands, and wetlands provides essential habitats that cater to the ecological needs of various species, helping to maintain stable populations. This makes it crucial for preserving biodiversity in the hemiboreal region. However, the increasing global human population and climate change have expanded agricultural areas, leading to the destruction and fragmentation of many natural communities. In Lithuania, arable land covers about 46% of the total area, with some regions having over 75% dedicated to agriculture. Only small patches of pioneer forests and forest plantations, or abandoned areas, along with wet scrub in early successional stages at the base of slopes or strips of dry scrub on slopes, remain in the agricultural landscape. Can these disturbed communities help stabilize biodiversity in landscapes degraded by agricultural activities? Traditional vegetation surveys cannot provide a clear answer to this question. Therefore, field research and data collection will be conducted. Data will be gathered from 8 study areas (approximately 100 km² each) spread across Lithuania, representing natural environmental conditions and varying land-use practices. Vegetation plots will be surveyed in forest and shrub communities, forest plantations, and clear-cut areas. Additional data reflecting the geographical, climatic, and ecological characteristics of these communities will be collected. The following study questions will be addressed: 1) the species pool in forest communities in an agrarian landscape; 2) the importance of different types of forest and shrub communities (natural and planted) in maintaining biodiversity; 3) differences in the ability of forest communities at different stages of succession to support biodiversity; 4) the ability of isolated and interconnected forest communities to support biodiversity. The research outcomes will significantly enhance the European vegetation survey and assess the effectiveness of eco-schemes under current agricultural and environmental standards in protecting biodiversity.

Dissimilar effects of deadwood on vegetation in nemoral and hemiboreal forests

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Windthrows are an important element of natural forest dynamics, but their impact on diversity is poorly understood. We studied changes in vascular plant species diversity in a hemiboreal coniferous – broad-leaved forests in the Prioksko-Terrasny Reserve and in a *Quercus* mesic broad-leaved forests in the Kaluzhskie Zaseki Reserve both located on the Russian Plain (54.88 and 53.63º N, 37.61 and 35.88º E, respectively). In the spruce dominated hemiboreal forest, we studied the dynamics of vegetation 5 and 10 years after a mass outbreak of bark beetle-typhophorus; one hundred and ten 10 × 10 m vegetation plots were analyzed. In the oak dominated nemoral forest, differences in vascular plant species composition between adjacent fifty four 1 m2 plots on fallen logs and on the forest floor were examined and compared with the vegetation in fifteen 10 × 10 m plots randomly placed in patches without large fallen logs. NMDS, PERMANOVA, generalized linear models, and additive diversity partitioning were applied to examine differences in species composition, the relationships between environmental variables and species richness; and to estimate the contribution of alpha and beta diversity caused by fallen logs and gaps in the canopy to the general gamma diversity in vascular plants. Species richness was calculated for different plant traits: growth form (herbaceous and woody species) and functional group according to the methodology of Smirnova et al. (1, p. 38) which divides species into 4 groups: (i) light-demanding species of open habitats, (ii) nemoral related to broad-leaved deciduous forests, (iii) boreal related to *Picea* spp. forests; and (iv) nitrophilous related to flooded forests. Results showed dissimilar effects of deadwood and gaps in the canopy following windthrows on vascular plant species diversity in these two types of forest (hemiboreal and nemoral ones). In the hemiboreal forest, after a mass outbreak of beetle-typhophorus we observed an initial drop in vegetation diversity followed by a recovery after 10 years. Nitrophilous and boreal plants that dominated in the gaps and on the deadwood were the same as those growing on the forest floor without deadwood and gaps. While on large oak logs in nemoral forest, boreal and light-demanding plants dominated along with nitrophilous species that were absent on the soil (2). As a result, the presence of coarse woody debris led to a significant increase in plant diversity in the nemoral forest. Probably, boreal flora is lost in broad-leaved forests due to artificial degradation of their structure, and it returns there together with deadwood and gaps in the canopies. Mass outbreaks of beetle-typhophorus did not result in a loss of plant diversity in the studied forests.

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Microclimate-driven biomass shifts in dry grasslands under a changing climate.

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The recent biodiversity crisis is most commonly attributed to land-use change, eutrophication and introduction of alien plants. However, rising temperatures and related drought stress are gradually gaining importance, especially in dry habitats such as temperate dry grasslands. At the scale of local communities, individual species likely vary in ways they respond to changing climate. While some species might be promoted by these changes, others might even face local extinctions. The understanding of those species-specific responses is challenging, since it is blurred by multiple factors that need to be accounted for. (1) Rather than long-term climate change, species reflect short-term weather fluctuations. (2) Short-term weather fluctuations manifest themselves differently under specific microclimatic conditions, i.e., they are either amplified or buffered. (3) Some species are capable of phenological adaptations and therefore they can avoid the summer drought by completing their life cycles earlier in spring. To account for these factors in modelling species-specific responses to changing climate, we established in 2021 a long-term permanent-plot monitoring of three types of dry grasslands presumably differing in microclimatic conditions (loess steppe, rocky steppe and dealpine *Sesleria caerulea*-dominated grasslands) in Southern Moravia (the Czech Republic). At each of nine blocks, we are measuring soil temperature using data loggers (EMS Minikin). Every second month, we record the cover and height of all species in six plots (0.25 m^2) per block. Preliminary analyses showed that most species do not accumulate biomass both during the warmest and coldest months, which did not apply only for short-lived species but also for perennials. Additionally, when relating biomass to temperature, expressed by growing degree hours > 5 ^oC, and predicting this relationship for RCP temperature scenarios of global warming, we found that peak biomass will considerably shift towards early spring and late autumn. This can be attributed to phenological adaptations of individual species which might thereby prevent local extinctions.

Preliminary results on the classification of *Bolboschoenus* spp. rich communities in Bulgaria

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In the recent years, the taxonomy and ecology of *Bolboschoenus* has been largely updated, both at European and regional scale. The genus *Bolboschoenus* in the European flora of is represented by six species. Within the flora of Bulgaria, the genus is characterized by four species. The most important characters used for discrimination of the individual taxa within the genus are, those related to achene morphology and anatomy. However, in the most recent floristic summaries in Bulgaria this novel concept of the taxonomic (and nomenclature) boundaries of the *Bolboschoenus* spp. has been updated only to a limited extent. Additionally, from a phytocoenological perspective, the plant communities in which representatives of the genus participate on the territory of the country have been studied only in few regions, limited area, and a small number of phytocoenological samples. In order to be able to prepare reliable, motivated and comparable floristic references, syntaxonomic decisions, assessment of the diversity and condition of natural habitats, monitoring, and mapping, etc., it is necessary to perform such studies on the territory of Bulgaria. The syntaxonomic identity of this type of communities has so far remained unresolved in many regions of Europe mainly because of adopting broader taxonomic boundaries of the dominant species. Representatives of *Bolboschoenus* on the territory of Bulgaria often dominate a wide range of habitats, including coastal and inland salt marshes, coastal zones of freshwater bodies and temporarily wet habitats, often of anthropogenic origin. Our preliminary analysis of about 30 phytocoenological releves shows the differentiation of four groups of communities with dominance or high abundance of *Bolboschoenus* spp. in Bulgaria: 1) Communities of *B. maritimus* s.s. of the coastal regions of the Black Sea, 2) inland *B. maritimus* s.s. associations, fresh water communities with 3) *B. glaucus*, as well as 4) *B. planiculmis*. The forth species, *B. laticarpus* is a rare and of restricted distribution in Bulgaria, so its participation in plant communities is very limited. As a result, we are presenting a new syntaxonomic scheme of *Bolboschoenus* rich vegetation in Bulgaria.

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Vegetation diversity, ecological heterogeneity and stand structure as indicators of the conservation status of *Tilio-Acerion* forests in Slovenia

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Maintaining the conservation status of priority habitat types (HT), such as the HT 9180* *Tilio-Acerion* forests of slopes, screes and ravines (1) investigated in this study, is of primary management importance within the European Natura 2000 network. We investigated pressures and threats, as well as structural and compositional drivers, affecting the conservation status of *Tilio-Acerion* forests in the Boč-Haloze-Donačka gora Natura 2000 site in Eastern Slovenia. These ravine forests are widespread throughout Europe, but as in the study area, they often occur in smaller, fragmented areas within the matrix of other forests. For monitoring purposes, as well as for adapted and optimal management, it is crucial to understand the compositional and structural heterogeneity of *Tilio-Acerion* forests, which are classified in two different sub-alliances (*Lunario-Acerenion* and *Tilio-Acerenion*). Due to heterogeneous geological and site conditions of the studied area, 4 different habitat subtypes were distinguished: i) Stands dominated by *Acer pseudoplatanus* and *Ulmus glabra*, mostly on concave terrain; ii) *Fraxinus excelsior* stands on slopes; iii) *Tilia* sp. stands with thermophilous broadleaves on ridges and steep slopes; iv) Stands on more acidic soils with *Acer pseudoplatanus* as the dominant tree species and frequent admixture of *Castanea sativa* (2). The studied ravine forests (81 plots of 400 m^2) were heterogeneous with high plant species richness, mostly in favourable and inadequate conservation status, with the relatively well-preserved stands (average canopy cover was 84%). In all vegetation layers (tree, shrub and herb) between 21 and 81 vascular plant species were recorded per plot. On average, the herb layer covered 60.5% of the plot area (ranging from 15 to 98%), with a mean species number of 45.4 (ranging from 15 to 77 species per plot) and a Shannon index of 3.0 (ranging from 1.2 to 3.9). The main pressures and threats to the long-term functioning and existence of these forests were game browsing pressure, mortality of key tree species and altered tree species composition. Favourable conservation status of the ravine forests studied was indicated by higher growing stock and basal area of trees. It was also associated with well-preserved and less intensively managed *Tilia*-dominated stands on rocky ridges and steep slopes. Conversely, indicators of bad conservation status were associated with *Fraxinus excelsior*-dominated stands that were severely affected by ash dieback, leading to higher tree mortality. This resulted in the creation of open canopies with a consequent increase in light availability at the forest floor, as indicated by an increase in the number of plant species in the herb and shrub layers. The results of our study are an important step towards the characterisation of heterogeneity and provide indicators for long-term monitoring and conservation management of the studied ravine forests.

