EASTERN ALPINE AND DINARIC SOCIETY
FOR VEGETATION ECOLOGY (EADSVE)

41st MEETING

Skopje, Republic of North Macedonia
May 27–30, 2026

BOOK OF ABSTRACTS

Skopje, 2026

41st Meeting of the Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE)

Skopje, Republic of North Macedonia, May 27–30, 2026

Book of Abstracts

Publisher	Ss. Cyril and Methodius University in Skopje, Faculty of Natural Sciences and Mathematics - Skopje
Editors	Renata Ćušterevska Cvetanka Stojchevska Sara V. Cvetanoska Angela Sharovikj Ivanova
Print	Студентски сервис
Place and year of issue	Skopje, 2026
Circulation	60

CIP - Каталогизација во публикација
Национална и универзитетска библиотека "Св. Климент Охридски", Скопје

581.5(062)(048.3)
630*18(062)(048.3)

MEETING of the Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE) (41st ; 2026 ; Skopje)
Book of Abstracts : [41st Meeting of the Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE) : Skopje, Republic of North Macedonia, May 27–30, 2026] / [Renata Ćušterevska, ...[и др.]]. - Skopje : Ss. Cyril and Methodius University in Skopje, Faculty of Natural Sciences and Mathematics - Skopje, 2026. - 80 стр. ; 23 см

Други уредници: Cvetanka Stojchevska, Sara V. Cvetanoska, Angela Sharovikj Ivanova. - Регистар

ISBN 978-608-4762-61-4

а) Vegetacija -- Ekologija -- Sobiri -- Apstrakti б) Shumarstvo -- Ekologija -- Sobiri -- Apstrakti

COBISS.MK-ID 68831749

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PREFACE

On behalf of the Faculty of Natural Sciences and Mathematics - Skopje, the Macedonian Academy of Sciences and Arts (MANU), and the Macedonian Botanical Society, we are pleased to welcome you to the 41st Meeting of the Eastern Alpine and Dinaric Society for Vegetation Ecology (EADSVE), held in Skopje, Republic of North Macedonia, from May 27 to 30, 2026.

This volume of abstracts presents a diverse collection of contributions covering a wide range of topics in vegetation ecology, including vegetation dynamics, classification, floristics, biogeography, conservation, and management.

A total of 69 participants have registered for the symposium. The scientific program includes one plenary lecture, 20 oral presentations, and 28 poster presentations, reflecting both the diversity of research topics and the active engagement of the scientific community.

The EADSVE meetings have long served as a platform for scientists, researchers, and practitioners to exchange knowledge, present new findings, and foster collaboration across the Eastern Alpine and Dinaric regions and beyond. The contributions included in this book highlight the rich biodiversity of these regions, as well as the growing importance of addressing environmental changes driven by climate change and human activities.

We are especially pleased to host this meeting in Skopje, bringing together participants from different countries and scientific backgrounds. The program offers opportunities for discussion and the exchange of ideas in both formal and informal settings.

We would like to express our sincere gratitude to all authors for their valuable contributions, as well as to the reviewers and organizers whose efforts made this meeting possible. We also thank all participants for their interest and engagement.

We hope that this meeting will inspire further research, strengthen collaborations, and contribute to a better understanding and conservation of vegetation and ecosystems in our region and beyond.

Organizing Committee

Skopje, 2026

PROGRAMME

Day 1 – Wednesday, May 27, 2026

Venue	Macedonian Academy of Sciences and Arts in Bulevar Krste Misirkov 2, 1000 Skopje
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19:00-20:00	Welcome Reception

Day 2 – Thursday, May 28, 2026

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10:00–10:15	Magdalena Brener: *LONG-TERM VEGETATION DYNAMICS IN UNMANAGED OAK-HORNBEAM FORESTS: OAK DECLINE AND MESOPHICATION*
10:15–10:30	Štěpánka Pustková: *BOGOVAĐA – A CASE STUDY OF FOREST UNDERSTORY VEGETATION CHANGE IN CENTRAL SERBIA*
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PS2-P03 Szabó-Szöllösi T., Horváthné É., Palla B., Papp V., Fintha G., Kende Z., Hofmann R., Somfalvi-Tóth K., Lisztes-Szabó Z., Szőke A., Bíró M., Szentes S., Saláta-Falusi E., Penksza K.: *ENDEMISM OR MORPHOLOGICAL VARIABILITY? FESTUCA TAXA IN THE CENTRAL SANDY REGION OF THE CARPATHIAN BASIN*

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PS3-P09 Šola Z., Krstonošić D., Sever K., Brener M., Dekanić S., Škvorc Ž.: MOUNTAIN NORWAY SPRUCE FORESTS UNDER CLIMATE CHANGE (BIOFORMA)

PLENARY LECTURE

SPECIES RICHNESS OF EUROPEAN PLANT COMMUNITIES

Milan Chytrý[1], Jiří Danihelka[1,2], Klára Friesová[1], Petr Hubatka[1], Ilona Knollová[1], Pavel Novák[1], Zdenka Preislerová[1], Štěpánka Pustková[1], Jan Roleček[1,2], Milica Stanišić-Vujačić [3], Danijela Stešević[3], Martin Večeřa[1], and data contributors

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Syntheses of floristic data at coarse resolution indicate that the southern European peninsulas have richer floras than other regions of the continent. However, the geographical pattern of species richness changes when smaller areas and plant community levels are considered. Continental studies have shown that forest plant communities are richest in the calcareous Alps and the sub-Mediterranean regions of south-eastern Europe, while grasslands do not display such a distinct pattern of species richness. Nevertheless, recent studies have identified specific areas in Europe with extremely species-rich plant communities. The most species-rich grasslands, with more than 140 vascular plant species per 100 m², were reported from the steppes of western Russia in the 1960s, but no similar records have been reported from this area since then. Only slightly lower species numbers have been recorded in the peri-Carpathian forest-steppe in Czechia, Slovakia, Romania, and western Ukraine. Recently, we have also found very species-rich grasslands in a forest-steppe landscape in Armenia. All these species-rich grasslands have similar species pools adapted to moderately base-rich, meso-xeric soils, and are characterized by regular but low-intensity management through mowing or grazing. Another rich non-forest plant community is the Cretan phrygana, a mosaic of dwarf shrubs, therophytes, and geophytes. Forests have been considered floristically poorer than grasslands, but we have recently discovered extremely species-rich oak and oriental hornbeam forests on the karst plateaus of western Montenegro and in Armenia. Several Montenegrin forests contained more than 110 vascular plant species per 100 m², and in one extreme case, we recorded more than 150 species. The richest forest in Armenia had more than 120 species per 100 m². All these rich forests were actively grazed by livestock, highlighting the importance of low-intensity traditional management for biodiversity maintenance.

KEYWORDS: *biodiversity, Europe, plant community, species richness, vegetation*

ORAL PRESENTATIONS

VEGETATION–HYDROLOGY INTERACTIONS IN A MANAGED WETLAND: A MONITORING FRAMEWORK FOR *TRAPA NATANS* IN THE KIS-BALATON SYSTEM

Andrea Kevi[1], Veronika Kozma-Bognár[2], Eszter Saláta-Falusi[1], Tünde Szabó-Szöllösi[1], Szilárd Szentes[3], Károly Penksza[1], József Berke[2]

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Managed wetland systems play a critical role in regulating water quality, supporting biodiversity, and buffering agricultural landscapes. However, the expansion of invasive aquatic macrophytes may significantly alter hydrological processes and ecosystem functioning. In the Kis-Balaton wetland (Hungary), *Trapa natans* has increasingly come to dominate open-water areas, raising questions about interactions between vegetation and the water regime in a regulated environment.
This ongoing research aims to develop a monitoring framework to better understand the spatial and temporal dynamics of *T. natans* within approximately 300 ha of managed wetland area (Phase I unit). The approach integrates repeated aerial surveys with complementary satellite observations to explore vegetation cover patterns and seasonal variability. Particular emphasis is placed on interpreting vegetation expansion in relation to hydrological factors such as water level fluctuations and flow regulation.
As data collection and analysis are currently in progress, this contribution focuses on the conceptual design of the monitoring system and its potential to support adaptive wetland management. By linking vegetation mapping to the hydrological context, the framework seeks to provide a structured basis for assessing feedback mechanisms between aquatic plant growth and the water regime in managed wetland landscapes. The study contributes to methodological discussions on integrative monitoring approaches applicable to complex agricultural–wetland systems.

KEYWORDS: *threats invasive macrophytes, wetland hydrology, vegetation dynamics, monitoring framework, managed ecosystems*

LONG-TERM VEGETATION DYNAMICS IN UNMANAGED OAK-HORNBEAM FORESTS: OAK DECLINE AND MESOPHICATION

Magdalena Brener[1], *Daniel Krstonošić*[1], *Željko Škvorc*[1]

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Lowland oak forests dominated by *Quercus robur* represent biodiversity-rich and economically important ecosystems in Europe. Their persistence has historically depended on active management that ensured successful oak regeneration. However, the long-term natural dynamics of these forests remain poorly understood because unmanaged stands are rare.

This study examines long-term structural and floristic changes in unmanaged oak–hornbeam forests in Croatia by resurveying permanent plots originally established between 1978 and 1986. The resurvey was conducted in 2024 at four sites (Stupnički lug, Česma, Prašnik, and Radiševo) following the original methodology. Changes in stand structure, species composition, and ecological conditions were analysed using redundancy analysis (RDA), non-metric multidimensional scaling (NMDS), and Ellenberg indicator values.

Across all sites, *Quercus robur* showed a clear decline and no successful regeneration was recorded. At the same time, shade-tolerant species, particularly *Carpinus betulus* and *Tilia cordata*, increased in dominance, indicating a process of mesophication. While total species richness remained relatively stable, species turnover was high. Understorey communities shifted towards more mesic and nutrient-demanding species, while forest-edge and grassland species declined. Environmental gradients among sites were also evident, with western sites showing more humid and acidophilous conditions compared to the drier eastern sites.

Overall, the results suggest that in the absence of management or major disturbances, pedunculate oak gradually loses dominance and forest communities shift towards more shade-tolerant compositions. These findings raise important questions about conservation objectives in protected oak forests: should management aim to preserve natural successional processes or actively maintain the historically oak-dominated forest structure?

KEYWORDS: *Quercus robur, Carpinus betulus, permanent plot, stand structure, Croatia*

BOGOVAĐA – A CASE STUDY OF FOREST UNDERSTORY VEGETATION CHANGE IN CENTRAL SERBIA

Štěpánka Pustková[1], Mirjana Ćuk[2], Klára Friesová[1], Petr Hubatka[1], Branislav Kopčan[1], Karolína Nejeschlebová[1], Kristýna Ratajová[1], Jaroslav Rohel[1], Martin Večeřa[1], Milan Chytrý[1]

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Forest ecosystems across Europe are currently undergoing rapid structural and compositional shifts. While the trends in understory plant communities have been well-documented in Western and Central Europe through repeated vegetation records from permanent or "quasi-permanent" plots, comparable data from other parts of the continent are lacking. Additionally, the Western Balkans is considered one of Europe's hotspots for forest plant species richness, and in some regions in the Balkan Peninsula, traditional practices like coppicing or forest grazing still persist, unlike in better studied areas of Europe. We provide first insights into forest vegetation changes in Southeastern Europe by presenting results of a vegetation resurvey in the Bogovađa Monastery forest in Central Serbia (44.3° N, 20.2° E). The forest is situated in the peripannonian region of Central Serbia, where the landscape is dominated by lowland oak forests with *Quercus cerris* and *Q. frainetto* and with beech forests occupying stream valleys. Historically, the forest was managed extensively; it served as a pig pasture in mast years, and the wood was used for the monastery. After WWII the forest was a state property, until it was restituted in 2009. Currently, it is an overgrown coppice, and forest management practices encompass both selective and clear-cutting systems to produce timber and biomass fuel. It also serves as a hunting ground. In 2024, we resampled 33 plots originally recorded in the 1960s. Although the original coordinates were unavailable, localization to forest compartments allowed highly accurate plot relocation. The results indicate a significant shift in understory species composition, manifested in a decline in light-demanding species and, in beech forests, also an increase in moisture-demanding species. In both oak and beech forests, there was a significant decline in disturbance-tolerant species. This study represents the first step toward understanding the changes of forest vegetation in Southeastern Europe.

