



Vegetation of sea,
oceanic and ecological
islands of Europe

66th ANNUAL SYMPOSIUM

From local to global:
vegetation patterns
across spatial scales
in a changing World

IAVS



16 - 20 SEPTEMBER 2024

Pestana Casino Park Hotel
Funchal, Madeira, Portugal

PROGRAMME AND ABSTRACTS

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32nd
CONFERENCE

EVS

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MADEIRA, FUNCHAL
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ISBN 978-989-33-6597-7

Título: IAVS 2024 Abstract Book

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Suporte: Eletrónico

Formato: PDF / PDF/A

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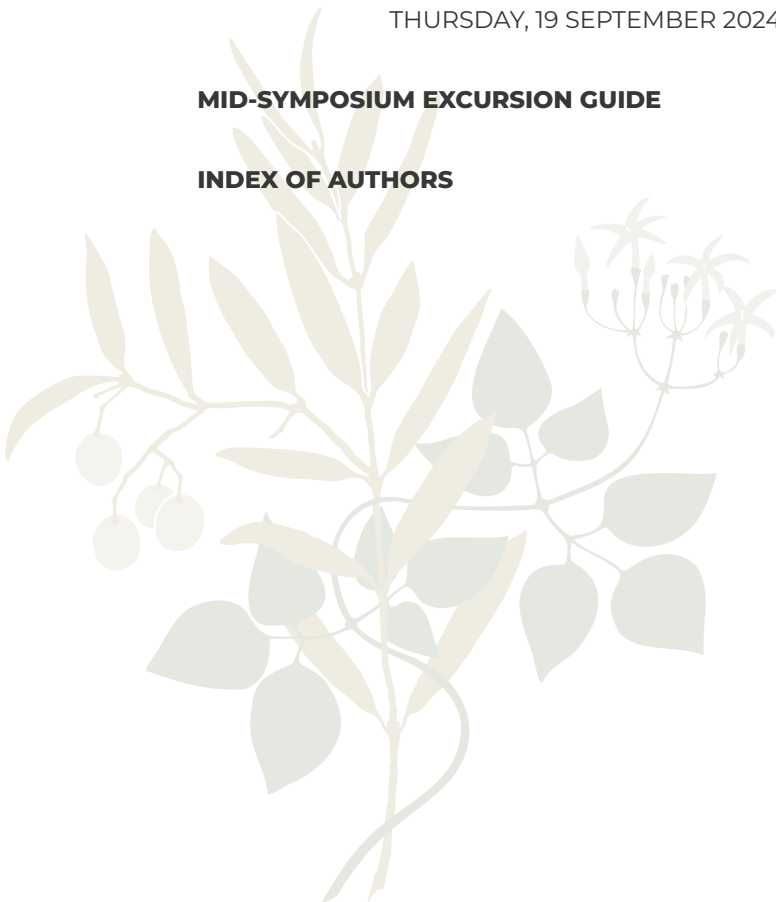
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Table of contents

WELCOME MESSAGE	7
SCIENTIFIC PROGRAMME	8-16
SUNDAY, 15 SEPTEMBER 2024	9
MONDAY, 16 SEPTEMBER 2024	9-10
TUESDAY, 17 SEPTEMBER 2024	11-12
WEDNESDAY, 18 SEPTEMBER 2024	13
THURSDAY, 19 SEPTEMBER 2024	14-15
FRIDAY, 20 SEPTEMBER 2024	16
POSTER SESSION P1 (A/B/C)	17
POSTER SESSION P2 (A/B/C)	18
POSTER SESSION P3 (A/B/C)	19
ABSTRACTS	20-147
PLENARY TALKS	21-28
ORAL COMMUNICATIONS	29-115
MONDAY, 16 SEPTEMBER 2024	29-54
TUESDAY, 17 SEPTEMBER 2024	55-79
THURSDAY, 19 SEPTEMBER 2024	80-104
FRIDAY, 20 SEPTEMBER 2024	105-112
POSTERS	113-147
MONDAY, 16 SEPTEMBER 2024	113-123
TUESDAY, 17 SEPTEMBER 2024	124-135
THURSDAY, 19 SEPTEMBER 2024	136-147
MID-SYMPOSIUM EXCURSION GUIDE	148-170
INDEX OF AUTHORS	171-175