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Ecological variation of plant communities with *Stellaria media* species group in Slovenia – preliminary results.

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The *Stellaria media* group. comprises four species since 2019, when a new species, *Stellaria ruderalis*, was described, and added to *S. media, S. pallida* and *S. neglecta*. All species occur predominantly in habitats with some kind of disturbances, from fully anthropogenic (e.g. fields, construction sites, road sides, forest tracks) to natural (e.g. river banks, alluvial deposits,) with *S. neglecta* occurring also in more natural (forest) habitats (1). Since the description of the new species, a new interest in the species group arose with new occurrence data accumulating from European countries. So far, however, the distinction of the four individual species in ecological preferences based on vegetation record data hasn't been analyzed. To do that for the Slovenian territory, we compiled a dataset of vegetation records, starting with existing data with available herbarium specimens (allowing for (re)identification of species from *Stellaria media* group), and supplemented it with new records, mostly from different ruderal sites. We performed a NMDS ordination with passively projected new Ellenberg-type ecological indicator values (2). We found that plant communities with the four species are well arranged along the gradients for light and moisture. Stands with *S. neglecta* have lowest values for light and highest values for moisture (species composition overlapping mostly with stands with *S. ruderalis*). Stands with *S. pallida* occupy the other end of the gradient (with species composition overlapping with stands with *S. media* and *S. ruderalis*). Species *S. media* and *S. ruderalis* seem to occur in most diverse plant communities (reflected in part also in the highest number of records). All species occasionally occur together, which highlights the need to collect more specimens in the field for accurate identification and vegetation record assignment.

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Diversity of chasmophytic and grassland vegetation on granitic outcrops of Southern Buh River basin (Central Ukraine)

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Granite rocky outcrops in Central Ukraine are associated with exposures of the Ukrainian Crystalline Massif, well-represented in the Southern Buh River basin. This territory is notable for its petrophytic endemic species, which have narrow or disjunct distribution ranges and close relation to the Balkan flora. The pronounced relief heterogeneity supports a wide variety of vegetation types, including distinctive chasmophytic and rocky steppe communities. These characteristics, along with unresolved syntaxonomic issues, emphasise the need of a comprehensive vegetation survey. During the field seasons 2018–2023, we collected 270 relevés of chasmophytic, pioneer and grassland vegetation on granitic rocky outcrops in the Southern Buh River basin. For the data processing and analysis, we used R 4.3, JUICE 7.0 and QGIS 3.4. As a result of the preliminary classification, we identified a total of 12 clusters that were grouped into four main groups: I. Species-poor and sparse communities of vertical cliffs, ledges, and cracks with minimal soil accumulation (cl. *Asplenietea trichomanis*, all. *Asplenion septentrionalis*): ass. *Asplenietum septentrionalis*, ass. *Moehringietum hypanicae*. II. Communities rich in mosses and ferns on shaded or moist rocks (cl. *Asplenietea trichomanis*, all. *Hypno-Polypodion vulgaris*): ass. *Asplenio-Cystopteridetum fragilis*, ass. *Asplenio trichomanis-Poetum nemoralis*, ass. *Hypno-Polypodietum*, comm. *Sedum borissovae* + *Cystopteris fragilis*. III. Pioneer vegetation on rocky and gravely substrates with shallow soils (cl. *Sedo-Scleranthetea*): ass. *Sedo acri-Dianthetum hypanici*, ass. *Sempervivo ruthenici-Sedetum ruprechtii*, ass. *Thymo pulegioidis-Sedetum sexangularis*. IV. Rocky steppe communities (cl. *Sedo-Scleranthetea*, all. *Poo bulbosae-Stipion graniticolae*): ass. *Achilleo ochroleucae-Poetum bulbosae*, ass. *Ephedro distachyae-Stipetum graniticolae*; ass. *Potentillo incanae-Seselietum pallasii*. The obtained preliminary classification scheme revealed a broad range of chasmophytic and rocky grassland communities. However, the syntaxonomic position of certain communities require further clarification throuhg comparisons with data from other regions, such as Central Europe and the Balkans. Specifically, the classification of pioneer communities on exposed granite rocks and gravely substrates (group III, cl. *Sedo-Scleranthetea*) remains unresolved at the alliance level, with potential assignments to either *Hyperico perforati-Scleranthion perennis*, *Sedo-Scleranthion*, or *Sedo albi-Veronicion* dilleniid alliances. Additionally, the rocky steppes of the *Poo bulbosae-Stipion graniticolae* alliance (group IV) combine diagnostic species of both *Festuco-Brometea* or *Sedo-Scleranthetea* classes, reflecting transitional ecological characteristics. The outlined *Sedum borissovae* + *Cystopteris fragilis* community reguires further publication as a new association. Finally, we emphasize the importance of prioritising conservation actions for the rare communities of granitic rocky outcrops, particularly those rich in endemic species with narrow ecological ranges

Edge Effects on Forest Ground Cover Vegetation in Black Alder Dominated Stands

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In Northern Europe, there has been ongoing debate about the ecological impacts of widely practiced timber harvesting and retention forestry. Harvested areas alter microclimatic conditions in adjacent sites, for example, by increasing solar radiation and heat stress. A better understanding of the effects of forest edges are crucial for both management and conservation, with such insights increasingly applied in close to nature management strategies. This study examined how clear-cutting in adjacent stands influences ground cover vegetation in black alder forests. Twelve black alder forest stands adjacent to clear-cuts were selected, categorized as unmanaged alder swamp woods (ASW) or biologically old eutrophic drained peatland (EDP) stands. Vegetation sampling was conducted along transects extending from the forest edge inward, with 1 × 1 m plots placed at intervals (0–40 m). Edge exposure was quantified as an angle between plots and the shared forest edge. Species diversity was assessed using linear mixed-effects models and Poisson generalized linear mixed-effects models. Detrended correspondence analysis (DCA) was applied to identify environmental gradients influencing vegetation patterns. In addition, stand type, edge age, and exposure effects were examined. The analysis revealed that a total of 102 ground cover vegetation species were identified across all alder stands, with 65 species in the herbaceous layer, 15 in the shrub and tree layer, and 22 in the moss and lichen layer. ASW stands hosted 83 species, while EDP stands had 75 vegetation species. The interaction between alder forest type and adjacent stand age significantly influenced species richness and diversity. In ASW stands, species number and diversity decreased with increasing adjacent stand age, while in EDP stands, in contrast, species richness increased as edge age increased. In ASW stands, second DCA axis was strongly correlated with stand and edge properties, particularly the scale of the disturbance, as indicated by the length of the mutual edge, and correlation was stronger than those with edge age or plot exposure towards the edge. In EDP stands, species characteristic of Fennoscandian deciduous swamp woods were more prevalent in plots with lower edge exposure. Conversely, ASW stands exhibited no clear trends in species distribution along the DCA gradients, with species occurring near both younger, shorter edges and older, wider edges. These findings suggest that edge effects, particularly edge age, length and exposure, play a significant role in shaping ground cover vegetation, with distinct differences observed between ASW and EDP stands. Further research is needed to explore these effects in greater detail and to better understand their implications for forest management and conservation practices.