KEYWORDS: *forest resurvey, Serbia, understory, succession*

HALOPHYTIC VEGETATION OF NORTH ADRIATIC SEDIMENTARY SEACOAST: FROM VEGETATION MAPPING TO HABITAT MODELLING

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Halophytic vegetation of the Slovenian sedimentary coast was sampled and analysed. A total of 140 relevés were classified into five vegetation classes. These vegetation types were subsequently translated into habitat typology and mapped at a fine scale. Coastal wetlands worldwide are increasingly threatened by accelerated sea-level rise (SLR), making their preservation a critical conservation priority.
A strong correlation between coastal habitat types and micro-elevational intervals was demonstrated. Based on this relationship, a habitat transition model was developed to predict future spatial changes under projected SLR. The analysis, conducted in two Slovenian nature reserves, indicates that habitat shifts will occur. However, overall losses are expected, with a projected decline of approximately 42% of Natura2000 habitats by 2060 according to both local estimates and global SLR projections.
A practical countermeasure for long-term habitat conservation was then tested through the construction of artificial islets. In the Škocjan Inlet Reserve, new islets were created along a micro-altitudinal gradient to promote the spontaneous development of Natura2000 habitats through primary succession. A six-year field experiment showed that the newly created mudflats underwent substantial change: unvegetated mudflats decreased from 71% to 26%, Mediterranean glasswort swards increased from 6.5% to 28.2%, and saltmarsh scrub expanded steadily from 0.6% to 28.9%. Mapping results revealed relatively deterministic successional pathways.
Finally, the potential impact of SLR on coastal habitats in the Venice Lagoon was modelled using fine-scale vegetation maps, elevation data, and environmental variables such as subsidence and accretion. Three SLR scenarios and the local linear trend were considered. By 2075, between 37% and 48% of lagoon habitats (or up to 51% under the linear scenario) may lie below sea level. Although most habitats are expected to decline, different habitat types show varying responses to SLR.
Such spatially explicit predictions provide essential guidance for decision-makers in planning effective coastal conservation and management strategies.

KEYWORDS: *halophytic vegetation, North Adriatic, sea level rise, habitat modelling*

A COMPARISON BETWEEN HALOPHYTIC STEPPES WITH *CAMPHOROSMA MONSPELIACA* IN NORTH BULGARIA AND NORTH MACEDONIA

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The species *Camphorosma monspeliaca* has a wide geographical range of distribution – from Western Mediterranean parts of Europe to Western Asia and Southern Siberia. Ecologically, *Camphorosma monspeliaca* is known mainly as a halophytic species. The dominated from the species halophytic communities are found in the saline plains and river lowlands on more or less saline soils. However, in many places - in North Bulgaria and also in N. Macedonia, it participates in the floristic composition of the relic steppe vegetation, often on steep and dry stony terrains. In this study the floristic composition and ecological characteristics of *Camphorosma monspeliaca* communities are compared in N. Bulgaria and N. Macedonia. This comparison aims to explain the main factor for the dominance of the species. In fact, the communities in Northern Bulgaria and Northern Macedonia are relicts of the Ice Age, which is evidenced by the proximity and their floristic composition. Their survival on salinized marls is also related to the low competitiveness of the species in conditions of dominance of perennial, mainly grasses.

KEYWORDS: *dry grasslands, relic vegetation, salinized marls*

PERIGLACIAL VEGETATION ON MT. CANIN (WESTERN JULIAN ALPS): PATTERNS AND TEMPORAL CHANGES

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Mt. Canin (2587 m a.s.l.) is located in the Western Julian Alps, on the border between Italy and Slovenia, and hosts one of the lowest-elevation glaciers in the Alps (ca. 2200 m a.s.l.). In recent decades, the glacier has undergone marked retreat due to climate change, representing a clear example of glacier retreat in the Alps.
The periglacial moraine areas support vegetation referable to the eastern Alpine basiphilous geosigmetum of primary high-elevation communities. On the most primitive substrates, pioneer communities of the *Thlaspion rotundifolii* alliance develop. These are followed by more structured vegetation dominated by *Poa minor*, with other elements of the *Thlaspion*, notably *Moehringia ciliata*. The most advanced stages can be classified into three main physiognomic types: (i) dwarf shrub communities dominated by *Salix retusa*, (ii) grasslands dominated by *Carex ferruginea*, and (iii) small shrub patches dominated by *Salix waldsteiniana*.
Since 2012, vegetation monitoring activities have been carried out (promoted by the Julian Prealps Regional Natural Park) to investigate vegetation dynamics driven by increasing temperatures. Data were collected using both nested permanent plots and JNP transects.
Observations reveal the first signs of species turnover in both pioneer and mature stages. Several pioneer and cryophilous species such as *Arabis alpina, Hornungia alpina, Papaver alpinum* and *Veronica alpina*, have disappeared from most of monitored plots. At the same time, more demanding species such as *Adenostyles alpina, Huperzia selago* and *Rumex arifolius* have newly appeared in more stabilized areas. Plant cover shows contrasting trends across sites, with an increase in more developed communities. No shifts in plant associations have yet been detected.
These results provide a baseline for understanding ongoing vegetation dynamics and underscore the need for long-term monitoring to assess the impacts of climate change on these highly vulnerable alpine ecosystems.

KEYWORDS: *alpine vegetation dynamics, climate change effects, Julian Alps, long term monitoring, periglacial vegetation*

PREPARING FOR POTENTIAL VEGETATION ESTIMATIONS FOR CLIMATE-ANALOGUE AREAS IN SOUTHERN CENTRAL EUROPE – CHALLENGES AND SOLUTIONS

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Climate change is ongoing and has the potential to reshape the vegetation cover of our landscapes. Modelling the impact of future climate change on vegetation cover can provide a basis for assessment of the expected impact of climate change on the future of current vegetation cover and are thus crucial for planning successful habitat conservation and restorations. However, training models solely on data from a single target area, without accounting for climatic connections, cannot provide a sufficient basis for impact assessment.

CLIMANATRES, a Danube Interreg Programme project aims at providing climate-smart support for restoration planning in the Middle- and Lower Danube area and faces similar challenges. To provide a basis for modelling in CLIMANATRES a climate analogy analysis, was conducted with regard to CLIMANATRES study area and relevant additions: Northern Italy, the Pannonian Basin, the Balkan Peninsula, and the Lower Danube area

We identified two major climate-analogue clusters: 1) Italy – Northern Croatia – Slovenia – Western Hungary, and 2) Eastern Hungary – Northern Serbia – Lower Danube. These two clusters exhibit distinct climate patterns with regard to similarity of

future expectations, characterized by strong internal coherence and clear differentiation from one another, which is particularly relevant in the context of climate change.
Based on the uncovered analogies, we started searching for a harmonised vegetation classification system, which would enable the collection of comparable vegetation maps within southern Central Europe, and which would than serve as coherent training data for potential vegetation models based on climate change predictions. Eventually, we decided to adapt the EUNIS level 4 habitat categories for the modelling purpose but in the process of category harmonisation, we encountered particular challenges such as overlapping and ambiguous definitions and occasional redundancy of EUNIS categories. As a result, we propose an adapted habitat category system that could serve coherent data collection and analysis in the region.

KEYWORDS: *climate change, habitat classification, nature restoration, vegetation maps, vegetation modelling*

NOMENCLATURAL REVISION OF THE CLASS *STIPO-TRACHYNIETEA DISTACHYAE*

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The class *Stipo-Trachynietea distachyae* was originally conceived to distinguish the ephemeral, xerophilous, basiphilous to neutrophilous annual vegetation, from the acidophilus therophytic communities of the class Tuberarietea guttatae. The "*Stipo-Trachynietea distachyae* S. Brullo in S. Brullo et al. 2001" [recte: *Stipo capensis-Brachypodietea distachyi* Brullo ex B. de Foucault 2001 nom. mut. nov.] is primarily found in the Mediterranean region, spanning from Portugal to Greece and extending to the Crimean Peninsula. This class is currently represented in the EuroVegChecklist (EVC) by three orders and eleven alliances. Many of these high-rank syntaxa are, however, cited in the scientific literature under incorrect names, and several are invalid, or illegitimate according to the rules of the International Code of Phytosociological Nomenclature (ICPN). A correct and consistent application of names is essential to ensure conceptual coherence in syntaxonomy and to support the effective communication of phytosociological information, ultimately contributing to advances in vegetation science and to the management and conservation of European biodiversity.
The present nomenclatural revision of the class led to: (i) the identification of the correct forms of all high-rank syntaxon names, along with their nomenclatural types; (ii) the validation of the orders *Ptilostemono stellati-Vulpietalia ciliatae* and *Stipo capensis-Bupleuretalia semicompositi*, and of the alliance *Hypochaeridion achyrophori*; (iii) the nomenclatural mutation of the names *Stipo capensis-Trachynietea distachyae* and *Trachynion distachyae* into *Stipo capensis-Brachypodietea distachyi* and *Brachypodion distachyi*, respectively; and (iv) proposals for the conservation of the names *Brachypodietalia distachyi* Rivas Martínez 1978 and *Lygeo sparti-Stipetalia* Braun Blanquet et O. de Bolòs 1958, with the aim of stabilising their usage according to current practice.

KEYWORDS: *Dry grasslands, EuroVegChecklist, International Code of Phytosociological Nomenclature, Mediterranean Phytosociology, Syntaxonomy*

NOTEWORTHY FLORISTIC RECORDS FROM THE OSOGOVO MOUNTAINS, NORTH MACEDONIA

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The Osogovo Mountains were floristically surveyed between 2020 and 2025 as part of an independent project aimed at mapping and digitizing their vascular flora. Approximately 1,300 taxa were recorded and incorporated into an open-access database, including georeferenced records, ecological notes, and extensive photographic documentation. The study provides the first national record of *Lamium bifidum* subsp. *bifidum* and confirms the occurrence of *Dianthus carthusianorum*, previously considered doubtful in the country. New data are presented for several taxa known only from historical records, including *Lamium album* and *Petrorhagia obcordata*. The occurrence of the species *Sempervivum ciliosum* is confirmed within the *S. ciliosum* complex. Several taxa with restricted national distribution were documented, including *Sedum aetnense, Helianthemum aegyptiacum*, and *Carex phyllostachys*. The hybrid *Geum coccineum* x *G. rivale*, previously known only from the Šar Mountains, was recorded, as well as the rare circumboreal species *Eriophorum vaginatum* and the Balkan endemic *Soldanella pindicola*. The adventive species *Senecio inaequidens* is reported for the first time in North Macedonia. These findings significantly contribute to the knowledge of the country's vascular flora and highlight the floristic importance of the Osogovo Mountains.