Welcome message

The 66th IAVS Annual Symposium 2024 will be held in Funchal, in Madeira Island, Portugal, from the 16th to the 20th of September 2024. The theme of the Symposium will be 'From local to global: vegetation patterns across spatial scales in a changing World'. A simultaneous joint event, the 32nd Conference of the IAVS Working Group European Vegetation Survey will also take place there, from the 16th to the 20th of September 2024. Some events will be shared between both meetings, namely some parallel sessions, the mid-symposium excursion, and some social events. The theme of the EVS conference will be 'Vegetation of sea, oceanic and ecological islands of Europe'.

Madeira is a large island in the NE Atlantic Ocean about 1000 Km SW of mainland Europe and it is a beautiful natural and historical setting: laurel forest, endemic vegetation, and the city of Funchal.

The symposium and conference are being organised by a group of Portuguese, Spanish, French and Ukraine IAVS members working for long in the islands of Macaronesia, the group of Azores, Madeira, Salvage, the Canaries and Cape Verde archipelagos. The IAVS symposium and EVS conference will be hosted, primarily, by the University of Madeira (Portugal), in association with the universities of Porto (Portugal), Lisbon (Portugal), Bilbao (Spain), Azores (Portugal), La Laguna (Spain) and Occidental Brittany (Brest, France); the National Institute of Agrarian and Veterinarian Research (Portugal), the Garajonay National Park (Spain), the National Academy of Sciences, Kyiv, Ukraine and La Orotava Botanical Garden (Spain).

We, the organizers, chose the theme of vegetation change assessment in multiple space and time scales because of the impending need of Vegetation Science to actively contribute to keeping and restoring of Earth's ecosystems.

At the same time, Madeira has a large stretch of well-preserved relict laurel forest of Macaronesia, the Macaronesian laurisilva. Such forest is the best preserved heir of the subtropical forests around the paleo-ocean Thetys (the ancestor of the Medieteranean Sea). Although a few scattered elements of the Thethysian geoflora might be still found in the Mediterranean mainland, for the most, they were later destroyed by several global geological events (e.g., Messinian salinity crisis, the Pleistocene glaciations). In turn, such events did not reach Macaronesian islands and, thus, remnants of thethysian laurel forest survived. Contemporary laurel forests (macaronesian laurisilvae) include such ancient tertiary elements (paleoendemics) but also a great wealth of neoendemics.

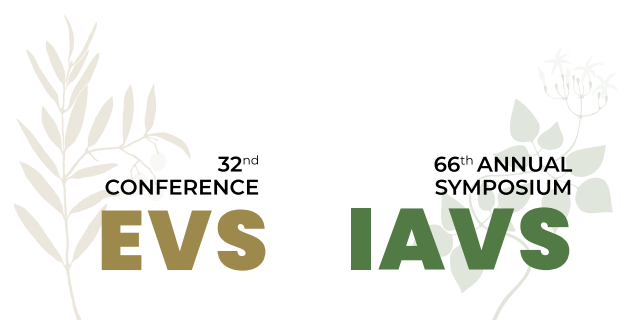
Participants will have the opportunity to approach such unique and overwhelming vegetation in the mid-symposium excursion in Madeira and during the pre- and post-symposium excursions. During the mid-symposium excursion in Madeira mostly Mediterranean and Temperate laurel forest will be visited.

The Pre-Symposium excursion will be in the Madeira Island. The Post-Symposium excursion will take place in the Canary Islands. The extremely beautiful arid volcanic islands of Tenerife and La Gomera will be visited during five days.

We, the Organizing Committee of the 66th IAVS 2024 Symposium and of 32nd EVS Conference, are delighted that many of us, vegetation scientists, can meet once again, this time in Madeira, for fruitful science and companionship celebrations, as usual in these gatherings.

Dear colleagues, be most welcome to Madeira, Portugal!