Plant and ant community organization is driven by contrasting trait-based mechanisms on Central European wood-pastures

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Complex landscapes are characterized by the presence of multiple habitat types at immediate spatial proximity. Owing to their high environmental heterogeneity resulting from the co-occurrence of different habitat types, complex landscapes are often key targets of biodiversity conservation and offer valuable opportunities to understand community assembly and species coexistence mechanisms. Despite their importance in both applied and theoretical contexts, the mechanisms shaping functional trait distributions, functional composition, and diversity metrics (e.g., taxonomic and functional diversity) across different trophic levels in these landscapes remain poorly understood and have not been studied in a comprehensive framework. To address this knowledge gap, we used Central European wood-pastures as a model system and focused on two ecologically prominent groups occupying different trophic levels: plants and ants. Our results revealed significant differences in taxonomic and functional composition for both groups among the different habitat types of wood-pastures (i.e., solitary trees, grassland matrix, forest edge, and secondary forest interior). However, the underlying mechanisms driving these patterns differed between plants and ants. Based on RLQ and fourth-corner analyses, heterogeneity in environmental conditions mainly influenced plant compositional patterns (taxonomic and functional composition). For ants, on the other hand, we did not detect any significant direct trait-environment associations, and local environmental conditions alone failed to explain compositional patterns and trait distributions. Instead, ant community attributes (species richness and functional diversity) were indirectly affected by microclimate through its strong effect on vegetation, as shown by path analyses. This highlights that while mapping the increased environmental heterogeneity of complex landscapes, the main mechanisms shaping functional composition and diversity metrics might differ for organisms at different trophic levels (i.e., predominantly environmental filtering for plants and interspecific competition for ants). As a result, the peaks of taxonomic and functional diversity of plants and ants did not align in space across different habitat types, as certain vegetation diversity metrics contrastingly influenced the diversity metrics of ants, and possibly other organisms along the food-web. This spatial mismatch reinforces the "ecosystem complex" approach of heterogeneous landscapes, emphasizing that conservation initiatives should focus on the landscape as a whole, rather than individual habitat types, to maximize biodiversity conservation.

State of knowledge on the bryophyte flora in old-growth forests of western Sicily

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The results obtained from a bibliographic and herbarium research carried out in the context of a PhD project entitled "Characterization of the bryophyte flora in old-growth forests of west-central Sicily" are here reported. The project aims to investigate some downy oak stands with old growth features located in the Sicani Mountains district, which are the forests of "Santa Maria del Bosco" and "Bosco del Fanuso", both included in the List of old-growth forests of Sicily (Regional Decree No. 373 of November 28th, 2024), and the monumental stand of Monte Carcaci. However, in order to obtain a stronger background of current knowledge the research of news data was extended to all the seven old-growth forests of western Sicily that are mentioned in the above-mentioned List. All these forests are protected sites of the regional Natura 2000 Network. Besides, the aforesaid "Santa Maria del Bosco" and "Bosco del Fanuso", are included in the Oriented Nature Reserves "Monte Genuardo e Santa Maria del Bosco" and "Bosco della Ficuzza, Rocca Busambra e Bosco del Cappelliere" respectively, while the remaining woods, which are the sessile oak forest of Pomieri (Petralia Sottana), the holly stand in Piano Pomo (Petralia Sottana), the holm oak forests of Monticelli (Castelbuono), and Orippotto (Isnello) and the beech forest of Cozzo Luminario (Castelbuono), are included in the Madonie Regional Park. Data on bryophyte floras, often rather incomplete, are available only for four of the ananlyzed stands. With reference to "Santa Maria del Bosco", a few records are reported in a contribution addressing the entire Sicani Mountain complex (1). The surveys in this area have made possible to draw up a list of 19 taxa (13 mosses and 3 liverworts). As for "Bosco del Fanuso", currently, no data are available on the bryophyte flora and the same lack of bryological knowledge concerns the monumental stand of Monte Carcaci. More information have been acquired instead on "Bosco Pomieri", which is, of all the investigated woodshe one that have received more attention in the past as it has been the main subject of two different studies from Dia *et al.* (2) and from Campisi *et al.* (3), and mentioned also in investigations involving the entire area of the Madonie Mountains (4). Overall, 41 taxa (30 mosses and 11 liverworts) have been reported so far for this forest, including some rare *taxa* from Sicily such as *Fissidens bryoides* Hedw. var. *caespitans* Schimp., an Endangered species in Italy (5), and the liverwort *Pedinophyllum interruptum* (Nees) Kaal. (3). In Piano Pomo, 26 species of mosses have been until now recorded (4,6). This locality host another species considered rare in Sicily, which is *Grimmia decipiens* (Schultz) Lindb., a moss that has also been assessed as Near Threatened at national level (5). As for "Monticelli" forest, some bryophyte records were reported too. Indeed, 17 taxa (10 mosses and 7 liverworts) were mentioned in a previous list of Madonie Mountains (4). No information are currently available for the old-growth forests of "Orippotto" and "Cozzo Luminario", since no investigation of the bryophyte flora has ever been specifically carried out there. Comparing the bryophyte floras of the four investigated stands a great variability turns up since most of the *taxa*, which are in total 81, occurs exclusively in one locality (76,5%).

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Ecological Niche Models for the Plants of Europe

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Aims: To create a set of ecological niche models for European vascular plants, bryophytes, and terricolous lichens which encompass the key environmental factors influencing habitat suitability. Location: Europe. Method: Adhering to the Hutchinsonian conceptualisation of the ecological niche as a n-dimensional hypervolume two sets of correlative, realised ecological niche models were trained - classification-based occurrence models and regression-based cover models. Support vector machines were utilised owing to their computational efficiency, flexibility, and conceptual alignment with the Hutchinsonian hypervolume. ~1,900,000 vegetation plots from the European Vegetation Archive and supplementary datasets formed the basis of the training data; with the predictor variables comprising of four bioclimatic variables (minimum temperature of the coldest quarter, maximum temperature of the warmest quarter, precipitation in the wettest quarter, and precipitation in the driest quarter) retrieved from plot locations, and six plot-mean ecological indicator values (soil moisture, soil nitrogen, soil reaction, salinity, light, and disturbance severity). Results: In total ~8000 species were modeled. The models performed well when evaluated using a holdout sample with ~80% of occurrence models yielding a precision-recall area under the curve of over 0.8 and ~40% of cover models yielding a Spearman's rank correlation coefficient of over 0.5. The ecological realism of 40 species models was evaluated using the literature and expert judgement, with ~good alignment being found between the modeled and actual niches, as understood by the co-authors. The models, performance metrics, univariate response curves, and additional data are made available in an R package - elements. Conclusions: Generating robust ecological niche models remains a challenge and is subject to inevitable reductionism, data limitations, sampling bias, and computational feasibility. However, we hope that these models represent the next step in the ecological niche modeling of European plants, bryophytes, and terricolous lichens providing 1) the capability to generate probabilistic habitat suitability predictions for taxa subject to multiple interacting drivers, and 2) descriptive insights to aid in ecological understanding of species niches.

What Shapes Vegetation in Managed Temperate Oak Forests?

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Oak forests dominated by *Quercus robur* and *Q. petraea* in Central Europe are among the most important sources of wood for several industrial sectors. At the same time, these forests encompass different vegetation types crucial for the conservation of natural forest flora. Forest management practices influence biodiversity as well as the structure and variability of these plant communities. This study aimed to identify key factors shaping vegetation diversity in economically managed oak forests.The sampled tree stands, ranging in age from 40 to 180 years, contained at least 50% oak species. Data were collected from 100 circular plots, each covering 300 m², within a lowland forest complex in southwestern Poland. In each plot, all vascular plant species were recorded, and their cover across forest layers was estimated. To classify the vegetation, TWINSPAN analysis was conducted, followed by ordination analyses. Detrended Correspondence Analysis (DCA) was applied to illustrate floristic relationships between communities, while Canonical Correspondence Analysis (CCA) was used to identify factors influencing vegetation diversity. Variability in plant communities was assessed based on several factors, including elevation, soil fertility and moisture, groundwater table depth, stand age, and the proportion of deciduous and coniferous forest and non-forest vegetation within a 1000 m radius. Additionally, we considered the size and shape of the deciduous forest patch containing each plot.The vegetation of the studied plots comprised four forest types: temperate acidophilous oak forests (*Agrostio-Quercion*), atlantic and subatlantic acidophilous oak forests (*Quercion roboris*), oak-hornbeam forests (*Carpinion betuli*), and oak riparian floodplain forests (*Alnion incanae*). The key drivers of vegetation variability were soil fertility and a high proportion of surrounding deciduous stands ($p<0.01$). Stand age had a statistically significant yet less pronounced effect. The area and shape of the patch where each plot was located had the least importance.Vegetation diversity in oak forests is primarily driven by local site conditions rather than large-scale management practices. The removal of old stands influences forest community development; however, site-specific regeneration does not result in permanent changes in vegetation diversity. Thus, sustainable forest management can coexist with biodiversity conservation, provided that forest regeneration aligns with the ecological requirements of natural oak forests.