KEYWORDS: *Osogovo Mountains, vascular flora, new national records, rare and restricted taxa, digital database*

DISTRIBUTION OF SPECIES OF THE GENUS *RAMONDA* L. C. M. RICHARD (GESNERIACEAE) IN THE FLORA OF THE RN MACEDONIA

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The genus *Ramonda* is represented by three tertiary species that survive as rare relict remnants in Europe, within refugial habitats of the Iberian Peninsula and the Balkan Peninsula. On the Balkan Peninsula, two relict species are present – *Ramonda nathaliae* Pančić & Petrović and *Ramonda serbica* Pančić – both of which also occur in the territory of the RN Macedonia. Numerous studies and data address the taxonomic differentiation between these two species, the determination of the precise boundaries of their distribution ranges on the Balkan Peninsula, their cytological status, phytocoenological affiliation, ecophysiological characteristics, and other aspects. Although today many of the issues and data concerning the taxonomy and chorology of the relict species *R. nathaliae* and *R. serbica* on the Balkan Peninsula are almost fully clarified, interest in studying these species within individual Balkan countries, where parts of their Balkan range occur, still persists. This is also the case with botanical research in the territory of the RN Macedonia, which continuously leads to new insights regarding the status of the populations of these unique relict species. The most recent floristic and phytocoenological data confirm previously established knowledge about their distribution, as well as the ecological and phytogeographical characteristics of their ranges, which have been reported in the works of Košanin, Micevski, Stevanović, and others. During the research, all available literature data concerning the presence of *R. nathaliae* and *R. serbica* in the territory of the RN Macedonia were collected. In addition, the rich herbarium material of this genus preserved in the Herbarium at the Faculty of Natural Sciences and Mathematics in Skopje (MKNH) was analyzed. A large number of localities throughout the territory of the RN Macedonia were visited, where new and more precise data (including GPS coordinates) were obtained, allowing for a more accurate determination of the ranges of these two species within the country.

KEYWORDS: *Ramonda nathaliae, R. serbica, distribution, RN Macedonia*

BIOGEOGRAPHICAL ELEMENTS OF ALPINE AND SUBALPINE PLANTS IN THE MONTENEGRO MOUNTAINS

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Alpine and subalpine ecosystems in the Balkan Peninsula are a meeting point of several European biogeographical regions, but detailed quantitative analyses of plant biogeographical patterns remain limited. Using occurrence records from the Global Biodiversity Information Facility (GBIF), we compiled distribution data for plant species recorded in 355 vegetation plots sampled by our team across mountain ranges in Montenegro between 2022 and 2025. Based on the global distribution patterns of these species, we classified them into six biogeographical elements: Dinaric, Pyrenean–Alpine–Carpathian, widespread boreal–temperate, temperate montane, arctic–alpine, and temperate European. To explore the ecological differentiation of these elements, we related their occurrences with environmental predictors. In addition, we classified vegetation plots into eight vegetation types and, for each type, quantified the proportional representation of the different biogeographical elements. Our results reveal clear associations between particular biogeographical elements and specific environmental conditions and vegetation types. For example, temperate montane and temperate European elements are predominantly associated with habitats characterized by higher temperatures, whereas Pyrenean–Alpine–Carpathian species occur mainly in colder environments. In terms of vegetation types, Pyrenean–Alpine–Carpathian species are most frequently found in alpine acidophilous dwarf-shrub heaths and grasslands, as well as in subalpine tall-herb communities, while temperate European elements are mostly associated with alpine juniper dwarf-shrub heaths.

KEYWORDS: *Biogeography, Montenegro, alpine & subalpine, niche*

FOREST VEGETATION OF MONTENEGRO

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Despite its relatively small area, Montenegro harbours a remarkable diversity of habitats and vegetation types, reflecting its heterogeneous landscape and varied climatic conditions. Although some local studies of forest vegetation have been published, a comprehensive analysis has not yet been carried out. In 2022 and 2023, we recorded 305 vegetation plots across the country and combined our data with existing plots from the Vegetation Database of Montenegro. The final dataset of 879 vegetation plots was classified using the TWINSPAN method. The distinguished vegetation types were characterized by their physiognomy and ecology. In the coastal zone, communities with *Carpinus orientalis* and *Quercus pubescens* of the alliance *Carpinion orientalis* prevail. They form dark, closed canopy stands with a species-poor Mediterranean understory. Evergreen oak forests of the alliance *Fraxino orni-Quercion ilicis* are rare, occurring sporadically within the narrow coastal zone. Dry Mediterranean vegetation with *Quercus trojana* occurs in the southernmost part of Montenegro. The sub-Mediterranean zone is characterized by forests with *Fraxinus ornus, Ostrya carpinifolia, Quercus cerris* and *Q. pubescens*, belonging to the alliance *Fraxino orni-Ostryion*. These communities are often species-rich, particularly traditionally managed oak forests at higher elevations. Mountain areas are dominated by beech and beech-fir forests (alliances *Aremonio-Fagion, Fagion sylvaticae* and *Luzulo-Fagion*), occasionally accompanied by thermo-mesophilous forests of the alliances *Quercion confertae* or Erythronio-Carpinion. Refugial communities of *Pinus nigra* and *P. sylvestris* are present in canyons of mountain rivers. The upper montane and subalpine belts are often covered by forests with *Abies alba* and *Picea abies* (alliances *Abieti-Piceion* and *Piceion excelsae*). Relic pine forests with *Pinus heldreichii* or *Pinus peuce* form the treeline in some mountain ranges. Azonal types are mainly represented by riparian forests of the alliance *Alnion incanae* and alluvial forests of the classes Alno glutinosae-Populetea albae and Salicetea purpureae.

KEYWORDS: *Balkan, forest, Montenegro, plant community, Syntaxonomy, vegetation*

MICROREFUGIA IN KARST LANDSCAPES: LINKING GEODIVERSITY TO VEGETATION AND LAND SNAIL COMMUNITIES IN SUB-MEDITERRANEAN AND SUBCONTINENTAL KARST REGIONS

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Dolines, enclosed karst depressions, are small-scale geomorphological features that create pronounced environmental gradients and may serve as climate refugia. In this study, we investigated biodiversity patterns in relation to geodiversity in two karst regions with contrasting climates: the sub-Mediterranean Kras Plateau (Slovenia) and the subcontinental Slovenský Kras National Park (Slovakia).
We selected twenty forested dolines (ten per region; 4–16 m deep) based on geomorphological characteristics derived from LiDAR data, including slope, closure, and shape variability. Vegetation was sampled along continuous transects using 2 × 2 m plots, recording species composition and cover (seven-grade ordinal scale), as well as litter and bare rock cover. Functional traits and Ellenberg indicator values (EIVs) were compiled from published databases. Land snails were sampled at the top, slope, and bottom of two dolines per region.
Slovenian dolines showed higher geomorphological heterogeneity, with more variable slopes and stronger top–down environmental differentiation, reflected in EIVs. In contrast, Slovak dolines were generally smaller and shallower, with more uniform geomorphology and more homogeneous environmental conditions. These differences were reflected in vegetation composition, ecological strategies, and land snail communities. Plant species richness, as well as land snail richness and abundance, were generally higher in Slovak dolines, whereas Slovenian dolines exhibited stronger vertical differentiation in species composition and ecological strategies.
Our results highlight the importance of fine-scale geomorphological and environmental heterogeneity in shaping biodiversity patterns within dolines and support their role as potential microrefugia under ongoing climate change.

KEYWORDS: *dolines, geodiversity, microrefugia, environmental heterogeneity, land snails*

PRESERVING AND RESTORING FLOODPLAIN FOREST HABITATS ALONG THE MURA-DRAVA-DANUBE

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Extending across Austria, Slovenia, Croatia, Hungary, and Serbia, the lower reaches of the Drava and Mura rivers, together with connected sections of the Danube, form one of Europe's most ecologically valuable river systems, often called the "Amazon of Europe." Despite decades of human alteration, this dynamic landscape supports remarkable biodiversity and remains a key refuge for rare and threatened habitats such as floodplain forests, river islands, gravel and sand bars, side channels, and oxbow lakes.

The "LIFE RESTORE for MDD – Preserving and restoring floodplain forest habitats along the Mura–Drava–Danube" project is a joint initiative of the five countries aimed at conserving the largest continuous riparian forest complex within the UNESCO Five-Country Biosphere Reserve Mura–Drava–Danube. Project partners work together to counter the ongoing degradation of floodplain forests by restoring 336 hectares of floodplain areas and 54 km of watercourses, while enabling natural river dynamics to redistribute nearly 966,000 m³ of sediment.

The project area covers a 2,100 km² river corridor linking 17 Natura 2000 sites and other protected areas. These form a continuous ecological network stretching along 700 km of the three rivers. Floodplain forests make up nearly half of the total forest cover in the area, accounting for 49.4% (435 km²).

The project focuses on conserving and restoring two priority habitat types: alluvial forests (HT 91E0*) and riparian mixed forests (HT 91F0). Both are currently classified at EU level as having an unfavourable–bad conservation status, with ongoing decline. The same negative status is reflected nationally in Austria, Hungary, and Slovenia, underscoring the urgency of coordinated restoration efforts.

This research is supported by Project: 101113557 — LIFE22-NAT-AT-LIFE RESTORE for MDD — LIFE-2022-SAP-NAT

KEYWORDS: *Life program, nature restauration, Mura, Drava, Danube*

RESTORATION AND GRAZING MANAGEMENT AS TOOLS FOR MAINTAINING PANNONIAN ALKALI, SANDY AND STEPPE GRASSLANDS

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As a consequence of climate change, the persistence of Pannonian dry grasslands is increasingly threatened, while their spatial extent has markedly declined over recent decades. This trend has continued despite increasingly intensive conservation-oriented grassland restoration efforts and economically motivated grassland establishment. One of the key management tools for maintaining grassland ecosystems is grazing-based management, preferably employing indigenous livestock breeds.

Our investigations were conducted at four Pannonian grassland study sites. 1. On the Tihany Peninsula, phytosociological surveys have been carried out annually since 1994. The site was initially managed by mowing, and since 2000 it has been grazed by Hungarian Grey cattle. 2. In the Csákvár steppe meadow, three grassland areas of different origin were examined: (i) a pasture established from arable land in 1997, (ii) a grassland restored in 2011 through direct seeding combined with lucerne (alfalfa) and (iii) an approximately 40-year-old fallow field where overseeding was applied. All grazed since 2012. 3. In the Hortobágy alkali pasture, grazing by sheep and cattle. 4. In a sandy grassland of the Danube–Tisza Interfluve, we investigated abandoned forest stands, former agricultural areas, and primary grasslands, where grazing is carried out with sheep.

The study also provides insights into which grassland establishment and restoration approaches represent the most suitable conservation and grassland management practices from the perspective of vegetation development. The phytosociological data

allow the analysis of vegetation composition and dynamics, as well as the derivation of implications for grassland management.
Furthermore, the taxonomic status of several difficult-to-identify *Festuca* taxa was clarified, and new data are provided on their phytosociological relationships. Data processing and statistical analyses were performed using the R statistical software environment. This study was supported by OTKA K-147342, the strategic research fund of the University of Veterinary Medicine Budapest (Grant No. SRF-002).

KEYWORDS: *Festuca species, livestock, grazing pressure*

SUB-MEDITERRANEAN LOWLAND MEADOWS IN NORTH MACEDONIA: VEGETATION PATTERNS AND SUCCESSIONAL TRENDS

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Lowland meadows in North Macedonia belong to the class *Molinio-Arrhenatheretea* Tx. 1937, order *Trifolio-Hordeetalia* Horvatić 1963, and alliance *Trifolion resupinati* Micevski 1957. According to the EU Habitats Directive, they correspond to habitat type *6540 – Sub-Mediterranean meadows with Molinio-Hordeion secalini*, representing semi-natural grasslands of high conservation value.

This study is based on 467 vegetation relevés from North Macedonia, Serbia, Kosovo, Bulgaria, and Greece, including 38 original relevés collected approximately ten years ago in the south-western part of North Macedonia (Debrca region). The dataset enables a regional assessment of floristic composition and variability.

Hierarchical cluster analysis was used to identify vegetation patterns and delineate distinct units, complemented by data from the national Natura 2000 project (2022–2023). The results indicate that these communities are significantly affected and undergoing successional change.