The Organizing Committee.





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**SCIENTIFIC
PROGRAMME**

Scientific Programme – Sunday 15 / Monday 16

66th ANNUAL SYMPOSIUM IAVS | 32nd EVS CONFERENCE

Sunday 15 (afternoon)			
15:00-17:45	REGISTRATION		
Monday 16 (morning)			
08:00-09:00	REGISTRATION		
09:00-09:30	Opening session		
09:30-10:30	Plenary session 1 (Room Funchal): Javier Loidi Chair: Kazue Fujiwara		
10:30-11:00	Coffee-break		
11:00-13:00	Session 1A. (Room Funchal) Restoration, Conservation and Vegetation Management Chair: Borja Jiménez-Alfaro	Session 1B. (Room Berlim) Historical Vegetation Ecology Chair: Ricardo Guarino	Session 1C. (Room Sidney) Ecoinformatics and Models in Vegetation Science Chair: Irena Axmanova
11:00-11:15	OC1 Marcos Bergmann Carlucci. Leathery or hairy vs. spiny: how are the woody plants in forest-grassland ecotone communities across environmental gradients in southern Brazil?	OC9 Marta Gaia Sperandi. VegTrends: assessing long-term trends in European vegetation and evaluating protected area effectiveness	OC17 Enrico Tordoni. The Hitchhiker's Guide to trait imputation: empirical insights from vascular plants
11:15-11:30	OC2 Mária Šibíková. Train your Community: Building an Online Database of Habitat Polygons for Satellite-based Habitat Identification	OC10 Martin Diekmann. Vegetation changes on a North Sea island over four decades – imprints of neophytes and climate change	OC18 Fabio Attorre. Classifying and Mapping third-level EUNIS habitats at fine scale in the Lazio region, Italy
11:30-11:45	OC3 Monika Janišová. Grassland Research and Conservation: An Interdisciplinary Journey	OC12 Sandra Mesquita. From Durer's Large Piece of Turf to 20 th century vegetation profiles: plant communities in botanical representation	OC19 Francesco Maria Sabatini. Global decoupling of functional and phylogenetic diversity in plant communities
11:45-12:00	OC4 Nadiia Skobel. Protected vascular plant species and habitats of the Resolution 6 and 4 of the Bern Convention at the old cemeteries of the Right-Bank of Dnipro Gras Steppe District (southern Ukraine)	OC11 Miguel Menezes de Sequeira. Historical development of vegetation belt models in Madeira Island following Humboldt & Bonpland's 'Essai' (1807), their interpretation and corollaries for landscape analysis and biodiversity conservation	OC20 Francesco Petruzzellis. Tracking plant functional composition combining Sentinel-2 and the Trait Probability Density approach
12:00-12:15	OC5 Norbert Hölzel. Restoration of a species-rich flood meadow by topsoil removal and green hay transfer – Lessons from 25 years of vegetation monitoring	OC13 Steffi Heinrichs. 46 years of vegetation succession after a forest fire in Scots Pine plantations - Deciduous forests are making a comeback	OC21 Soghra Ramzi.★ IranVeg vegetation database; with a phytosociological survey synthesis of Iran
12:15-12:30	OC6 Ole Vetaas. Restoring heathlands after clear-felling of Spruce plantations on two neighbouring islands in western Norway	OC14 Víctor González-García.★ Vegetation of NW-Iberia from LGM to present based on modern climatic analogues	OC22 Hamid Gholizadeh. How do relict vegetation of Hyrcanian forests respond to climate change?
12:30-12:45	OC7 Pedro Augusto Thomas. Burn them all? Use and efficiency of fire as a tool for grassland restoration	OC15 Yuna Le Gouëf. Community thermophilisation rate within riparian forests is faster than expected.	OC23 Jake Eckersley. Separating leaf and plant area index through semi-supervised hemispheric photography classification
12:45-13:00	OC8 Péter Török. Alkaline and loess grasslands with contrasting richness and biomass patterns are not separated on the CSR strategy spectrum	OC16 Guillaume Decocq. Foiling suspected invaders with their DNA: the cold case " <i>Vinca minor</i> L." (re)opened	OC24 Denys Vynokurov. Changes in multifaceted biodiversity across spatial scales and grassland types
13:00-14:00	Lunch		