Effect of plant species composition in mown and abandoned mesic grasslands on biogas production: Implications for habitat conservation

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In many parts of Europe, semi-natural grasslands are disappearing, mainly due to a lack of mowing as a result of the declining need for hay and its low profitability. Therefore, it is crucial to find a biomass management approach that corresponds to current economic challenges. This study investigated the potential of biomass from mown and abandoned grasslands for biogas production and examined the main factors related to plant species composition and chemical properties. In the Sudetes Mountains (Poland and Czechia), 30 regularly mown grasslands (hereafter referred to as "mown") and 30 grasslands abandoned for 5–15 years (hereafter referred to as "abandoned") were selected. These sites represent plant communities of the *Arrhenatherion* and *Triseto-Polygonion* alliances. A 10 × 10 m focal plot was established at each site. In a 1 m² central area, plant species composition (with percentage cover) was recorded, and biomass was collected for chemical analyses and biogas potential tests. Four 0.4 × 0.4 m squares in the corners of the focal plot allowed for species-specific biomass separation and weighing. Short herbs had a significantly higher cover on mown grasslands, while tall herbs dominated on abandoned grasslands. A higher proportion of herbs in biomass had a negative effect on the specific biogas yield (SBY, NL kg^{-1} volatile solids) due to their inhibitory effect on biodegradation, related to increased lignin in plant cell walls. This study evaluates the role of individual plant species in grassland biomass in terms of the amount of biogas produced per hectare (area biogas yield—ABY, m^3 ha^{-1}). All plant species that contributed most to higher ABY were medium to tall in height, with most of them being tall. The research shows that biomass from both abandoned and mown grasslands has suitable properties for biogas production in agricultural biogas plants. However, changes in species composition, particularly the increase in tall herbs on abandoned grasslands, can negatively impact the biogas production process but do not negatively affect ABY. The restoration of grassland use through the production of biogas from hay can be crucial for the conservation of semi-natural habitats. This is especially important for areas already designated as part of the Natura 2000 network, as well as those that may be included in the future. Mesic grasslands in the early stages of secondary succession can still be effectively restored to their ecological function through regular mowing, while their biomass remains a suitable feedstock for biogas production.

Freshwater macrophyte assemblages in human-disturbed landscapes of Greece: environmental driving factors, ecological quality and future challenges.

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Rivers and riparian landscapes are among the most fragmented, degraded and threatened ecosystems in the world (1). Riparian zones are responsible for many ecological functions considered crucial to the preservation of river ecological conditions (2). However, they are severely altered by human disturbances at basin and corridor scales, especially in Mediterranean countries, where high population densities and water scarcity aggravate pressures around water bodies (3, 4). Alterations in flow regime and hydromorphology are often responsible for changes in the aquatic macrophyte community, narrowing of the riparian buffer zone and loss of longitudinal connectivity (5). Aquatic and riparian plants are an important component of freshwater and play a crucial role in river functioning. In Mediterranean type-rivers macrophytes form dynamic assemblages adapted to the high seasonal and annual variability of the hydrological regime (5). The main objective of this work was to examine relationships between species composition and environmental stressors along longitudinal gradients in more than 200 river reaches from mainland Greece, with particular focus on identifying species that can serve as indicators of ecological quality impairment. The main findings showed that hydro morphological modifications are the main environmental factors that have a defining role in shaping aquatic macrophyte assemblages. Our results showed that we were able to distinguish a total of 53 plant taxa as potential indicators of the five ecological quality classes as derived from the WFD 2000/60 assessment. Species indicators of each ecological quality class were associated mainly with the hydromorphological change of riparian habitat features and the geomorphology of the watercourses. It seems that further research is needed to investigate the linkages between environmental stressors and macrophyte communities, that are critically important in improving freshwater biodiversity conservation in east Mediterranean rivers.

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Trends in the change of fallow land vegetation in the Chornobyl radiation and ecological biosphere reserve

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The cessation of economic activity more than 30 years ago in the Chornobyl Exclusion Zone, a region with low-fertile soils, led to the launch of the processes of restoring natural vegetation, both grasslands and forests (1). The study of grasslands that form on abandoned lands can be divided into several types, due to their location in the landscape and edaphic conditions. Most often, communities dominated by *Calamagrostis epigejos, Poa angustifolia, Artemisia campestris*, and *Achillea millefolium* are formed on fallow land on poor sandy soils on the uplands. In some places, the fallow lands are overgrown with *Pinus sylvestris* and *Betula pendula* trees, and form thickets with canopy closure of up to 0.5. On more nutritious soils, *Carex praecox, Agrostis canina, A. vinealis, Rumex acetosa, R. thyrsiflorus* dominate the grass stand, and in lower elevations *Elytrigia repens, Convolvulus arvense, Urtica dioica* are added to the coenosis. On the slopes of birch terraces of rivers, communities close to the psammophytic vegetation of the Koelerio-Corynephoretea canescentis class grow on the sands, with a complex of species *Arenaria serpyllifolia, Artemisia campestris, Berteroa incana, Centaurea diffusa, Corynephorus canescens, Helichrysum arenarium, Jasione montana, Oenothera biennis, Rumex acetosella, Trifolium arvense, Veronica dillenii, V. verna.* A lichen layer of species of the genus *Cladonia* is often developed: *C. sp. C. rei, C. mitis, C. rangiformis.* Floodplains on meadow and sod soils are often overgrown with poplar and shrub willow species. In open areas, grass communities close to meadows dominated by *Carex hirta, Achillea millefolia, Rumex thyrsiflorus* are formed. It should be noted that *Solidago virgaurea* is present in that communities, but single alien species *Solidago canadensis* were recorded too, which often form dense thickets on fallow land outside the Exclusion Zone. In general, alien species have an insignificant part of the floristic composition of the Reserve, and they are the most common: *Erigeron canadensis, Setaria viridis, S. pumila, Apera spica-venti, Bromus tectorum, Chenopodium album*, most of which are segetal weeds. In the fallow lands closer to abandoned settlements, invasive tree Robinia pseudoacacia and Acer negundo are found. Studying the biodiversity of the Exclusion Zone's fallow lands, which is a unique model site, is very important for monitoring the transformation processes in modern conditions.

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Assessment of changes in plant functional traits along forest road verges.
Session: Vegetation monitoring and mapping

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Road construction can significantly impact the forest ecosystem, causing habitat fragmentation and altering ecological processes[1]. Forest road verges are considered early successional habitats characterized by frequent disturbances and increased resource availability[2,3]. Vegetation on forest road verges is dominated by non-forest species that require high levels of light and nutrients and are more tolerant to disturbances than forest species[4]. However, less is known about vegetation dynamics. We used the approach of plant functional traits to study vegetation changes along forest road verges in a conventionally managed forest area in Latvia by conducting repeated ground vegetation assessments along forest road verges. We analyzed three different plant traits: life span, life form and soil disturbance indicator values. The study was conducted from 2017 to 2024. In total, four newly built and reconstructed forest roads were surveyed in six assessments and one vegetation-covered forest road in two assessments, representing more natural road conditions. Along each road, ground vegetation composition was assessed within a 1 km road section, where 20 vegetation survey plots, each measuring 3 × 10 m, were established. Over the study period we found a significant increase in species diversity and abundance. There is a shift in vegetation composition towards species less adapted to soil disturbances. Thus, showing a decline in soil disturbances over study period. In the second assessment we found a significant decrease in annual plant abundance and an increase in perennial plants, while no changes were observed in further assessments. A total of five different plant life forms were identified, with hemicryptophytes being the dominant throughout the study. In the second assessment, therophyte abundance decreased, while the abundance of hemicryptophytes, phanerophytes and geophytes increased. However, no clear trend in life form changes was observed in further assessments, possibly due to variations in the disturbance regime caused by forest logging. The study was carried out within the frames of Latvian State Forest Research Institute “Silava” and JSC “Latvia’s State Forests” collaboration research program “The impact of forest management on ecosystem services provided by forests and related ecosystems” (No. 5-5.9.1_007n_101_21_76).

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New and overlooked syntaxa of European vegetation and their accumulation over time

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Since the publication of the first comprehensive classification system of European vegetation (EuroVegChecklist) by Mucina and collaborators in 2016, many new high-rank syntaxa (classes, orders and alliances) have been published across Europe. However, only a few of them have been included in the updated versions of the EuroVegChecklist so far. During the review of European literature for the characterization of distribution ranges and structural, biogeographical and ecological characteristics of all alliances dominated by vascular plants listed in EuroVegChecklis (1, 2), many high-rank syntaxa described after the publication of EuroVegChecklist or even before were revealed. Here we review new high-rank syntaxa published from Europe in the period 2016-2022 or before 2016 but not included in EuroVegChecklist. We also describe the temporal dynamics of publishing new high-rank syntaxa of European vegetation since the beginning of the Braun-Blanquet school in the early 20th century to 2022.

We systematically reviewed 21 journals that publish new descriptions of high-rank syntaxa from Europe after 2016. We added other syntaxa found by non-systematic searches that were not listed in EuroVegChecklist. We summarized information on these syntaxa in a database. Additionally, we analysed the frequency of descriptions of new syntaxa before and after 2016.

New syntaxa have been continually described for more than a century. There were several waves of new syntaxon descriptions. There was no decrease in the publication of new syntaxa after the EuroVegChecklist was published. We found 375 high-rank syntaxa (307 alliances, 49 orders and 19 classes) not included in the EuroVegChecklist, of which 83 were published before 2016 and 292 between 2016 and 2022. However, many of them were not described validly according to the International Code of Phytosociological Nomenclature. Most of the new high-rank syntaxa were described both in the countries with well-studied vegetation (e.g. France, Italy and Spain) and in the countries with assumed gaps in vegetation research (e.g. Russia, Ukraine, Greece and the Georgia). New alliances of forest, scrub and non-forest vegetation were most frequently described within widespread vegetation classes such as *Quercetea ilicis*, *Crataego-Prunetea*, *Alno glutinosae-Populetea albae*, *Carpino-Fagetea* and *Festuco-Brometea*.