The main driver is the abandonment of traditional land-use practices, particularly mowing and grazing, which historically maintained community structure and biodiversity. Consequently, these habitats are increasingly prone to succession, leading to degradation and potential loss, emphasizing the need for targeted conservation and adaptive management.

KEYWORDS: *Trifolion resupinati, meadow vegetation, succession*

MOUNTAIN PINE STANDS IN MAIELLA NATIONAL PARK, CENTRAL ITALY: RESURVEY OF VEGETATION DATA AND MICROBIAL RELATIONSHIPS IN ORTHILIA SECUNDA ASSOCIATED WITH DIEBACK DYNAMICS

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This study presents a floristic-vegetation and ecological analysis of *Pinus mugo* subsp. *mugo* communities in Maiella National Park (central Italy), where the species reaches the southernmost limit of its distribution along the Italian Peninsula. In the Maiella massif, two main mountain pine communities have been described (Stanisci, 1997): *Orthilio secundae-Pinetum mugo* in the subalpine belt and the *Hypericum richeri–Pinus mugo* community in the upper montane belt. Both are included in the priority habitat 4070* ("Habitats" Directive 92/43/EEC). Dieback phenomena have been recorded in these stands and are associated with pathogenic fungi causing root rot. Mortality develops centrifugally, giving rise to distinct vegetation belts within the dieback rings, conventionally identified from the centre outwards as In, Dead, Front and Out. The Front zone is characterised by standing, declining *P. mugo* individuals and by the dominance of *Orthilia secunda* (Tesei et al., 2022). The aims of this study were: (i) to assess floristic and vegetation changes in mountain pine stands over the last 28 years, following the resurvey protocol of the project ECODIPA-net; and (ii) to investigate the root microbiome and mycorrhizal relationships of *O. secunda* inside and outside dieback areas using microbiological approaches. The first results indicate thermophilisation in the subalpine mountain pine stands, with a decline in microthermal species and an increase in macrothermal and generalist taxa from the upper montane belt. In the upper montane stands, the occurrence of nemoral beech-forest species supports the role of *P. mugo* in facilitating the upward expansion of beech woodland. Marked differences between the root microbiome of *O. secunda* in the Front and Out zones suggest potential mechanisms underlying the persistence of the species under stress conditions.

KEYWORDS: *vegetation, resurvey, Pinus mugo, microbiome*

PHYTOSOCIOLOGICAL ANALYSIS OF PEDUNCULATE OAK (*QUERCUS ROBUR* L.) AND HORNBEAM (*CARPINUS BETULUS* L.) FORESTS ON THE SOUTHERN MARGIN OF THE PANNONIAN PLAIN

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Pedunculate oak (*Quercus robur* L.) and hornbeam (*Carpinus betulus* L.) forests on the southern margin of the Pannonian Plain represent an ecologically and economically important, yet insufficiently studied, vegetation type. Although these forests form a coherent spatial unit, they have not been comprehensively investigated across the entire region. The aim of this study was to revise the associations of pedunculate oak–hornbeam forests throughout the study area, describe their floristic, ecological, and spatial characteristics, and identify the main factors shaping their floristic composition. The initial dataset was compiled by collecting and harmonising all available phytosociological relevés corresponding to oak–hornbeam communities belonging to the order Carpinetalia betuli. The dataset was first classified using the TWINSPAN algorithm, which separated floodplain forests of the order Alno-Fraxinetalia excelsioris from oak–hornbeam forests of the order Carpinetalia betuli; only the latter were retained for further analyses. The final dataset was classified using a modified TWINSPAN with cut levels set at 0, 3, 5, 15, and 25. Relevés were subsequently projected onto a DCA ordination and interpreted using Ellenberg indicator values. The classification identified five clusters corresponding to previously described associations. The differentiation of associations along the southern margin of the Pannonian Plain is primarily determined by a combination of climatic conditions, groundwater influence, soil water-retention capacity, and biogeographical factors. The analysed forest associations show clear differentiation along climatic gradients of temperature and precipitation, separating communities occurring in cooler, wetter, and thermally stable environments from those developing under warmer, drier, and more seasonally variable conditions. Some associations also show high variability in precipitation-related parameters, reflecting the influence of local hydrological factors, such as groundwater, which can regulate soil moisture independently of precipitation. Floristic composition is further influenced by the position of the Illyrian refugium.

KEYWORDS: *Carpinetalia betuli; forest communities; Phytosociology; vegetation classification; Pannonian Plain*

TWO DECADES OF AWARENESS – INVASIVE ALIEN PLANTS IN CROATIA

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Although by the end of the 20th century, numerous records existed of new plants introduced into the flora of Croatia from other parts of the world, the problem of invasive alien species (IAS) remained unrecognized for a long time. This changed two decades ago, in 2006, when the first national project was implemented, initiating more systematic research and monitoring of invasive alien plants. At that time, national standards (harmonized with European standards) for managing non-native flora were established, and the "Allochthonous Plants" module was developed within the already existing “Flora Croatica Database”. This module has since become a platform for the national monitoring and mapping of alien and invasive plants. According to the “Flora Croatica Database”, invasive alien plants have been recorded in more than 50% of the national territory, with urban and anthropogenic habitats being the most threatened. The preliminary list of invasive alien plants in Croatia compiled 20 years ago included 64 taxa, whereas today it comprises 82 invasive alien taxa. The most significant invasive plants, along with their current status and impacts on the Croatian flora, will be briefly presented. Since these initial efforts, the approach to invasive alien plants in Croatia has improved, reflecting an increasingly multidisciplinary perspective on this issue. Collaboration among botanists (biologists, foresters and agronomists), as well as experts from national institutions responsible for nature protection and IAS-related legislation, has intensified. Key findings from several implemented and ongoing projects (e.g. LIFE OrnamentalIAS) will also be presented. The results of more or less continuous work over the past twenty years (characterized by increasingly systematic and well-documented monitoring of invasive alien plants) provide a reliable national and European framework for strategic planning of invasive alien species management. However, further improvements are still needed, particularly in prevention and early warning systems.

KEYWORDS: *Flora Croatica Database, invasive alien species (IAS), non-native plants*

POSTER PRESENTATIONS

A PHYTOSOCIOLOGICAL SURVEY OF POTATO FIELDS IN MEDITERRANEAN CROATIA

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Changes in food production over the last 50 years have transformed traditional European agricultural landscapes. Shifts from extensive, traditional farming to intensive, industrial practices have simplified landscape structures. While many traditional crops once grown in the Mediterranean part of Croatia (e.g., wheat, rye) have declined, potato cultivation has persisted alongside the long-standing tradition of viticulture. This study documents the diversity of weed vegetation in traditional potato fields using original phytosociological data. In 2025 and 2026, 40 phytosociological relevés were collected from March to May. The study area has a Mediterranean climate, with hot, dry summers and mild, rainy winters. Soil disturbance from hoeing occurs mainly in March and April, directly influencing segetal vegetation and determining the timing of sampling. The most frequent species were *Chenopodium album, Amaranthus retroflexus, Heliotropium europaeum, Convolvulus arvensis, Polygonum aviculare*, and *Sorghum halepense*. The *Sonchus asper-Convolvulus arvensis* community was dominant. These results provide a baseline for future research and inform conservation strategies aimed at maintaining plant diversity in Mediterranean agroecosystems.

KEYWORDS: *agriculture, agroecosystem, arable flora, Phytosociology, potato fields*

ADDITIONS TO THE PHYTOSOCIOLOGICAL COMPOSITION AND ECOLOGICAL CHARACTERISTICS OF PLANT COMMUNITIES FROM THE ALLIANCE TRIFOLION CHERLERI MICEVSKI 1970 IN THE REPUBLIC OF NORTH MACEDONIA"

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The vegetation occurring on dry grasslands developed on siliceous substrates in the Republic of North Macedonia is classified within the class *Helianthemetea guttati* Rivas Goday et Rivas-Mart. 1963, the order *Helianthemetalia guttate* Br.-Bl. in Br.-Bl. et al. 1940, and the alliance *Trifolion cherleri* Micevski 1970. Within this alliance, a total of five plant associations have so far been recognized in the country: *Tunico-Trisetetum myrianthi* Micevski 1971, *Helianthemo-Euphorbietum thessalae* Micevski 1973, *Erysimo-Trifolietum* Micevski 1977, *Diantho-Cistetum incani* Micevski et Matevski 1984, and *Biserrulo-Scleranthetum dichotomae* Matevski et Kostadinovski 1998.
As part of field investigations carried out in the area of the Monument of Nature “Markovi Kuli” in southwestern North Macedonia, a total of 27 vegetation relevés were recorded in dry grassland habitats following the Zurich-Montpellier phytosociological approach (Braun-Blanquet, 1964). The primary objective of this study was to establish the syntaxonomic classification of the collected relevés. To achieve this, a comprehensive database was created using the TURBOVEG software (Hennekens & Schaminée, 2001), comprising 348 relevés and 550 taxa. Hierarchical agglomerative cluster analyses were performed using JUICE 7.1 (Tichý, 2002) in combination with the PC-ORD software package (McCune & Mefford, 2016).
In addition, ecological analyses were conducted to assess the biological and chorological characteristics of the vegetation. Mean Ellenberg indicator values were calculated for each relevé and community, enabling the identification of statistically significant relationships and their effects on vegetation patterns.
The results showed that all 27 relevés from the MN “Markovi Kuli” can be assigned to the association *Helianthemo-Euphorbietum thessalae* subass. *campanuletosum* Micevski 1973. Furthermore, analysis of the biological and chorological spectra indicates that the community in this area is characterized by a hemicryptophytic–therophytic life-form structure, with a predominance of Eurasian and Euri-Mediterranean floristic elements.

KEYWORDS: *vegetation, dry grasslands, siliceous substrate, chorological analysis, Ellenberg indicators*

DETERMINATION OF FOREST COMMUNITIES ON THE BASIS OF SMALL PLOTS (MICROPLOTS) WITHIN THE GEOMORPHOLOGICALLY DIVERSE LANDSCAPE OF THE KRAS PLATEAU (ITALY, SLOVENIA)

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The article deals with forest communities that develop on small surfaces on steep gradients of the geomorphologically diverse landscape of the Kras plateau. They appear in small depressions called dolines, where a steep gradient of ecological conditions appears over a small spatial scale. We tried to detect the turnover of forest communities on this small scale and steep gradient with small plots (microplots) of 4 m2 arranged in a continuous transect. We sampled only the ground layer and estimated the cover of each vascular plant species. The main problem was that we could not sample vegetation plots in standard sizes, which would allow a standard classification procedure. We built an expert system based on all of the relevant standard vegetation plots from the region and applied this system on a microplot matrix. We classified one third of microplots in this way, but the remainder were classified by semi-supervised k-means clustering. We thus established 8 communities that appear in dolines and compared their characteristics and ecological conditions by Ellenberg indicator values. Our results show that oak-hornbeam forests can be found in the bottom of dolines. Towards the bottom of deeper dolines, mesophilous ravine forests dominated by sycamore on rock, and sessile oak forests on deeper soils appear. On lower slopes, thermophilous ravine forests dominated by limes appear on rocky places. Upper slopes are dominated by Turkey oak, hophornbeam-pubescent oak forests and scrub formations. Turkey oak forests can be found on rather deeper soils than hophornbeam-pubescent oak forests. At the top, hophornbeam-pubescent oak forests can be found that build the zonal vegetation of the region. On rock walls vegetation of rock crevices can be found. The high biodiversity of the region supports the idea that diverse karstic features might have the potential for formation of refugia in future foreseen climate change, related to the potential of karstic relief to create diverse climatic conditions.