★ IAVS Young Scientists Awards

Scientific Programme – Monday 16

Monday 16 (afternoon)			
14:00-15:00	Plenary session 2 (Room Funchal): Jonay Cubas Chair: Monika Janisova		
15:00-15:30	Coffee-break		
15:30-17:45	Session 2A. (Room Funchal) Restoration, Conservation and Vegetation Management Chair: Andraž Čarni	Session 2B. (Room Berlim) Historical Vegetation Ecology Chair: Susan Wiser	Session 2C. (Room Sidney) Ecoinformatics and Models in Vegetation Science Chair: Manuele Bazzichetto
15:30-15:45	OC25 Carsten Hobohm. Fire ecology, perception and open questions	OC34 Carlos Vila-Viçosa. A New Checklist of The Western Iberian Oak Forests and tall-shrub communities (<i>Quercus</i> L.)	OC43 Jan Divíšek. Estimating species richness in a common landscape: insights from stratified random sampling in Czech grasslands
15:45-16:00	OC26 Elisabeth Prangel. Recovery of grassland functioning and biodiversity after large-scale restorations	OC35 Friedemann Von Lampe.★ 60 years of macrophyte vegetation changes in standing waters of Northwest Germany	OC44 Jorge González Le Barbier.★ Predicting the potential area of occupancy of habitat types and their successional stages at a biogeographical scale
16:00-16:15	OC27 Francisca C. Aguiar. Predicting changes of aquatic flora to guide restoration efforts in human-disturbed rivers	OC36 Gabriele Midolo. Plant species ecological preferences reflect two-century-old land-use in Central European herbaceous vegetation.	OC45 Jose Manuel Alvarez Martinez. Artificial intelligence for habitat mapping: evaluating strengths and weaknesses at a regional scale
16:15-16:30	OC28 Leticia Pereira Giacom. Cattle grazing impacts belowground plant community diversity in tropical savannas	OC37 Gianmaria Bonari. Grasslands resurvey along an elevation gradient of the Alps	OC46 Miriam García.★ Contribution of the urban ruderal vegetation to N, P and S cycles
16:30-16:45	OC29 Greta La Bella.★ Predicting changes in ecosystem functioning in coastal dunes using long-term census data	OC38 Jalil Noroozi. Classification of subalpine tall herb Umbelliferous vegetation of the Iranian Plateau	OC48 Pier Paolo Roggero. Land surface phenology applications to Mediterranean permanent grasslands vegetation
16:45-17:00	OC30 Grzegorz Swacha. Varying patterns of plant composition and diversity in urban and rural grasslands	OC39 Jürgen Dengler. Biodiversity and composition change in Swiss grasslands over more than one century	OC49 Simone De Santis. Paleobotanical data enhances past predicted distribution of an evergreen woody genus (<i>Arbutus</i> L.)
17:00-17:15	OC31 Heloiza Lourenço Zironi.★ A summary on seed-focused regeneration strategies in the Cerrado	OC40 Kacper Foremnik.★ Natural disturbances modulate changes in temperate forest vegetation over the last century	OC50 Clement Cupido. Unveiling Sustainability: Insights from Vegetation Assessment in South African Rangelands
17:15-17:30	OC32 Imke C. Smit.★ Drivers of biotic interactions in global drylands	OC41 Karol Ujházy. Accelerating change of temperate forest vegetation in the Carpathians over 55 years	
17:30-17:45	OC33 Jaan Liira. Functional succession of field margins and the role of sub-ordinate species	OC42 Linda Mikulenкова. Historical Development of an Alpine Meadow – There and Back	
17:45-19:00	Poster session P1. Future ecosystems climate and land change; Ecoinformatics and Models in Vegetation Science; Biogeography and Evolution in Island ecosystems Chairs: Sandra Mesquita, Zoltan Botta-Dukat, Ricarda Pätsch		
17:45-19:00	IAVS Asian Section Meeting (Room Tóquio)	Ecoinformatics Working Group (Room Caracas)	IAVS Young Scientists Working Group (Room Funchal)
19:30-21:00	Welcome Reception		