As most of the newly described syntaxa have not been submitted for consideration to the European Vegetation Classification Committee, our list provides an information resource for vegetation scientists that complements the EuroVegChecklist and may serve as the basis for its future updates.

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Early Richness, Later Loss: Threatened Plant Species Dynamics in Restored Wetlands

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In the past two decades, many wetland restoration projects were realized in the lowland agricultural landscape of the southeastern Czech Republic. One of their main goals is to support biodiversity, but their real impact on biodiversity remains unclear. To assess the impact of these projects on wetland flora and vegetation, a survey was conducted in 30 restored wetlands in 2022–2023, where floristic inventories were made, and vegetation samples were taken. Information about each restoration project was obtained from the project documentation or through interviews with mayors and people who implemented these projects. The richness of all plant species, threatened, halophilous, alien and invasive species was modelled using linear and generalized linear models. Restored wetlands hosted more than 450 species in total, 62 of which are listed in the Red List of vascular plants of the Czech Republic (1). Vegetation types resembling critically endangered halophytic habitats (2) were documented. They occurred mainly in areas where salt marshes and steppes used to exist in the past. The models showed that the restored wetlands in the river valleys were generally more species-rich than those in the adjacent hilly landscapes. The overall species richness and the number of alien species increased with the wetland size. However, the number of endangered species has decreased over time since restoration. The size of a wetland had no significant effect. Observations of flora and vegetation dynamics and the experience of people involved in wetland conservation support the following principles for ecological restoration and maintenance of lowland wetlands: 1. Ponds should be large enough and have shallow banks to allow littoral vegetation development. 2. A large number of trees should not be planted in restored wetlands. 3. Cattle grazing is a suitable way to manage competitively strong species. 4. In cases where cattle grazing is not possible, it is necessary to ensure regular mowing and biomass removal, along with occasional disturbance of the soil surface. Most importantly, restoration activities must not lead to the destruction of botanically or zoologically valuable habitats, such as ephemeral wetlands on arable land.

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The structural composition of bryophyte communities in meadow ecosystems as an indicator of vegetation cover transformation caused by wind farm construction

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The construction of wind farms, especially in high-mountain areas, significantly impacts the environment, particularly vegetation cover and soil. At different stages of wind farm construction on the Vododilno-Verkhovynsky Range (Eastern Carpathians, Ukraine), vegetation damage was recorded due to the installation of cable lines, power poles, and the movement of heavy machinery, as well as the initiation of erosion processes and pollution from construction waste. A particular threat is the colonization of disturbed areas by ruderal species, which may lead to the degradation of meadow ecosystems. Thanks to their alternative adaptation strategy, bryophytes are more sensitive to even minor environmental changes, especially anthropogenic influence (2). During the 2024 seasons, observations were conducted on the recovery of bryophyte cover in areas disturbed by wind farm construction. Additionally, adjacent partially disturbed areas and territories with natural vegetation cover were surveyed. For sampling, six transects were established in meadow ecosystems with varying disturbance levels. Within each transect, 10 plots of 1 m^2 were described under homogeneous conditions. Bryological material was processed in the Plant Ecomorphogenesis Department laboratory at the Institute of Ecology of the Carpathians, NAS of Ukraine (Lviv). To determine species diversity, samples were analyzed based on specific richness, coverage, and Simpson and Shannon-Wiener indices. To assess changes in epigeic bryophyte communities under different levels of anthropogenic impact, a multivariate analysis was performed using Permutational Multivariate Analysis of Variance (PERMANOVA). The PERMANOVA test was conducted in R v.4.4.1 (3) using the "vegan" package (1). Depending on anthropogenic impact, the species composition of bryophytes changed and declined. Specifically, on transformed dry meadow sites, species richness decreased threefold, while in wet and moist meadows, only 8 out of 13 characteristic species were recorded. Recently disturbed sites had small patches of stress-tolerant pleurocarpous and acrocarpous mosses, remnants of previous communities. On an unfinished construction site, bryophyte cover was fragmented and structurally heterogeneous. In completed construction areas, bryophyte communities were dominated by pioneer and ruderal acrocarpous species, best adapted to prevailing ecological conditions. The installation of wind farm towers negatively impacted epigeic bryophyte diversity, as initially undisturbed areas exhibited greater species richness, and bryophyte communities varied depending on disturbance levels. This study confirms that wind farm construction is a key factor in determining not only bryophyte diversity but also community structure. Epigeic bryophytes can be effective indicators of negative changes in vegetation cover, which may be used in the development of comprehensive measures to preserve unique high-altitude meadow ecosystems.

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Phenological patterns of grassland species in response to mowing at different heights and

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Grassland species are adapted to regular biomass loss, including adjustments to their phenology. Regular mowing is essential for maintaining grassland ecosystem functions. However, biomass from extensively used, biodiverse grasslands is often of limited value in modern agriculture. The main objective of our project is to develop an optimal scheme of semi-natural grassland management (including mowing height and season), which will: 1. maintain high biodiversity; 2. maintain regulated relationships between plant species; 3. reduce the amount of biomass. In this study we focused particularly on phenological patterns of grassland species in response to mowing at different heights and seasons. Our study assumed field two-factorial experiment, in which different configurations of mowing heights (5 cm, 15 cm, 25 cm) and mowing date (May, June, July, August) are applied. In each experimental plot, plant species composition was visually assessed, the sward was manually cut to a predetermined level, and chemical analyses of the biomass were conducted. Additionally, we measured the height of each plant species and recorded their phenological phases. The mayor of grassland species flowered from May to July. Mowing had an impact on flowering plant species by 1) delaying flowering, or 2) inducing a second flowering. Mowing the sward in June influenced the flowering of the largest number of species; however, cutting height had a minor effect in this season. Mowing at a higher height in May had the greatest effect on species phenology. The effect of the grasses and forbs proportion on biomass quality was minor. Biomass properties were related to the collection time, followed by mowing height. Mowing grasslands at a height greater than the traditional 5-8 cm may be a promising alternative for non-productive, biodiverse grasslands. We assume that it will promote forb species by mitigating the dominance of grasses adapted to mowing at low heights. However, long-term studies are needed to assess the impact of alternative management schemes on grassland plant species composition and biomass properties.

Land surface phenology for the monitoring and mapping of Mediterranean temporary grasslands

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Land surface phenology (LSP) parameters derived from satellite images (Sentinel-2) proved to be effective in generating proxies of agronomic characteristics of Mediterranean permanent grasslands in Sardinia, Italy (Tanda et al., 2025). In this study we propose a scaling up of the LSP applications to Mediterranean grasslands by testing the effectiveness of LSP parameters in providing proxies of relevant agronomic characteristics of Mediterranean temporary grasslands. Temporary grasslands are the main forage crops to produce hay in the large-scale grazing systems of Sardinia supporting some 40% of total sheep in Italy. These temporary forage crops are sown in the autumn-winter season, depending on the altitude and the timing of the drought season break, and are often grazed until mid-February to yield a single hay cut in May or sometimes grazed until the end of the crop cycle at the end of the spring. The sown grasslands are mostly based on annual grasses like Italian ryegrass (*Lolium multiflorum* Lam.) or oats (*Avena sativa* L.) either pure or in mixture with annual clovers like crimson clover (*Trifolium incarnatum L.)*, persian clover (*T. resupinatum* L.), berseem clover (*T. alexandrinum* L.) or squarrose clover (*T. squarrosum* L.). However, the botanical composition includes also wild species and weeds, particularly during the fallow period between two subsequent sowings. Eighty-six grassland polygons across five sites were monitored for four years. Data on the grassland vegetation composition were collected in at least three 2 m × 2 m randomly chosen sample quadrats in each polygon. Grassland management was also recorded to identify grazed vs. haycrops and the stocking rate. Sentinel-2 satellite images were processed to derive NDVI, and LSP parameters were calculated using the TIMESAT 3.3 software. The canonical correspondence analysis revealed a significant association ($P<0.05$) between a combination of LSP metrics and a set of vegetation and agronomic indicators of the grasslands. It was possible to differentiate haycrops vs grazed grasslands and to assess several useful agronomic parameters for the characterization of the growing season length, earliness, forage availability, mowing and grazing intensity. The remote sensing characterization through LSP parameters can support the assessment of the agronomic performances in relation to the vegetation composition and different management types of Mediterranean temporary grasslands.