KEYWORDS: *expert system, forest, karst, k-means, refugium, vegetation*

FIRST RECORD OF *LITTORELLION UNIFLORAE* VEGETATION IN KOSOVO: *SPARGANIUM ANGUSTIFOLIUM* - DOMINATED COMMUNITIES

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Soft-water vegetation of alpine and subalpine lakes ranks among the most specialized and least documented vegetation types in southeastern Europe. In Kosovo, such communities have so far remained phytosociologically unknown. During fieldwork conducted in August 2025, six relevés were recorded in the alpine lake complex of the Gjeravica massif in western Kosovo, on siliceous substrate at 2281–2300 m a.s.l. The sampled stands were highly uniform in structure and species composition, with *Sparganium angustifolium* Michx. as the unequivocal dominant species and with constant occurrence of a small set of associated taxa, notably *Sphagnum subsecundum, Juncus alpinoarticulatus, Carex nigra* and *Carex echinata*.
The Kosovo data were compared with published relevés of related *Sparganium angustifolium* - dominated vegetation from Spain, the Pyrenees, and Greece, including *Sparganio angustifolii-Callitrichetum font-queri*, *Sparganio angustifolii-Isoetetum echinospori,* and other alpine *Sparganium* stands. In comparison with the Iberian communities, the Kosovo stands are distinctly poorer in species and lack several characteristic isoetid elements, such as *Isoetes* spp., *Subularia aquatica* and *Callitriche* spp. Despite this floristic impoverishment, their ecological setting, physiognomy, and dominance pattern indicate clear affinity with the alliance *Littorellion uniflorae* Koch ex Klika 1935.
This study provides the first phytosociological evidence of *Littorellion uniflorae* vegetation in Kosovo and likely represents one of the few documented records of this vegetation type in the Balkans. The Gjeravica stands are provisionally assigned to *Sparganietum angustifolii*, pending broader comparative studies across southeastern Europe.

KEYWORDS: *Alpine lakes, aquatic vegetation, Littorelletea, phytosociology, syntaxonomy*

FLORISTIC AND STRUCTURAL CHANGES IN *QUERCUS TROJANA* FORESTS OF PASHTRIK MT. (KOSOVO) AFTER FOUR DECADES

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Pashtrik Mt. is among the most remarkable mountain massifs in the Republic of Kosovo in terms of both floristic richness and vegetation diversity. Its lower parts are influenced by sub-Mediterranean climatic conditions, whereas the hilly-montane belt is characterized by a more continental climate. Due to its predominantly calcareous substrate and diverse ecological conditions, the massif supports a rich flora, including numerous plant taxa of conservation importance, several of which are listed in the Red List of vascular flora of Kosovo. Among its most distinctive forest types are stands dominated by *Quercus trojana* Webb, representing a rare and phytogeographically important vegetation type in Kosovo.

In this study, we conducted new phytosociological relevés in *Quercus trojana* forest habitats on Pashtrik Mt. and compared them with relevés recorded more than 40 years ago. The comparison focused on differences in floristic composition, species abundance and cover and shifts in forest structure. Particular attention was given to the syntaxonomic interpretation of these stands in light of recent classification advances. According to recent studies, the Kosovo stands are classified as *Quercetum trojanae* subass. *rutosum graveolentis* Šilc et al. 2025 (syn.: *Quercetum trojanae dukagjini* Rexhepi 1982), a distinct vegetation unit within this part of Europe, belonging to the class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Pass. 1959.

The observed differences between historical and recent relevés indicate long-term changes in species composition, abundance patterns, and stand structure, highlighting the dynamic nature and conservation significance of these forests. These stands correspond to habitat type 9250 – *Quercus trojana* woods and deserve consideration within Kosovo's future Natura 2000 framework.

KEYWORDS: *Kosova, forest vegetation, Quercetum trojanae, Phytosociology, Syntaxonomy*

FLORISTIC FEATURES OF THE NEW FIR ASSOCIATION *MELAMPYRO VELEBITICI-ABIETETUM* ASS. NOVA ON LIMESTONE BOULDER SCREES (WHITE AND SAMARIAN ROCKS STRICT RESERVE, CROATIA)

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Mesic herb-rich fir forests on limestone and dolomite boulder screes in the montane and subalpine belts of the Western Balkans (*Calamagrostio-Abietion*) represent important yet understudied mesophilous and basophilous ecosystems of the Illyrian floral province (Horvat, 1962; Cikovac, 2002). Research conducted in the White and Samarian Rocks Strict Reserve (Croatia) led to the syntaxonomic identification of a new fir community: *Melampyro velebitici-Abietetum* ass. nova. Following that, this study analyzes its species composition based on syntaxonomic spectrum, spectrum of life-form (Raunkiær from Dřevojan et al., 2023), chorological types (Pignatti, 2005), and CSR strategies (TRY database from Kattge et al., 2020). Vegetation survey followed Braun-Blanquet approach (1964), yielding 31 relevés from representative sites (2023–2024 growing seasons). Based on the conducted research, a total of 142 species of vascular plants were identified. The most represented syntaxonomic group were *Vaccinio-Piceetea* (25%) and *Fagetalia* (24%). Among the life forms, hemicryptophytes were predominant (57%), while the numerous chorological type showed representation of South-European species (41%). Ultimately, stress-tolerators (37.7%) and competitors (27.9%) made up the largest proportions of plant species' survival strategies. The findings provide the first Insights into the floristic features of fir forest vegetation in a strictly protected area of the Republic of Croatia, significantly advancing knowledge of *Calamagrostio-Abietion* in the mid-Dinaric region and serving as a baseline for necessary future research.

KEYWORDS: *chrological types, CSR strategies, life-forms, syntaxonomic spectrum*

SPECIES COMPOSITION OF VEGETATION WITH *STACHYS OCYMASTRUM* ON IŽ ISLAND (ZADAR ARCHIPELAGO, CROATIA)

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The Italian hedge nettle, *Stachys ocymastrum* (L.) Briq. is an annual herb (therophyte) belonging to the mint family (Lamiaceae). It is native to the western part of the Mediterranean region, where it occurs in various natural habitats, such as dry and open rocky grasslands, herbaceous vegetation with scattered shrubs, and evergreen Mediterranean cork-oak forests. The species is also common in anthropogenic habitats, including ruderal vegetation affected by human disturbance such as roadsides, paths, village edges, and agricultural lands especially olive groves. *Stachys ocymastrum* was recently recorded on Iž Island representing the first documented occurrence in the Eastern Adriatic region. During April of 2025 we studied vegetation in newly reported sites of this species in Croatia. The species was found in a green area within the village Veli Iž, and in a regularly mown grassland area with scattered *Pinus halepensis* trees near the seashore. We recorded five phytosociological relevés in this grassland, where dominant grasses were *Avena sterilis, A. barbata, Brachypodium pinnatum, Bromus madritensis, Dactilis glomerata, Elymus repens* while small forbs were abundant including *Aetheorhiza bulbosa, Lotus ornithopodioides,* and *Medicago spp. Stachys ocymastrum* also occurred in a ruderal coastal habitat near the marina, as well as in a garden waste dump along a roadside. The main threats to the population of this rare plant are intensive green-area management including grassland treatment with herbicides, and trampling by tourists. This species was recorded in the same area for several consecutive years, suggesting that it is either native or well naturalised if introduced.

KEYWORDS: *anthropogenic habitats, grassland, Phytosociology, ruderal, threats*

PHYTOSOCIOLOGICAL DIFFERENTIATION OF SCOTS PINE- PINUS SYLVESTRIS FOREST VEGETATION IN THE NIDŽE–KOŽUF MOUNTAIN RANGE

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In the Nidže–Kožuf mountain range lies one of the southernmost parts of the broad Eurasian range of Scots pine. On primary substrates characterized by poorly developed soils on limestone, dolomite, and ophiolitic bedrock, together with slow soil-forming processes and specific microclimatic precipitation and temperature regimes, Scots pine forests reach their biocenotic optimum for development. Under such conditions, these forests exhibit a relict character, represent a very rare occurrence, and have been the focus of our research.

This study provides a floristic, vegetation, and ecological analysis of Pinus sylvestris communities in the Nidže–Kožuf mountain range. Numerical classification and ordination were performed using the PC-ORD and JUICE software packages. The most appropriate methods for data analysis were selected: "Relative Euclidean distance" and the "Flexible Beta" method. The species cover data were transformed using the function b = log (Xi, j + 1) p with 0,5.

The software analyses revealed a clear differentiation of Pinus sylvestris forests, resulting in their classification into three distinct groups: one well-defined association and two smaller units at the community level. These groups represent three distinct ecological hotspots where this vegetation develops. This pattern is supported by differences in floristic composition, edapho-ecological characteristics, and their distribution along a partially overlapping altitudinal gradient. The studied vegetation belongs, in syntaxonomic terms, to the class Erico-Pinetea, order Erico-Pinetalia, and alliance Fraxino orni-Pinion nigrae.

KEYWORDS: *Pinus sylvestris; forest communities; Phytosociology; vegetation classification; Nidže–Kožuf*

THE CLASS RHODODENDRO HIRSUTI-ERICETEA CARNEAE ON MT GALIČICA (NORTH MACEDONIA)

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The subalpine and alpine dwarf-shrub vegetation of calcareous rocky habitats in southern Europe is syntaxonomically included within the class *Rhododendro hirsuti-Ericetea carneae*. During vegetation surveys on Mt Galičica, a distinctive shrub community dominated by *Genista radiata* was recorded on exposed limestone slopes above the upper forest limit, between 1800 and 2050 m a.s.l. Based on its floristic composition and ecological characteristics, this vegetation type is provisionally described as *Daphne oleoides–Genista radiata* comm.

The stands were documented from several localities (Volko Legalo and adjacent ridges), where *Genista radiata* determines the physiognomy of the community. Accompanying species include *Daphne oleoides, Festuca cyllenica, Stipa mediterranea, Melica picta, Sesleria wettsteinii, Bupleurum alpinum, Rumex scutatus,* and other taxa characteristic of high-mountain grasslands and rocky habitats. Comparative analysis with the association *Daphno-Genistetum radiatae* described from Kosovo revealed substantial similarity, but the absence of *Daphne mezereum* and the presence of the vicariant species *Daphne oleoides* support its provisional treatment as a separate community unit.

Life-form analysis indicates a hemicryptophyte–chamaephyte structure, with hemicryptophytes comprising 64% of the flora. Chorological analysis showed dominance of Eurasian floristic elements (30%), while Balkan endemic and subendemic taxa represented a significant proportion, with Balkan sensu stricto elements accounting for 29%.

This community represents a rare and phytogeographically important vegetation type of Mt Galičica, contributing to the biodiversity value of the mountain and emphasizing the need for continued phytosociological and conservation research in high-mountain habitats of the Balkans.

KEYWORDS: *Genista radiata*, Mt Galičica, subalpine vegetation, phytosociology, limestone habitats

VEGETATION OF VINEYARDS IN MEDITERRANEAN CROATIA: A PHYTOSOCIOLOGICAL SURVEY

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The aim of this study was to present the results of a phytosociological investigation of segetal plant communities colonizing vineyards in Dalmatia, southern Croatia, during 2025–2026. Dalmatia has a centuries-old tradition of intensive grapevine cultivation. The study area has a Mediterranean climate characterized by hot, dry summers and mild, rainy winters. Vegetation was analyzed using phytosociological relevés collected at 30 sites across the region between February and June. The selected sites reflect the conservative character of traditional agricultural practices. The recorded communities belong to the classes *Papaveretea rhoeadis, Chenopodietea, Artemisietea vulgaris*, and *Sisymbrietea*, with *Papaveretea rhoeadis* communities being the most frequent. The *Anthemis arvensis-Crepis sancta* community and *Mercurialietum annuae* were the most common vegetation types. Species abundances gradually changed from February to May. The studied vineyards are generally not tilled. Following herbicide treatment of a narrow strip around the vines in January, *Poa annua* becomes abundant in this zone by March. Vegetation between the vine rows is mown, typically four times during the growing season. Most recorded species are therophytes with Mediterranean distribution ranges. In general, the low proportion of cosmopolitan species and especially alien species (mainly the invasive *Amaranthus retroflexus* L. and *Conyza sumatrensis* (Retz.) E. Walker) reflects the conservative character of traditional agricultural practices and their role in maintaining plant diversity. Further studies across other regions of Croatia are needed to provide a more comprehensive understanding of these vegetation types, particularly for conservation planning that integrates environmental and socio-economic perspectives.