Scientific Programme – Tuesday 17

Tuesday 17 (morning)				
09:30-10:30	Plenary session 3 (Room Funchal): Ladislav Mucina Chair: Robert Peet			
10:30-11:00	Coffee-break			
11:00-13:00	Session 3A. (Room Funchal) Restoration, Conservation and Vegetation Management Chair: Anna Kuzemko	Session 3B. (Room Berlim) Future Ecosystems Climate and Land Change Chair: Denys Vynokurov	Session 3C. (Room Sidney) Alien Plant Species: Invasion Trends and Impacts Chair: Fabio Attorre	Special Session 3D. (Room Caracas) Dark diversity Chair: Meelis Pärtel
11:00-11:15	OC51 Scott Franklin. Sagebrush Restoration and the Question of Seed Provenance	OC59 Manuele Bazzichetto. Biodiversity-mediated mechanisms of ecosystem's response to compound dry-hot extreme events	OC67 Adrián Lázaro-Lobo.★ Understanding invasion patterns at the ecoregional scale	OC74 Meelis Pärtel. DarkDivNet explores the dark diversity of plant communities at the global scale
11:15-11:30	OC52 Sle-Gee Lee. Literature review on seed dispersal by wind to enhance natural regeneration practices	OC60 Marcelo Sternberg. Climate Futures Now: Experimentally Simulating the Impact of Drought on Mediterranean Ecosystems	OC69 Giacomo Trotta.★ Wildfire severity triggers alien plant invasion in temperate Karst forest	OC75 Riin Tamme. Observed and dark diversity patterns in different ecosystems
11:30-11:45	OC53 Sofia Campana. Land uses and nutrients differently modify plant community temporal and spatial stabilities	OC61 Markus Neupert. Intraspecific plant trait plasticity in estuarine constraints	OC70 Hana Skokanová. Identifying potential habitats for restoration in the Central European Green Belt	OC76 Junichi Fujinuma. Global patterns of vascular plant dark diversity affinity
11:45-12:00	OC54 Sophie Vermeersch. Are peat translocations beneficial to the development of alder carrs (European habitat)	OC62 Martin Kopecký. Atmospheric water demand affects forest plant communities more than soil water supply	OC71 Helena Streit. The biogeography of alien plants in the Río de la Plata grasslands	OC77 Carlos Perez Carmona. Functional Insights into Global Dark Diversity: Findings from DarkDivNet.
12:00-12:15	OC55 Thuy Hang Le.★ Micro-scale plant diversity in traditional wood pastures	OC63 Nicola Pavanetto. Macroecology of abiotic stress tolerance in woody plants of the Northern Hemisphere	OC72 Irena Axmanova. Alien plants in Europe - a new open dataset in the FloraVeg.EU	
12:15-12:30	OC56 Toby Elliott. Influence of a virulent soil pathogen on understorey sapling population dynamics.	OC64 Niv Demalach. Revising the global biogeography of annual and perennial plants	OC73 Marta Czarniecka-Wiera. Long-term changes in plant species composition during Solidago invaded site restoration	
12:30-12:45	OC57 Vigdis Vandvik. Modelling Ecological state and Condition Maps to support knowledge-based decision-making in Area management and spatial Planning (ECoMAP)	OC65 Pablo Manzano. Fine-scale delimitation of Open Ecosystems through vegetation growth indexes: a proposal		
12:45-13:00	OC58 Virve Söber. Insect-pollinated plants are first to disappear from overgrowing grasslands	OC66 Sara Sánchez-Carmona.★ Plant diversity patterns along woody plant encroachment gradient in sub-mediterranean grasslands		
13:00-14:00	Lunch			