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Topological vegetation differentiation of Central Podillia

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Central Podillia is the geographical region of Ukraine covering the Khmelnytskyi and Vinnytsia districts, which exhibits a distinctive geological composition and diverse landscape features. The region is part of the Podillian Upland, shaped by tectonic uplift and prolonged erosion. Its northern part is dominated by Precambrian crystalline bedrock, consisting of granites and gneisses that form the foundation of the ancient Ukrainian Crystalline Shield. In contrast, the southern part features predominantly Paleozoic sedimentary rocks: limestones, sandstones, and shales, contributing to the region's varied topography. The study aims to identify the distribution patterns of plant communities, determine their topological differentiation within the landscapes of Central Podillia, and assess their position within the system of geobotanical zoning. To identify the features of each geobotanical region of Central Podillia (1), we classified vegetation data comprising 806 relevés using the Twinspan algorithm (2) and, based on geographical data, analyzed the spatial distribution of the syntaxa within the boundaries of four geobotanical regions. In addition, we analyzed the relief of each geobotanical region and constructed ecological profiles (3) for each of the four regions. Central Podillia is divided into four geobotanical regions: Khmilnytsko-Litynskyi, Vinkovetsko-Zhmerynskyi, Nemyrivsko-Haisynskyi, and Novoushytsko-Mohyliv-Podilskyi. The south part of Central Podillia (Novoushytsko-Mohyliv-Podilskyi region) with the effect of "warm Podillia "and canyon river valleys of the Dniester River basin is characterized by the presence of thermophilous forests (Cl. *Quercetea pubescentis*) and calcareous rocky grasslands (Cl. *Sedo-Scleranthetea*, Ord. *Alysso-Sedetalia*; Cl. *Festuco-Brometea*, Ord. *Stipo pulcherrimae-Festucetalia pallentis*). Fragments of boreal communities (Cl.*Scheuchezerio-Caricetea fuscae*) are recorded in the north part of Central Podillia (Khmilnytsko-Litynskyi region). The eastern art of the Central Podillia (Nemyrivsko-Haisynskyi region) with vast valleys of the South Bug River basin is characterized by the high diversity of semi-dry (Cl. *Molinio-Arrhenethereteа*, Ord. *Galietalia veri*) and wet (Cl. *Molinio-Arrhenathereta*, Ord. *Molinietalia*) grasslands and acidophilous rocky grasslands (Cl. *Sedo-Scleranthetea*, Ord. *Sedo-Scleranthetalia*). Semi-dry (Cl. *Festuco-Brometea*, *Brachypodietalia pinnati*) grasslands are widely spread in the western part (Vinkovetsko-Zhmerynskyi region) of the study area. The deciduous forests of Cl.*Carpino-Fagetea sylvaticae* are widely distributed within four geobotanical regions. In general, it has been determined that the overall differentiation of vegetation is primarily influenced by edaphic parameters such as soil moisture, carbonate content, and aeration, while climatic parameters like thermoregime, ombroregime, and continetality play a somewhat insignificant role. Such regional differences in vegetation cover and the specifics of ist topological differentiation form the basis for revising the existing geobotanical zoning, which was previously based on the principles of assessing zonal forest and steppe vegetation.

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Classification of floodplain forests and scrub in the Pannonian region of Serbia

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Floodplain forests are among dynamic habitats, playing a crucial role as a buffer between terrestrial and aquatic ecosystems, with their landscape shaped by the constant fluctuations in river levels. The natural vegetation of the Pannonian part of Serbia has the characteristics of forest-steppe vegetation. Pannonian floodplain forests of this area consist of broadleaved deciduous forests with dominant tree species, such as, willows (*Salix alba*), poplars (*Populus alba, P. nigra*), ashes (*Fraxinus angustifolia*, *F. excelsior*), elms (*Ulmus minor*, *U. laevis*) and oak (*Quercus robur*). The floodplain forests vegetation changes due to natural and human influences. Changing in river flow and improper management are the primarly factors responsible for the ongoing changes in the ecosystem structure, highlighting the need for a revision of its current status. Classification of floodplain forests represent a first step in revision process. Vegetation monitoring was conducted from 2020 to 2023 using the traditional Braun-Blanquet method. The study area for this survey was the Southern part of the Pannonian plain, including Northern Serbia. We analyzed 446 relevés to perform revision of syntaxonomic classification. The hierarchical classification of the dataset was performed using TWINSPAN method in JUICE software ver. 7.1. Based on the results, floodplain forests of Northern Serbia can be classified into three classes: *Franguletea* Doing ex Westhoff in Westhoff et Den Held 1969, *Salicetea purpureae* Moor 1958, and *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968.

Supervised classification of *Pinus* forest stands from Slovenia

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Scots pine (*Pinus sylvestris*) and black pine (*Pinus nigra*) are pioneer tree species with very different ecological characteristics and distribution areas. In Slovenia, they thrive in a wide range of ecological conditions and habitats, including very extreme. We have carried out a supervised classification of pine forests in Slovenia using the Cocktail method at the association level. We used the Vegetation of Slovenia database, which was extended with data from other institutions and contained 28,425 vegetation relevés. Classification was performed on a stratified dataset of 19,145 relevés of all vegetation types. A total of 14 associations with dominant *Pinus* species were identified using formal definitions. They are classified into *Quercetea pubescentis* (*Seslerio autumnalis-Pinetum nigrae*), *Erico-Pinetea* (*Molinio litoralis-Pinetum, Brachypodio-Pinetum sylvestris, Fraxino orni-Pinetum nigrae, Alno incanae-Pinetum sylvestris, Carici sempervirentis-Pinetum nigrae, Daphno alpinae-Pinetum nigrae, Genisto januensis-Pinetum sylvestris, Primulo carniolicae-Pinetum nigrae, Thymo praecocis-Pinetum nigrae, Rhodothamno chamaecisti-Pinetum sylvestris*), *Vaccinio-Piceetea* (*Galio rotundifolii-Pinetum sylvestris, Vaccinio myrtilli-Pinetum sylvestris*) and *Molinio-Betuletea pubescentis* (*Vaccinio uliginosi-Betuletum pubescentis*). For each association, we presented a formal definition and determined diagnostic, constant and dominant species. For ecological interpretation, we used Pignatti's ecological indicator values. The distribution of syntaxa was represented by grid maps. All together 14 associations with dominating *Pinus* species were identified using formal definitions.

Vegetation of mesophilous ravine forests in the White and Samarian Rocks Strict Reserve in the context of ravine forests of the Dinaric Alps

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The research took place in the Dinaric Alps, a mountain range that stetches from Slovenia in the northwest to Montenegro in the southeast. It consists mainly of limestone and dolomite and is part of the Illyrian floral province. We have studied ravine forests, which grow on spatially limited areas with specific soil conditions. They occur on slopes, at the bases of slopes, in dolines, ravines and depressions with colluvial, skeletal and unstable soils that favor the growth of deciduous tree species such as: *Acer platanoides, A. pseudoplatanus, Fraxinus excelsior* and *Ulmus glabra*, which crowd out otherwise more competitive tree species, such as *Fagus sylvatica* (1). We considered mesophilous ravine forests (*Fraxino-Acerion*) sampled in the White and Samarian Rocks Strict Reserve (central part of Velika Kapela mountain range) at an altitude between 900 and 1,335 m and analyzed them in the context of ravine forests of the wider Dinaric region (2). A database for these forest types was created for the entire region. After preparing the dataset (standardizing the nomenclature of plant species, eliminating mosses and merging the cover layers), we applied the TWINSPAN classification (3), which reveals the main groups of ravine forests in the Dinaric Alps. We also used Ellenberg indicator values (4) and geomorphologic features (both presented in BW diagrams). The synoptic table was based on species constancy and fidelity. The results indicate four groups following the altitudinal gradient. The submontane group (*Hacquetio-Aceretum, Dryopterido-Aceretum*) is common in warmer areas with higher temperatures. The montane group (*Chrysanthemo-Aceretum, Omphalodo-Aceretum*) occurs at altitudes between 500 and 900 m in the intermediate site conditions between the submontane and altimontane vegetation belts. This is followed by the altimontane group (*Lamio orvalae-Aceretum*), which is found in regions with high precipitation above the former group. Finally, the association found in the White and Samarian Rocks Strict Reserve is situated at the highest altitude (altimontane/subalpine vegetation belt) and can be assigned as a new association *Ribeso alpini-Aceretum.*

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Plant diversity of steppe enclaves within old cemeteries of the Northern Black Sea Region (Southern Ukraine)

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Anthropogenic activities have led to a significant loss of natural habitats in the world over the last few centuries (2) and in Ukraine (1). Steppe flora is preserved mainly in protected areas, ravines, gullies, river terraces and sea cliffs (usually due to steep slopes, which make ploughing with agricultural machinery impossible) (2). Recently, studies in different countries have recognized the natural value of old cemeteries and other cultural heritage sites (2,3,4). We conducted our study at the Northern Black Sea Region (within the Dnipropetrovsk, Kherson, Mykolaiv and Odesa administrative Regions) (5,6,7). We inventoried the flora of 50 old cemeteries, mainly focusing on good-preserved old cemeteries with steppe vegetation of the class *Festuco-Brometea* and established 20 nested plots at the old cemeteries in Ukraine of 7 grain sizes from $1cm^2$ to $100m^2$ ("EDGG biodiversity plots"). The area of the old cemeteries ranges from 0.10 to 32.5 hectares (median 3.05 hectares), age from 100 years to 387 years (median 224 years). We focused on the evaluation of species richness, the presence of protected species, the potential of old cemeteries as refuges for steppe vegetation on the species richness of steppe plant communities in the old cemeteries. The article includes the results of the previous investigations carried out in 2007-2017, 2020-2021 and 2023-2024. To include different phenological aspects we visited each site in different seasons of a year: in spring (April/May), summer (July), and autumn (October). A total list of flora includes 684 species of vascular plants recorded at the 50 old cemeteries. As well, we recorded 204 species of vascular plants within the 'biodiversity plots', within 14 protected species. The floristic composition of old cemeteries includes 66 protected species with a different level of conservation status: 3 species are listed in the Resolution 6 of the Bern Convention, 16 species listed in the Red Data Book of Ukraine and 49 species listed in the Regional Red Lists of the administrative regions of Dnipropetrovsk, Kherson, Mykolaiv and Odesa. The species richness in different grain sizes could be used in comparisons between the data from other steppe steppe enclaves within the steppe zone and within cultural heritage sites (kurgans,old settlements etc.).