KEYWORDS: *Dalmatia, Papaveret,ea rhoeadis vascular plant composition, vineyards, weed vegetation*

AN INTEGRATIVE TAXONOMIC APPROACH TO THE *EUPHORBIA NICAEENSIS* ALLIANCE (EUPHORBIACEAE) REVEALS CRYPTIC LINEAGES IN THE CENTRAL BALKAN PENINSULA

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The Eurasian steppes constitute one of the most extensive continuous biomes on the planet, supporting a notable biodiversity of plant species that have adapted to particular climatic and ecological conditions. *Euphorbia glareosa* is widely distributed throughout the Pontic steppe zone, as well as in adjacent extrazonal steppe habitats shaped by local environmental factors. Within regions such as the Anatolian, Danubian, Thracian, and Pannonian grasslands, the species exhibits a predominantly continuous range, while in the central Balkan Peninsula it is present in fragmented and isolated populations within a well-known biodiversity hotspot.

Despite the recognition of several infraspecific taxa within *E. glareosa* s.l., their evolutionary relationships remain insufficiently resolved. In this study, an integrative taxonomic framework was employed, combining cytogenetic analyses (relative genome size and ploidy estimation, chromosome counting), morphometric evaluation, and molecular approaches such as ITS sequencing and AFLP fingerprinting.

The results obtained from this study suggest the occurrence of multiple polyploidisation events and unveil intricate evolutionary patterns within the examined group. Notably, we identified cryptic lineages in the central Balkan region that were previously unrecognized, which justified the description of two new species: the diploid *Euphorbia balcanica* and the tetraploid *Euphorbia skopjensis*. Populations from the eastern Balkans and Pontic steppes exhibit substantial genetic and morphological differentiation, suggesting the presence of additional taxa.

Phylogeographic analyses have revealed a significant divergence between western (Pannonian and central/eastern Balkan) populations and those from the eastern Balkans, Pontic region, and Anatolia. These findings underscore the conservation importance of extrazonal steppe habitats in Europe and reinforce the Balkans as a significant center of biodiversity requiring further research.

KEYWORDS: *biodiversity, Balkan Peninsula, new species, polyploidy, taxonomy*

DISTRIBUTION AND POPULATION DENSITY OF *RANUNCULUS WETTSTEINII* DÖRFL. IN NORTH MACEDONIA

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Ranunculus wettsteinii is a rare Balkan stenoendemic restricted to the high-mountain zone of Korab mountain along the Albanian-Macedonian border. The species was first recorded in 1918 by Dörfler on the scree slopes of Cüseli (Kula e Ziberit) at 2375 m a.s.l. and it has rarely been documented since.
The species occurs in a specific habitat with siliceous screes and morainic terraces within alpine zone. Hence, this study provides the first quantitative estimation of population density and population size for the species.
Population density and size were assessed using 1×1m quadrats along transects. At Kobilino Pole, 258 individuals were recorded in 47 quadrats, indicating a mean density of 5.5 individuals m² (SD13.71; SE2; CI95% 1.6-9.4). The species occurred in 25.5% of quadrats, indicating a strongly patchy distribution. Extrapolation resulted in an estimated population size of 69713 individuals. At Kula e Ziberit, 362 individuals were recorded in 48 quadrats, with a mean density of 7.5 individuals m² (SD12.23; SE1.76; CI95% 3.7-11.4). The species occurred in 68.8% of quadrats, and the estimated population size was 166101 individuals. The combined population across both sites is therefore estimated at roughly 236000 individuals with an estimated Area of Occupancy of only 0.3 km2 and Extent of Occurrence of only 7.2 km2 (two 10x10 grid cells).
This combination of restricted distribution and confinement to two known locations is characteristic of alpine endemic species. Although local population sizes appear relatively large due to dense clustering in suitable microhabitats, the overall conservation status may still be of concern due to the limited spatial distribution and dependence on specialized alpine habitats. Continued monitoring of population trends, habitat stability and threats (e.g., climate change, grazing pressure, or habitat disturbance) is therefore important for assessing the long-term viability of *Ranunculus wettsteinii* populations.

KEYWORDS: *endemic, alpine, Korab, buttercup*

ENDEMISM OR MORPHOLOGICAL VARIABILITY? *FESTUCA* TAXA IN THE CENTRAL SANDY REGION OF THE CARPATHIAN BASIN

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Festuca vaginata is the dominant species of open sandy habitats throughout the Carpathian Basin, extending to the Romanian Plain. Species richness increases towards the central part of the basin. The northern margin hosts the endemic *Festuca javorkae*, while *Festuca wagnerii* occurs in the southern and central regions, and *Festuca pseudovaginata* represents another endemic in the central basin. To examine whether this pattern reflects anthropogenic influence or other environmental drivers, we investigated the forest-steppe zone of the central basin, analysing vegetation composition and climatic conditions. *Festuca* species were studied using leaf cross-sections and 24 morphological traits of inflorescence and leaf anatomy. Leaf micromorphology was further analysed by stereomicroscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy (EDS) and phytolith analysis to evaluate the taxonomic relevance of epidermal characters. During the study, a new species (*Festuca tomanii*) was identified. Anthropogenic disturbances such as deforestation and scrub removal created bare soil patches that facilitated the establishment of new vegetation. At the same time, increasingly extreme climatic conditions in the central basin (very dry and hot periods) impose stronger environmental stress, likely promoting ecological adaptation and contributing to the relatively high proportion of endemic species.

This study was supported by OTKA K-147342, the Strategic Research Fund of the University of Veterinary Medicine Budapest (SRF-002), the Research Excellence Programme of the Hungarian University of Agriculture and Life Sciences, and the EKÖP-MATE/2025/26/A University Research Scholarship Programme of the Ministry for Culture and Innovation from the National Research, Development and Innovation Fund.

KEYWORDS: *Carpathian Basin, sandy grasslands, endemic Festuca, forest-steppe zone, leaf micromorphology*

FLORISTIC CHARACTERISTICS OF A FRAGMENT OF THE FORMER STRUGA SWAMP (SHORE OF LAKE OHRID)

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During the period 2014–2015, floristic research was carried out along the coastal belt of Lake Ohrid between the town of Struga and the village of Kalishta. This area represents a remaining fragment of the former Struga Swamp. Wet habitats are important ecosystems with high biodiversity values and an important role in maintaining ecological balance.
The aim of the research was to determine the floristic composition of the swamp and coastal vegetation and to identify the plant species that still occur in this area.
The research included field collection of plants, preparation of herbarium samples, and species identification using identification keys and botanical literature. A total of 75 plant species belonging to 30 families were recorded, representing the typical swamp and coastal flora of the area.
The analysis of life forms shows the dominance of hemicryptophytes (50%), which is typical for temperate humid grassland and coastal habitats. The relatively high presence of therophytes (25%) indicates human influence and periodic disturbance of the habitat. The presence of geophytes (10%), as well as helophytes and hydrophytes (about 7%), reflects the wet and swampy character of the investigated locality.
The chorological analysis of floristic elements shows the dominance of Euroasian species, with a notable presence of Paleotemperate and Euro-Caucasian species, while European, Eurosiberian, and cosmopolitan species are represented in smaller numbers.
The obtained results highlight the floristic importance of the investigated locality as a significant remnant of the former vegetation of the Struga Swamp. The area plays an important role in preserving biodiversity in the coastal zone of Lake Ohrid. These findings provide a basis for further research and for the protection of these important wetland ecosystems.

KEYWORDS: *life forms, chorological analysis, wetland vegetation, Struga Swamp, Lake Ohrid*

FLORISTIC COMPOSITION OF MOUNT NËMËRÇKË AND ITS POTENTIAL AS A SUSTAINABLE ECONOMIC RESOURCE

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The Nemercka Mountain is part of Trebeshinë–Dhëmbel-Nëmërçkë mountain range in Southern Albania, rich in endemic species and biodiversity. However, this ecosystem is increasingly affected by habitat degradation and climate change. Given the critical importance of high mountain regions as biodiversity hotspots and centers of endemism, a quantitative evaluation of Mount Nemercka's flora is essential for informing conservation strategies and understanding its contribution to Balkan biodiversity. This study aims to comprehensively document the vascular flora of Mount Nemercka, evaluate biogeographical spectrum and assess the conservation status of endemic and threatened taxa. Additionally, the research will explore the potential of this floristic richness to support sustainable economic development, particularly through the identification of species of high economic value, as medicinal and aromatic plants. The study findings included 560 taxa belonging to 69 families, demonstrating the high richness of this mountain. The floristic spectrum analysis revealed a dominance of Mediterranean elements with 26.7 % of total recorded species. This pattern highlights a strong biogeographical affinity of the vegetation with the Mediterranean region, in accordance with the prevailing Mediterranean climatic conditions in the area. Hemicryptophytes made up the highest percentage of all life forms (51.4%), suggesting a considerable degree of habitat degradation. This pattern is largely attributed to anthropogenic impact such as uncontrolled logging, recurrent fires, and overgrazing. In total, 20 endemic species were recorded including 4 strict endemics. Species were assessed using IUCN categories, the results showed that 73% of them were classified as threatened. Furthermore, 48 aromatic and medicinal plant species belonging to 32 families were recorded in the area. The high floristic diversity observed suggests that Nëmërçkë Mountain represents an important biodiversity hotspot in Albania and emphasizes the critical conservation value of the area and its significant potential for economic development through the sustainable utilization of medicinal resources.

KEYWORDS: *fen biodiversity, endemic, threatened species, protection, conservation*

HABITAT DIVERSITY OF *LATHYRUS PALUSTRIS* IN NEWLY DISCOVERED SLOVENIAN POPULATIONS

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The wetland species *Lathyrus palustris* L., a conspicuous taxon with a broad Holarctic distribution, is reported here as newly confirmed for the flora of Slovenia. Despite extensive historical and contemporary research on Slovenian wetland vegetation, the species had not been reliably documented within current national borders. Our findings are based on field surveys conducted between 2022 and 2024 in the area of Lake Cerknica, one of the largest intermittent karst lakes in Europe.

The species was recorded at eight sites, forming three spatial clusters across a range of wetland habitats shaped by the lake's dynamic hydrological regime. It occurs in diverse plant communities, including tall-sedge stands, *Molinia caerulea* meadows, and *Schoenus ferrugineus*-dominated fens, reflecting broad ecological amplitude within mesic to wet conditions. Vegetation data were collected using the Braun-Blanquet approach, and species identification was confirmed through floristic literature and herbarium comparisons. No prior confirmed herbarium records from Slovenia were found.

This discovery fills a biogeographical gap between Central and Southeastern Europe, where the species is generally rare and often threatened. The presence of multiple populations suggests local establishment, though the species is likely not widespread. These findings emphasize the ecological importance of hydrologically dynamic wetlands and the need for continued monitoring to better understand species distribution and conservation status.