Scientific Programme – Tuesday 17

Tuesday 17 (afternoon)		
14:00-15:00	Plenary session 4 (Room Funchal) EVS: Arnoldo Santos Chair: Alicia Acosta	
15:00-15:30	Coffee-break	
15:30-17:45	Session 4A. (Room Funchal) Restoration, Conservation and Vegetation Management Chair: Helena Streit	Session 4B. (Room Berlim) Future Ecosystems Climate and Land Change Chair: Felicia Fischer
	Session 4C. (Room Sidney) European Vegetation Survey Chair: Joop Schaminée	
15:30-15:45	OC78 Jana Müllerová. Wildfire as an interplay between water deficiency, manipulated tree species composition and bark beetle. A remote sensing approach	OC86 Giacomo Puglielli. Functional constraints to abiotic stress polytolerance in Northern Hemisphere woody plants
	OC95 Alessandro Silvestre Gristina. Species distribution modelling to identify habitat islands for narrow endemics climate relicts: an update	
15:45-16:00	OC79 Julius Tjelele. Ecology and management of woody plant encroachment: a paradigm shift	OC87 György Kröel-Dulay. Grassland recovery after an extreme drought: what long-term monitoring and field experiments can teach us
	OC96 Eva Papastergiadou. Freshwater macrophytes of Mediterranean rivers. Results from an extensive river monitoring campaign	
16:00-16:15	OC80 Kazue Fujiwara. Large-Scale Restoration of Natural Forests based on the Miyawaki Method	OC88 Irati Sanz-Zubizarreta.★ How do changes in hydrological regime affect forest structure in riparian ecosystems?
	OC97 Jacopo Iaria.★ Reviewing 30 years of biases, analysis, and trends in vegetation resurvey studies	
16:15-16:30	OC81 László Erdős. Tree plantations have low conservation value despite high taxonomic and functional diversity	OC89 Jérémy Bacon.★ Plant functional diversity through space and time: what happened in the shallow ponds of the Iles Kerguelen for five years?
	OC98 Léo Rasse. Evaluation of remote sensing methods for the monitoring of submerged aquatic vegetation	
16:30-16:45	OC82 Leopoldo De Simone. Measuring canopy structural complexity through UAS-based photogrammetric point clouds to assess its effects on understory vegetation of riparian forests	OC90 Jozef Šibík. Revealing the Hidden Tapestry: Exploring Biodiversity Interactions in European Forests Under Different Management
	OC99 Luciano Ludovico Maria De Benedictis.★ A fully mapped community approach to unveil the effects of biotic interactions	
16:45-17:00	OC83 Lucia Doni. From Taxonomic, through evolution to functionality: Plant communities in alpine pastures	OC91 Jules Segrestin. Biodiversity loss disrupts seasonal carbon dynamics in a species-rich temperate grassland
	OC100 Remigiusz Pielech. Biases in species richness data in large phytosociological databases	
17:00-17:15	OC85 Nicolas De Brabandère. Report on the evolution of 6 Miyawaki forests in Belgium	OC94 Francisco I. Pugnaire. Microbial effects on holm oak (<i>Quercus ilex</i>) germination
	OC101 Silvia Cascone. Coastal Dunes in the Northwest of Ireland: Analysing Vegetation and Functional Trends	
17:15-17:30		OC102 Svitlana Iemelianova. Syntaxonomical overview of the <i>Crypsitea aculeatae</i> class in Europe
17:30-17:45		
17:45-19:00	Poster session P2. European Vegetation Survey; Alien plant species: invasion trends and impacts; Historical Vegetation Ecology; Human disturbance in islands; Restoration, conservation, and vegetation management (I) Chairs: Gianmaria Bonari, Jozef Sibik, Carlos Vila-Viçosa	
17:45-19:00	IAVS Latin America and Caribbean Section Meeting (Room Tóquio)	VCS Editorial Meeting (Room Caracas)
	S-Plot Working Group (Room Caracas)	
19:30-21:00	IAVS Council Meeting (Room Tóquio)	