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Analogies of unique peri-Carpathian forest-steppe grasslands in the Balkan peninsula: unknown diversity hotspot worth conserving

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Forest-steppe grasslands are among the most species-rich ecosystems on a fine scale, with more than 100 species occurring within just 10 m². Their most species-rich and precious segments belong to the *Brachypodio pinnati-Molinietum arundinaceae* association, which used to be considered unique to the area of White Carpathians (Czech Republic) from where it was described (1). However, recent studies report its distribution on the entire periphery of the Western and Eastern Carpathians and some adjacent regions (2). This community is characterised by a mixture of species with different ecological demands – their co-occurrence is thus rare and determined by both the specific local conditions, such as landscape heterogeneity, land use and bedrock and the specific regional quaternary history. The community is interpreted as a relic of late-glacial and early-Holocene ecosystems that persisted in mesic habitats due to continuous disturbances such as grazing by large herbivores and fire, and later grazing, burning and mowing by humans. In addition to the studies from the Carpathian region, some literature data point to the existence of similar vegetation in south-eastern and southern Europe, which has only been studied very sparsely to date. This specific vegetation might be often overlooked and misclassified as it usually occurs in small patches within more common grassland types. We started the research in the Balkan peninsula to explore the link between the peri-Carpathian forest-steppe grasslands and analogical grasslands in the Balkans. We surveyed over 30 sites with 70 phytosociological plots across Montenegro, Serbia, Croatia, and Slovenia. During the selection of sites to sample, we focused on the occurrence of species shared with extremely rich peri-Carpathian grasslands, such as species of forest-steppe, tall-forb fringes and intermittently wet grasslands. We further aimed to cover analogous local conditions in terms of soil moisture, texture and depth. We indeed confirmed the occurrence of species-rich grasslands with a high ratio of species considered as indicators of the *Brachypodio-Molinietum* association (3) in the Balkans. Despite their ecological, biogeographical and conservation importance, these grasslands often lack sufficient attention and protection, and therefore, they are currently under threat of massive decline because of ongoing changes in the landscape. The most common threat is the cessation of traditional low-intensity agricultural practices, which leads to shrub encroachment, litter accumulation and intense competition for light. Large-scale infrastructural projects, such as highways, tourist resorts, and power stations, even lead to the direct disappearance of the habitat. A better understanding of the distribution and ecological conditions that sustain these habitats is essential for their effective management and chance for long-term preservation.

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Global overview of the Lusitanian dwarf-oak (Quercus lusitanica Lam.) communities: The particular case of the Temperate Atlantic community

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The Lusitanian dwarf oak (Quercus lusitanica Lam.) is a shrub with an Atlantic distribution across the western Iberian Peninsula and Morocco. Traditionally, its communities have been classified within *Quercion fruticosae* (*Pistacio-Rhamnetalia alaterni*), a sclerophyll mid-successional stage of Mediterranean evergreen forests (*Quercetalia ilicis*). However, its broader occurrence in the European Atlantic Province has been largely overlooked. Recent evidence suggests the existence of temperate-Atlantic Q. lusitanica communities as seral stages of pedunculate oak (*Quercus orocantabrica*) deciduous forests (*Quercion orocantabricae-pyrenaicae*). In the later context, *Quercion fruticosae* is strongly relatable to heathlands (*Calluno-Ulicetea*), characterized by *Ulex latebracteatus*, *U. minor*, *U. micranthus*, and Erica cinerea, rather than to *Pistacio-Rhamnetalia* tall scrub, challenging conventional syntaxonomy. This study provides a global geobotanical review of Q. lusitanica communities, analyzing floristic datasets, by applying hierarchical clustering (Ward's method using Bray-Curtis distance) and Detrended Correspondence Analysis (DCA) to a matrix of 85 relevés and 295 species. Results reveal a clear segregation between temperate-Atlantic and Mediterranean communities, the latter (*Quercion fruticosae*) clustering biogeographically among themselves. On the other hand, the temperate communities show distinct ecological and floristic traits, justifying their exclusion from such Mediterranean unit and ascribing it to *Ulicetalia minoris* instead. Thus, no single high-level syntaxon encompassing the whole of *Q.lusitanica* communities is to consider. We describe a new association, *Ulici latebracteati-Quercetum lusitanicae* ass. nova, with a Euro-Atlantic distribution and ascribed to a thermo-mesomediterranean to thermotemperate and subhumid to humid bioclimatic belts. It includes three subassociations across the Galician-Portuguese (2) and Portuguese-Divisorian (1) sectors. This is a comprehensive assessment of *Q. lusitanica* communities, offering a global biogeographical and geobotanical perspective. By distinguishing a northern temperate-Atlantic community, our findings challenge existing classifications and provide insights into the species' ecological range, evolutionary dynamics, and resilience. Recognizing this Atlantic counterpart has significant implications for conservation, habitat restoration, and ecological modeling.

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Understanding aboveground biomass responses to environmental factors in grasslands: the key role of less abundant species

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Biomass production in grasslands is a central focus of agricultural and ecological research, with aboveground peak biomass (AGB) serving as a widely used indicator of ecosystem productivity and functioning. While many studies have explored how AGB responds to variation in environmental conditions, there remains a critical gap in understanding how different functional groups of species—characterized by their frequency and biomass contributions—respond to environmental gradients. To address this gap, we analyzed vegetation-plot data from species-rich mesic hay meadows, incorporating species-specific biomass measurements. Using a well-established functional group framework, we classified species into three groups based on their relative frequency and cumulative biomass: AGB-dominant, AGB-subordinate, and AGB-transient. We then employed Random Forest (RF) models to assess how climatic and edaphic factors influence biomass accumulation in these groups. Separate RF models were developed for each functional group to compare their explanatory power against a global AGB-total model, allowing us to determine whether functional group responses align with or diverge from overall biomass patterns. Our study aimed to answer two key questions: (1) Are the environmental drivers of biomass accumulation consistent across functional groups? (2) Which functional group most closely aligns with the AGB-total model in its response to environmental gradients? Our results align with previous findings that emphasize the dominant role of soil properties—particularly pH, potassium, carbon-to-nitrogen ratio, and phosphorus—in shaping AGB-total. However, functional groups displayed distinct response patterns to environmental conditions. While some groups followed patterns similar to the AGB-total model, others exhibited divergent trends. Soil pH and potassium emerged as the strongest predictors of AGB-total, but their influence varied among groups. Notably, the AGB-transient group exhibited the most consistent response patterns with the AGB-total model, whereas the AGB-dominant and AGB-subordinate groups showed weaker alignment. This discrepancy was evident in their lower predictor explanatory power and differences in relationships of environmental variables with biomass accumulation. Our study highlights the critical role of infrequent and sparsely distributed species in shaping overall AGB responses. Transient species, often existing near the edges of their ecological tolerance, originate from a wide range of source habitats with contrasting environmental preferences. Their narrow niche breadth and limited niche overlap with dominant and subordinate species suggest low resource utilization capacity and weak competitive ability. As a result, even small environmental shifts can significantly alter their interactions with more competitive species, ultimately influencing their survival and persistence. While individual transient species may appear ecologically marginal, their cumulative presence can substantially impact ecosystem functioning by contributing to biomass variability.

Classification of subalpine tall herb Umbelliferous vegetation of the Iranian Plateau

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In this study, we aim to present the first comprehensive syntaxonomic overview of the subalpine Umbelliferous vegetation of the Iranian Plateau. Based on our vegetation plot data and published data from different mountain systems of the region, we provide a dataset of 331 vegetation plots. They usually cover steep slopes with a high proportion of scree in the subalpine belt of the area. The plots were analyzed by modified TWINSPAN with three cut levels of 0, 5, and 25. Diagnostic species were identified by constancy measure and phi coefficient as a fidelity measure. DCA was used to find the relationship between the associations and environmental variables. Analysis of the plots resulted in 19 well-separated associations. We assigned the units of this vegetation type to the class *Pangetea ulopterae* which was provisionally introduced before and verified in this study. We describe three new orders, i.e. *Artemisietalia aucheri* (with three alliances, i.e. *Ferulo persica-Artemision aucheri, Ferulo ovina-Artemision aucheri, Ferulion assa-foetidae, Ferulo hezarlalezarica-Artemision aucheri*, mostly distributed over the Alborz and Kerman mountains), *Ferulagietalia agulatae* (with one alliance, i.e. *Ferulagion angaulatae,* distributed over Zagros mountains) and *Prangetalia ulopterae* (with two alliances, i.e. *Ferulion ovinae, Prangion ulpterae,* distributed over the whole study area). Elevation, Geographic distribution, proportion of screes, and degree of inclination were the main factors determining the species composition of the vegetation units. Our study expands the knowledge about the syntaxonomic classification and diversity of this vegetation type in South-West Asia. Further studies are necessary to fill the gaps and find the syntaxonomic relations/links to other adjacent regions.