KEYWORDS: *flora, Lake Cerknica, Lathyrus palustris, wetland vegetation*

MICROHABITAT PATTERNS OF *LIPARIS LOESELII* IN THE LJUBLJANA MARSH (SLOVENIA)

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Liparis loeselii is a rare, endangered, and protected orchid species in Slovenia. One of its larger remaining populations occurs in the Strajanov Breg Nature Reserve, located at the southeastern edge of the Ljubljana Marsh. There, the monitoring of the species population has been taking place for more than 15 years. In July and August 2025, we conducted a vegetation survey to obtain data on the (micro)habitat characteristics of this species. Vegetation records were carried out (standard Braun-Blanquet method using the expanded scale), on circular plots of 1 m diameter. The aim was to identify potential differences in vegetation composition between microhabitats where *L. loeselii* is present and those where it is absent. A total of 58 relevés were recorded. We selected a balanced set of plots i) according to major habitat types present in the valley (calcareous fens, *Molinia caerulea* wet meadows and tall sedges), and ii) according to presence of the orchid: 1) plots where *L. loeselii* was present in 2025, 2) plots where the species was absent in 2025 but recorded in previous years, 3) random plots where the species has not been recorded to date. All data were stored in the FloVegSi database and subsequently imported into the JUICE software and the R statistical environment for analysis (vegan package). Community similarity was assessed using the PERMANOVA method based on the Bray–Curtis dissimilarity index. The results revealed statistically significant differences in plant species composition among the three vegetation groups. Analysis of Pignatti ecological indicator values indicated that the group of plots where *L. loeselii* is present is characterized by a greater representation of hygrophilous species.

KEYWORDS: *Liparis loeselii, Slovenia, microhabitat, vegetation, fen*

NEW RECORD, POPULATION ASSESSMENT AND CONSERVATION STATUS OF *PTEROCEPHALUS PERENNIS* COULT. IN NORTH MACEDONIA

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Pterocephalus perennis Coult. is a sub-Mediterranean Balkan endemic previously known from Greece and Albania, typically occurring on rocky limestone slopes between 800 and 2000 m a.s.l. In July 2024 the species was recorded for the first time in the flora of North Macedonia at the locality Beli Breg on Mt. Jablanica near the village of Vevchani. This study aimed to verify its distribution on Mt. Jablanica, characterize habitat conditions and provide the first assessment of its population parameters and conservation status in the country.

Potential habitats were identified through literature sources, iNaturalist records and GIS analysis of altitude, slope, exposure and limestone substrate. Based on these criteria, 18 sites were surveyed during field trips in June and July 2025. The species was detected only at the previously known locality Beli Breg. Population structure was assessed using 1 × 1 m quadrats along linear transects. *P. perennis* occurred in 12 of 49 quadrats (frequency 24.49%), indicating a patchy distribution. The occupied area was estimated at 1193 m² within a locality of 29,326 m² (4.07% coverage). The number of individuals was approximated at 316 using drone imagery, although accuracy was limited by image resolution, flight distance and steep terrain, resulting in an estimated error of 78%.

Morphometric measurements were conducted on 210 flowers from 10 inflorescences and 79 leaves. Leaf length ranged between values reported in the literature, while corolla and calyx length also corresponded with published descriptions, indicating no morphological deviations in the Macedonian population.

Based on the very limited distribution (AOO 0.029 km²) and small population size, the national conservation status is proposed as Endangered (EN: B1 + B2ac, C2aii, D1) according to IUCN criteria. Preliminary evaluation of the species' total known distribution in Albania, Greece and North Macedonia suggests that the global status may also approach EN, although *P. perennis* currently remains categorized as Data Deficient.

KEYWORDS: *Balkan endemic, Mt. Jablanica, population density, morphometric analysis*

HERBARIUM BUNS: THE MAPPING VEGETATION OF VOJVODINA PROJECT COLLECTION

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The Herbarium BUNS at the University of Novi Sad was established in 1948 and has since been continuously enriched through teaching and scientific activities of professors and students. While the majority of the collection consists of specimens gathered during floristic and taxonomic studies, a significant and still insufficiently explored segment is the material originating from the project Mapping the Vegetation of Vojvodina. This project was conducted between 1978 and 1988 as part of the broader initiative Mapping the Vegetation of Yugoslavia. Unlike some regions (e.g., Croatia and Bosnia and Herzegovina), where comprehensive vegetation maps and monographs were published, in Vojvodina the results remained fragmented, mostly presented through studies of smaller areas with relatively homogeneous habitat types. As a legacy of this project, the Herbarium BUNS houses a collection of 325 herbarium boxes containing specimens organized in bundles corresponding to vegetation relevés. The collection primarily includes less common, insufficiently known, or taxonomically critical species that required verification. Each bundle is accompanied by metadata on locality, date, and vegetation record. The material covers a broad area of Vojvodina, with the strongest representation from Bačka and Banat, followed by Srem. Notably, data from Fruška Gora are absent, likely because this region was assigned to the Faculty of Forestry in Belgrade. In addition to Vojvodina, the collection also includes material from eastern Slavonia (Croatia), which was likewise studied by researchers from Novi Sad. The specimens are still stored in their original envelopes, some identified and others pending determination. A preliminary assessment confirms that the material is generally well preserved. Planned future activities include conservation measures, databasing, and digitization, which will make this valuable resource accessible for scientific research. This collection represents a unique and largely untapped source of historical vegetation data, providing important insight into field methodologies and vegetation research practices in the 1980s, as well as a baseline for contemporary comparative studies.

KEYWORDS: *botanical collection, Pannonian plain, habitats, historical monitoring, digitization*

ASSESSING THE BIODETERIOGENIC VASCULAR FLORA ON CROATIAN HISTORIC STRUCTURES BY PHYTOSOCIOLOGICAL PLOTS

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Biodeterioration caused by vascular plants represents a major threat to stone-built cultural heritage. In Croatia, plant-driven deterioration of historic limestone structures remains insufficiently investigated. This study assesses the composition, ecological patterns, and hazard potential of biodeteriogenic vascular flora colonizing Croatian monuments using a phytosociological approach.
Field surveys were conducted at 40 historic sites (castles, fortresses, archaeological remains) across coastal and inland Croatia. A total of 452 phytosociological plots (1 × 1 m) were sampled on vertical limestone surfaces. Species cover was estimated using the Braun–Blanquet scale. Environmental variables included elevation, distance from the sea, exposure, and conservation status. Floristic diversity (Shannon Index), life forms (Raunkiær classification), and the Hazard Index (HI) were analyzed using cluster analysis and ANOVA.
A total of 154 taxa were recorded. The most frequent species were *Parietaria judaica*, *Hedera helix, Ficus carica,* and *Asplenium ceterach*. Alien invasive taxa such as *Ailanthus altissima* and *Robinia pseudoacacia* were also documented, alongside endemic species (e.g., *Centaurea dalmatica*). Vegetation cover decreased significantly (−67.75%) from poorly maintained to well-preserved sites ($p < 0.001$). Elevation significantly influenced vegetation cover, diversity, and Hazard Index values, with the highest HI recorded at mid-elevations (150–300 m a.s.l.; HI = 158). Distance from the sea affected diversity and hazard levels, whereas exposure showed no significant effect. Phanerophytes and Chamaephytes dominated poorly maintained sites, contributing most to structural risk.
Elevation and conservation status are key drivers of plant colonization and biodeterioration risk on Croatian limestone heritage. Mid-elevation sites represent priority areas for management due to higher hazard levels. Integrating phytosociological data into conservation planning supports targeted, preventive strategies for safeguarding cultural heritage.

KEYWORDS: *biodeterioration, cultural heritage, Hazard Index; Phytosociology, vascular plants*

CATTLE GRAZING ON CONSERVATION AND FORAGE VALUE ACROSS GRAZING PRESSURE GRADIENTS IN ALKALI GRASSLAND IN HORTOBÁGY

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Studying the effects of grazing pressure on species composition, beta diversity and yields is important for both conservation and grassland management. The case study area in Hortobágy, one of the largest continuous grassland areas in Europe, has been managed for centuries through grazing by Hungarian grey cattle. The effect of grazing pressure was investigated in terms of distance from the livestock enclosure (50 m, 250 m, 500 m, 1000 m and 1700 m) and in an ungrazed control on dry and mesic alkaline grasslands in spring and autumn of 2024. In both types of grasslands at each distance, species composition and mean plant height were recorded in six 4 × 4 m plots. Overall, across both seasons, the control areas were the poorest in species richness among the grazed areas in both grassland types. The 1700 m distance had the fewest species. Species richness in mesic grassland decreased linearly with distance. The dry grassland showed a polynomial trend and was more species-rich at all distances than the mesic grassland. Green yield was highest in the dry grassland at 250 m in spring and 50 m in autumn, while in the mesic grassland it was highest at 1700 m in spring and between 500 and 1700 m in autumn. Forage quality in dry grassland was lowest at 50 m and highest between 500 and 1000 m. In mesic grassland, this parameter was equalised at all distances. The highest Simpson diversity was found in both associations from the livestock enclosure at 500-1000 m. This study was supported by OTKA K-147342, the strategic research fund of the University of Veterinary Medicine Budapest (Grant No. SRF-003).

KEYWORDS: *Festuca pseudovina, livestock, grazing pressure, forage value, diversity*

DISAPPEARING HABITATS: INVASIVE SPECIES AS ECOSYSTEM SUPPRESSORS OF FLOODPLAIN FORESTS

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Floodplain forests are among the most fragile ecosystems in Europe and are classified as critically endangered habitats according to the European Red List. Positioned along major rivers, they serve as essential ecological corridors and buffer zones between terrestrial and aquatic ecosystems. However, these native types of forest are undergoing rapid changes due to systemic imbalances in species diversity and mounting ecological pressures.

Key threats to riparian forests include wood exploitation, alterations in natural flooding regimes, strongly linked to global climate change, various forms of pollution, and the aggressive spread of invasive species.

This study focuses on monitoring the current state of willow (*Salix* spp.) and poplar (*Populus* spp.) stands in floodplain forest communities, aiming to assess the presence and impact of invasive species. Methodology of the study were based on collecting of phytosociological relevés using a Braun-Blanquet abundance scale. Special attention is given to evaluating floristic diversity and identifying the negative effects invasive taxa have on community composition and structure.

The results revealed a significantly higher proportion of invasive species in poplar forest stands compared to willow forests and scrub vegetation. This pattern suggests that more structurally complex riparian forest communities may be more susceptible to plant invasions, potentially due to altered disturbance regimes and environmental instability. The recorded floristic shifts indicate that invasive taxa represent an important driver of compositional change in these endangered habitats.

Our findings highlight the need for continuous monitoring and targeted conservation measures in riparian forests, particularly in habitats exposed to hydrological alteration and biological invasions.

KEYWORDS: *Braun-Blanquet approach, floristic diversity, phytosociology, plant invasions*

GRAZING AND DEFORESTATION AS LAND-USE PRACTICES ALTER THE PHYTOSOCIOLOGICAL COMPOSITION OF PANNONIAN CALCAREOUS SANDY GRASSLANDS

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During the phytosociological surveys we examined pristine, non-grazed, Pannonian dry sandy grasslands established on abandoned vineyard sites, and secondary grasslands that developed following deforestation. These habitats were managed with different grazing intensities. At each sampling site, phytosociological relevés were recorded over three consecutive years using 2 × 2 m quadrats. Recorded species were assigned to coenosystematic groups, resulting in six distinct categories. In addition, the dominant *Festuca* species determining community structure were analysed separately. Data analysis was performed in R Studio (version 2025.05.1) using PERMANOVA statistical methods. The results indicated that natural sandy grasslands and abandoned arable lands exposed to low grazing pressure are phytosociological similar habitat types. Nevertheless, each habitat type was characterised by distinct diagnostic species. In less intensively grazed areas, *Festuca tomanii* and *Festuca pseudovaginata* emerged as potential character species, whereas *Festuca wagneri* was primarily associated with natural sandy grasslands. In grazed sites, particularly in open sandy habitats subjected to intensive use, typical stands of the *Festucetum vaginatae* association were observed. The deforested sampling area exhibited the most pronounced phytosociological structural divergence and proved to be the habitat of the *Festucetum pseudovaginatae* association. Despite their similar physiognomic appearance, the studied grasslands differed markedly in species composition. These differences can largely be attributed to variation in land-use history and intensity. This study was supported by OTKA K-147342, the strategic research fund of the University of Veterinary Medicine Budapest (Grant No. SRF-002) and the Research Excellence Programme of the Hungarian University of Agriculture and Life Sciences, and by the EKÖP-MATE/2025/26/A university research Scolarship

Programme of the Ministry for Culture and Innovation from the source of the National Research, Development and Innovation Fund.