Scientific Programme – Wednesday 18

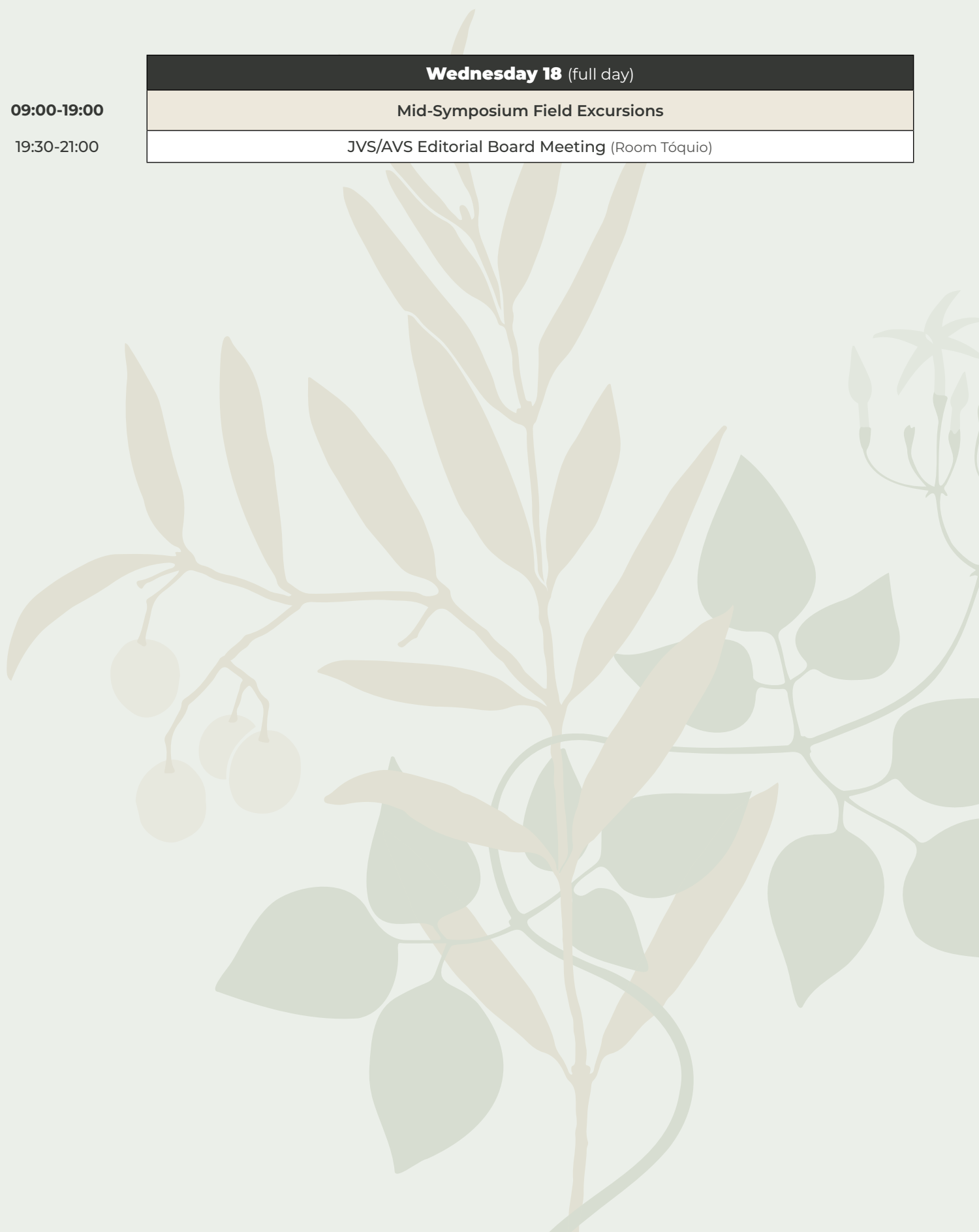
09:00-19:00

Wednesday 18 (full day)

Mid-Symposium Field Excursions

19:30-21:00

JVS/AVS Editorial Board Meeting (Room Tóquio)