Combining in situ surveys with remote sensing techniques for vegetation mapping and monitoring in the Natura 2000 site "Duna e Lago di Lesina-Foce del Fortore" (Puglia, S Italy)

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In many parts of the world, and especially in the Mediterranean area, coastal dune systems are under severe pressures leading to different forms of degradation. In this scenario, continuative and consistent monitoring programs are fundamental to implement effective conservation strategies (1). The combination of in situ surveys with remote sensing methods and techniques has proven to be a robust approach for the monitoring of coastal ecosystems on large spatial and temporal scales (2). Specifically, we addressed our study to a Natura 2000 site in southern Italy (Puglia), namely IT9110015 - "Duna e lago di Lesina-Foce del Fortore". The site is characterized by extensive dune systems hosting several vegetation types, many of which are habitat types under the 92/43 EEC Directive. The activities included field surveys and the analysis of remote sensing products (i.e., satellite images and orthophotos, by both aircraft and drone). The first ones were mainly aimed at characterizing the morphology and the structure of plant communities; the second ones at achieving an automatic habitat-tailored mapping system. Original vegetation data (about 120 relevés) were sampled according to the phytosociological approach between 2022 and 2023 and then were subjected to numerical analysis in order to define dune plant communities. The connection of plant communities to habitat types and vegetation transects according to the Italian Manual for the Monitoring of species and habitats of community interest (3) was performed to assess dune standard zonation; all this information was used to process indexes for the evaluation of the conservation status of the dune system habitats and vegetation types (4). The remote sensing approach followed different strategies: the simple visual interpretation of aerial multi-temporal orthophotos; the classification of Very High Resolution (VHR) satellite images by both Data-Driven Object-Based (DDOB) and Knowledge-Driven Object-based (KDOB) approach supported by the expert knowledge of the site; the combined use of machine learning techniques and ground truth data obtained through both field campaigns and Unmanned Aircraft System (UAS) acquisitions. Both UAS acquisitions and KDOB procedures have produced very promising results with a view to automatic mapping of the vegetation types in terms of coverage (distribution area) and occupied volume (biomass). Finally, a set of specific Landscape Metrics (LMs) (5) was applied to vegetation maps, across multiple spatial and temporal scales, to evaluate spatial patterns and assess their changes over time; results were consistent with those obtained from the field surveys.

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Vegetation of pristine versus spontaneously recovered grasslands

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We studied pristine and recovered steppic grasslands using plots ranging from 0.01 to 100m^2 in Hungary. We found that there are remarkable differences in taxonomic diversity between pristine grasslands and spontaneously recovered ones from small to large scale. But we found no difference between pristine and recovered grasslands in functional diversity based on multi-trait indices. Patterns and physiognomic structure of spontaneously recovered grasslands are similar to those of pristine grasslands, but the species richness and diversity remained much lower. These findings suggest that there is a functional saturation of the species assembly. The frequent species recover but the high diversity of rare species characteristic to pristine grasslands is missing in the spontaneously recovered grasslands even 50 years after abandonment. Thus, we emphasize the protection of small fragments of pristine grasslands, because they act as important refuges for rare plant species; pristine grasslands harbour high and unique diversity missing from recovered grasslands even after a long time of spontaneous dynamics.

Vegetation monitoring within framework of National forest monitoring in Latvia

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Monitoring can help determine changes in the ecosystems and their spatial and temporal variability (1). Vegetation assessment in a forest stand can provide information about the forest type and structure (2) and supply valuable data on the distribution and occurrence of various plant species. Additionally, understory vegetation data can be used to assess soil fertility and the stage of forest succession. National Biodiversity Monitoring (NBM) in Latvia aims to obtain information on the state of biodiversity and assess its changes at the national level. Within Framework of the National Forest Inventory forest vegetation monitoring is a small part of the NBM. Vegetation monitoring was established in 2019 and aims, through repeated vegetation surveys on permanent plots, to estimate trends in forest vegetation. To set up an adequate monitoring network first, the sample plots are distributed across the entire country to represent the regional diversity of natural conditions. Second, the monitoring sample plots represent the diversity of forest types across different regions of Latvia - more rare forest types have been included in the sample set with a higher probability than their actual occurrence. Third, forest biodiversity monitoring plots represent the structure and age composition of dominant tree species. This contribution summarizes the results of Biodiversity Monitoring, conducted in Latvia on a subset of National Forest Inventory plots, to estimate vegetation and its temporal changes in different forest types. Data was collected from 2019 to 2023 on 483 permanent sample plots. In each stand, one 20×20 m plot and twelve 1 × 1 m plots were established. The cover of all trees, plants, mosses, and lichens were recorded using the Braun-Blanquet method. The sample plots were compared based on forest type, and dominant tree species, and species diversity, richness, composition, and Ellenberg indicator values were compared. Additionally, a detrended correspondence analysis was performed using Ellenberg indicator values as explanatory variables. Over 600 taxa were recorded along all forest plots in different vegetation layers. We observed a consistent increase in species richness in those sample plots where recent forest management had been carried out. The highest species count, and Shannon diversity index values were recorded in plots where a clearfelling had occurred two or three years before the survey, or where the stand bordered another stand that had recently undergone regeneration felling. This shows that natural disturbances and human-induced disturbances, such as clear-felling and commercial thinning increase plant species richness for different forest types by introducing pioneer species and, in some cases, invasive species, potentially reducing the richness of plants characteristic to the late successional stages of the specific forest types.

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Towards a European classification of aquatic plant communities

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Traditional classification systems for aquatic plant communities often lack consistency, resulting in varied interpretations and limited practical application. In Europe, multiple systems, often based on differing concepts, coexist even within individual countries. This fragmentation complicates the harmonisation and application of such systems. Over the past decade, efforts have been made to address these inconsistencies by employing formal logic and sociological species groups, supported by large vegetation databases. These efforts have resulted in comprehensive classification systems for several phytosociological classes. However, there is still no standardised system for European aquatic vegetation.
Our objective is to develop a comprehensive, consistent, and unambiguous phytosociological classification for European aquatic vegetation, focusing on the classes *Lemnetea*, *Potamogetonetea* and *Charetea intermediae* from the association to the order level. To achieve this, we analysed over 82,000 vegetation plots sampled across 43 countries from the European Vegetation Archive (EVA) using a Cocktail-based approach. Additionally, we conducted an extensive literature review to identify key classification criteria and association concepts. Aquatic vegetation is characterised by its relatively low species richness and high dynamics. We used functional species groups, including traits such as life form, morphology and spatial location, which has proven effective in distinguishing aquatic communities (1). A key challenge lies in balancing broad definitions of associations, which group species with similar ecological roles, against narrower definitions based on dominant species. We present our preliminary classification as an advancement of the work previously shared at the 63rd IAVS Symposium (2). By highlighting critical challenges and inviting feedback on unresolved issues, we aim to further refine and finalise a comprehensive European classification system for aquatic vegetation.

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The grassland habitat continuity over 200 years and remnant patches

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The habitat loss and fragmentation represents key drivers of recent biodiversity and specialist species decline worldwide. Until the middle of the 20th century, many populated areas of the Central Europe featured an open landscape, characterized by a fine mosaic of managed grasslands and extensive fields, both often covered with scattered trees. This landscape structure allowed natural dispersion of diaspores, which helped to sustain a population dynamic of many valuable and now-endangered species. However, agricultural intensification transformed this landscape into large blocks of arable land, while many field margins and edges were abandoned and later overgrown. Recently a modern landscape with only small fragmented remnants of these once extensive managed grasslands remain, where the extinction debt began to be repaid.The implementation of the Nature Restoration Low represents an important opportunity for grassland restoration. Based on the TopoLandUse database, which covers the entire Czech Republic across five periods (1840s, 1870s, 1950s, 1990s and 2006), we identified grasslands with approximately 200 years of continuity. Then an overlay with the National habitat inventory maps (NATURA 2000) allowed us to identify remnants of likely continuous habitats. This sites may serve as valuable biodiversity conservation cores and often also potential biocentres for adjacent area restoration. The landscape-scale approach to nature conservation encourages the recovery of more extensive grassland networks, which should also include former grasslands with valuable ecological legacies. We identified 1,730 km^2 of continuous grasslands (defined as permanent grassland by land use), representing 2% of the Czech Republic's total area (78,871 km^2). However the National habitat inventory maps (NATURA 2000) showed, that 905 km^2 (1.2%) of these continuous grasslands represent vegetation strongly affected, created or transformed by man. Additionally, 431 km^2 (0.55%) of continuous grasslands are still covered by valuable grassland vegetation and 255 km^2 (0.32%) consist of continuous mosaics with a notable grassland component. Some of these grasslands are located in protected areas, while others could harbour an important biodiversity potential. Concurrently, restoring some historical legacies of human-influenced continuous grasslands offers numerous benefis for nature conservation, contributing to the recovery of extensive grassland networks and biodiversity resilience.

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