KEYWORDS: *Festuca, plant association, grassland management*

GRASSLAND AND FOREST FRINGES HABITATS AS A SOURCE OF MEDICINAL AND EDIBLE PLANTS: ETHNOBOTANICAL PERSPECTIVE OF CROATIA AND NORTH MACEDONIA

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The Balkan Peninsula is a major biodiversity hotspot in Europe, characterized by high floristic diversity and a long history of human–nature interactions. Semi-natural grasslands are among the most species-rich habitats in the region and provide significant ecological, cultural, and ethnobotanical value in both Croatia and North Macedonia.

Grasslands in these countries have developed under comparable environmental conditions, including Mediterranean and sub-Mediterranean climate influences, predominantly calcareous soils, and long-standing traditions of extensive grazing and low-intensity land use. Consequently, similar vegetation types occur in both regions. Dry and semi-dry grasslands of the class Festuco-Brometea are widespread on shallow, rocky, nutrient-poor soils, hosting drought-tolerant grasses and a rich assemblage of aromatic and medicinal herbs. Thermophilous annual grasslands combination of the class Tuberarietea guttatae and Stipo-Brachypodietea distachyi (syn. Thero-Brachypodietea) occur in warmer, more xeric habitats, further enhancing herbaceous diversity.

The aim of this study was to compare ethnobotanical knowledge related to grassland plant species in Croatia and North Macedonia and to identify taxa of shared cultural and medicinal importance.. The analysis was based on published ethnobotanical studies and available floristic data from both countries. Results show that many grassland species have long been used in traditional practices. Aromatic and medicinal taxa, such as *Salvia* spp., *Thymus* spp., *Origanum vulgare, Satureja montana, Achillea millefolium*, *Plantago lanceolata, Teucrium chamaedrys* and *Hypericum perforatum*, as well as wild edible vegetables, including *Allium ursinum, Bellis perennis, Taraxacum officinale*, *Chenopodium album, Mentha longifolia, Malva sylvestris, Rumex acetosa*, and *Urtica dioica*, are commonly found in both countries. These species are traditionally used for medicinal preparations, herbal teas, food seasoning, and other cultural purposes.

In conclusion, grassland and forest fringer habitats represent important reservoirs of biodiversity and traditional ecological knowledge. These findings highlight the importance of semi-natural grasslands as reservoirs of both biodiversity and traditional ecological knowledge and underline their relevance for the conservation and sustainable use of wild medicinal and edible plants in the Balkan region

KEYWORDS: *vegetation, ethnobotany, medicinal plants, comparative analysis, Balkan flora*

HOW CAN MYCOLOGICAL SURVEYS SUPPORT DYNAMIC DIAGNOSES CONCERNING FOREST VEGETATION IN THE CONTEXT OF CLIMATE CHANGE?

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In recent decades, the forest vegetation of the Central European plains has undergone differentiated evolutive or regressive dynamics, characterised, for example, by the regression of certain key species due to fungal or complex pathologies (forest decline), the progression of invasive alien species, the influence of hydrogeological processes linked to aquifers and, last but not least, climate change. With climate change underway, the linear and cyclical dynamics of vegetation are often diverted towards phases whose stability over time is unknown. Massive progression of alien species into the tree stock also complicate the picture. At the same time, it has been demonstrated in recent decades that these dynamics in forest stands and, more generally, in the vegetation associated with them, are interrelated with changes in mycorrhizal symbiosis that occur in forest succession and guide the evolution of forest stands. In general, it is still difficult to identify what interactions may exist between these forest dynamics and symbiotic or saprophytic fungal dynamics in the soil. From a methodological point of view, to our knowledge, there are still no mixed, vegetational, mycological and structural survey protocols in place that would allow for an evolutionary diagnosis. Although floristic-vegetational databases and thematic mapping in the forestry sector exist, it is more difficult to have properly georeferenced mycological data systematically linked to such forest mapping.

KEYWORDS: *mycorrhizae; forest succession; alien species; mycological inventories; climate change*

MEADOW VEGETATION OF THE DANUBE FLOODPLAIN: DIVERSITY, THREATS AND CONSERVATION

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Meadow vegetation across the territory of Vojvodina (northern Serbia) has been exposed to increasing pressures resulting from multiple environmental and socio-economic changes over recent decades. These include shifts in agricultural practices, particularly the decline of extensive livestock farming and the reduction of livestock numbers, which historically played an important role in maintaining traditional meadow ecosystems. Additional drivers include habitat fragmentation, intensification of agricultural production leading to soil eutrophication, as well as changes in both global and local climatic conditions.

However, meadow vegetation in the floodplains of large rivers such as the Danube is exposed to additional pressures, as its persistence is closely linked to the natural dynamics of seasonal flooding and groundwater levels. Changes in hydrological regimes can strongly influence vegetation composition and habitat stability. Furthermore, these floodplain areas are increasingly affected by intensive forestry practices and by the expansion of invasive plant species, which may significantly alter the structure and ecological functioning of meadow communities.

In this study, we analysed meadow communities within the Koviljsko-Petrovaradinski Rit Special Nature Reserve, located in the lowest part of the Danube alluvial plain and extending for approximately 20 km. This wetland complex represents a remnant of once widely distributed floodplain habitats, where many original ecological characteristics of these ecosystems are still preserved.

Within the study area, four associations belonging to three alliances and two orders of the class Molinio-Arrhenatheretea Tx. 1937 were recorded (in 98 plots). The study focused on evaluating the current status of these communities, their ecological characteristics, and the main pressures they face today. Particular attention was given to identifying threats related to hydrological changes, invasive species, and land-use practices.

The results indicate that all analysed meadow associations require targeted active conservation measures to ensure their long-term persistence. Appropriate management, including the maintenance of traditional land-use practices and improved protection strategies, will be essential for preserving the ecological integrity and biodiversity of Danube floodplain meadows in the future.

KEYWORDS: *Molinio-Arrhenatheretea, alluvial habitats, floodplain*

RESTORATION ATTEMPTS OF THE FLOODPLAIN FORESTS ALONG THE MURA RIVER IN SLOVENIA

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Floodplain forests across major European rivers are increasingly degraded due to altered disturbance regimes, biological invasions, and disrupted regeneration. These pressures have simplified vegetation structure, reduced successional diversity, and weakened ecosystem resilience. This study applies a vegetation-centred restoration framework that integrates structural, compositional, and successional approaches. Key measures include removing invasive species and competitive herb layers, converting artificial stands into near-natural forests, promoting natural regeneration through early successional stages, and restoring habitat elements such as oxbows and wet meadows to increase heterogeneity. Restoration also incorporates the use of genetically diverse, stress-tolerant native tree material to enhance long-term adaptability. A harmonised monitoring framework assesses vegetation structure, regeneration success, and habitat diversity. Results show that degradation is mainly driven by competitive exclusion, altered successional pathways, and dominance of non-native species, which suppress regeneration. Reducing invasive biomass and restoring structural heterogeneity enables recovery of native vegetation dynamics. By supporting early successional stages, our approach promotes self-organising vegetation development and improves long-term stability. Integrating genetic considerations further strengthens resilience to environmental stress. Restoring habitat mosaics, including transitional zones and small-scale features, enhances biodiversity and ecosystem functioning. The study demonstrates that effective floodplain forest restoration requires combining vegetation management with process-based approaches that restore natural dynamics. Prioritising successional continuity, structural diversity, and adaptive genetic resources is essential for long-term resilience and conservation success.

KEYWORDS: *Mura River, Floodplain forests, Restoration, Invasive species*

MOUNTAIN NORWAY SPRUCE FORESTS UNDER CLIMATE CHANGE (BIOFORMA)

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Mountain Norway spruce-dominated forests (MSF) are considered particularly vulnerable to shifting environmental conditions driven by climate change. At the same time, within Europe's alpine biogeographic region, these ecosystems hold significant ecological, economic, and cultural value. For this reason, gaining insight into their future development pathways is essential to preserve their functionality and resilience. This project mainly aims, (1) to evaluate the consequences of different forest management scenarios in the context of climate change for biodiversity and ecosystem functions of spruce-dominated mountain forests and (2) to provide recommendations to stakeholders for adaptive management options in these sensitive forest ecosystems. To accomplish our objectives, we will carry out a comprehensive assessment of forest structure in 500 plots within 100 forest stands, encompassing a wide range of structural diversity in MSF and representing outcomes of various forest management systems traditionally applied in Switzerland, Croatia, Bulgaria, and Romania - from unmanaged forests to small-scale irregular shelterwood systems and clear-cut harvesting. We will then evaluate the biodiversity of key functional groups within these plots, encompassing a broad spectrum of taxa - including soil microorganisms, vascular plants and mosses, fungi, insects, and birds - and relate these patterns to forest structural characteristics. Scientifically, the project will elaborate relevant connections between stand structure and biodiversity, at different spatial scales and analyze trajectories of stand structure-biodiversity links between current and future climatic conditions by using forest growth models. Although MSF face broadly similar challenges across European countries, local differences in geomorphology, soil characteristics, climate, and historical management practices complicate the development of a unified strategy. To address this, each partner country has assembled expert teams with strong cross-disciplinary expertise. Through collaboration across all partner institutions, these diverse teams will actively exchange knowledge, strengthening and expanding their collective capacities.

KEYWORDS: *Picea abies, biodiversity, forest structure, climate change, future predictions*

HIERARCHICAL CLASSIFICATION OF HABITATS IN BOSNIA AND HERZEGOVINA

Oral presentation

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Bosnia and Herzegovina (BiH) harbours exceptional biological diversity, yet has lacked a unified, phytosociologically grounded habitat classification system compatible with contemporary European frameworks. Here we present the first comprehensive hierarchical classification of habitats in BiH, structured across six hierarchical levels and compliant with the syntaxonomic framework. Levels one through four represent broad ecological and physiognomic categories, while level five corresponds to the phytosociological alliance and level six to the association or sub-association. The classification encompasses 675 habitat units distributed across eight major categories: marine, freshwater, grasslands (with tall-herb communities and peatlands), shrublands, forests, sparsely vegetated habitats, cultivated non-forest habitats and finally constructed and industrial habitats. Forest and shrubland habitats are fully elaborated to the sixth level, comprising 157 forest associations and 57 shrub associations, reflecting the particularly rich and well-documented woody vegetation of BiH. All remaining habitat categories are, where applicable, elaborated to level five, with 247 alliances documented in total. Each endnode unit (of fifth or sixth level) is cross-referenced with four European classification systems: the EUNIS Habitat Classification (2021/22), Natura 2000 Annex I habitat types, the Resolution 4 of the Bern Convention, and the European Red List of Habitats — enabling direct interoperability with EU biodiversity reporting obligations. Red List assessments indicate that numerous grassland, riparian, and mire habitats carry Vulnerable (VU) or Endangered (EN) status, underscoring the conservation urgency of the dataset. The complete dataset is openly accessible via the Zenodo repository (https://doi.org/10.5281/zenodo.19372958) and integrated into two publicly accessible Web GIS platforms serving the two BiH entities (https://e-priroda.rs.ba and https://e-prirodafbih.ba). This classification constitutes the essential phytosociological baseline for systematic large-scale habitat mapping and vegetation survey campaigns in BiH, the forthcoming implementation of the Natura 2000 network in BiH, for standardized vegetation monitoring programmes etc.

KEYWORDS: *Phytosociology, Natura 2000, EUNIS, European Red List of Habitats*

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