Scientific Programme – Thursday 19

Thursday 19 (morning)			
09:30-10:30	Plenary session 5 (Room Funchal): Reginald Tang Guuroh Chair: Viktoria Wagner		
10:30-11:00	Coffee-break		
11:00-13:00	Session 5A. (Room Funchal) Future Ecosystems Climate and Land Change Chair: Jürgen Dengler	Session 5B. (Room Berlim) Restoration, Conservation and Vegetation Management Chair: Francisca Aguiar	Session 5C. (Room Sidney) Biogeography and Evolution in Island Ecosystems Chair: Alessandro Chiarucci
11:00-11:15	OC103 Aleš Lisner. Changes in intra-/interspecific competition drive stability and asynchrony of dominant species	OC111 Alireza Naqinezhad. Trends of globally-traded CITES-listed plants across space and time, implication for biodiversity conservation	OC119 Alessandro Chiarucci. Protected area expansion to cover the plant community gradients across Mediterranean islands
11:15-11:30	OC104 Aud Helen Halbritter. Climate change impacts on biodiversity and multifunctionality across a boreal landscape	OC112 Maren Schüle.★ Land-use legacies and post-fire forest management drive recolonization patterns of ground vegetation	OC120 Felícia M. Fischer. Can we predict synchrony by functional traits and phylogeny in plant communities?
11:30-11:45	OC105 Tomas Herben. How perennials exploit vegetation season in temperate climates	OC113 María Lucrecia Lipoma. No general support of functional diversity enhancing resilience across terrestrial plant communities	OC121 Giuseppe Bazan. Sexual composition of <i>Chamaerops humilis</i> L. populations in the Mediterranean coastal vegetation of Sicily
11:45-12:00	OC106 Daniela Hoss. Species loss and emergent metacommunity dynamics	OC114 Mariasole Calbi. Assessing dunes and salt marshes conservation status through coupled field and remote sensing approaches	OC122 Glenda Mendieta Leiva. Drivers of epiphyte diversity in the Neotropics
12:00-12:15	OC107 Diego Trindade.★ Integrating species pools and functional redundancy to assess stability in plant communities	OC115 Mercedes Valerio.★ Twenty-year effect of sewage-sludge fertilization on vegetation dynamics in a Mediterranean grassland	OC123 Hang Sun. Characteristics, evolution, and adaptation of the "Sky Island" flora on Qinghai-Tibet Plateau
12:15-12:30	OC108 Eva Janíková. Influence of biodiversity loss and environmental factors on shaping plant community competition	OC116 Raelene Crandall. Demographic stability of dominant plant species in frequently burned old-growth savannas	OC124 Fábio Attorre. Analysis of the facilitative effect of nurse shrubs on the regeneration of endangered endemic tree species in Socotra Island (Yemen)
12:30-12:45	OC109 Tereza Švancárová.★ Can traits help us predicting ecosystem functions from species composition?	OC117 Riccardo Testolin. Roadless areas for nature protection in the European Union	
12:45-13:00	OC110 Duccio Rocchini. Plants are colorful: allowing colorblind people to interpret remotely-sensed vegetation variables	OC118 Rut Sánchez De Dios. Effect of forest management in the taxonomic and functional diversity of Mediterranean Scot pine understory plant communities	
13:00-14:00	Lunch		

Scientific Programme – Thursday 19

Thursday 19 (afternoon)		
14:00-15:00	Plenary session 6 (Room Funchal) EVS: Frederic Bioret Chair: Elgene Box	
15:00-15:30	Coffee-break	
15:30-17:45	Session 6A. (Room Funchal) European Vegetation Survey Chair: Idoia Biurrun	Session 6B. (Room Berlim) Restoration, Conservation and Vegetation Management Chair: Corrado Marceno
		Session 6C. (Room Sidney) Biogeography and Evolution in Island Ecosystems Chair: Glenda Mendieta-Leiva
15:30-15:45	OC126 Wolfgang Willner. Phytosociological revision of the dry and semi-dry grasslands of the Eastern Alps	OC135 Andra Dalbeto. Impact of Water Table Depth on Cerrado Wetland Plant Communities
15:45-16:00	OC127 Alessandra Pollo.★ Monitoring of vulnerable habitats to climate change in the Western Alps	OC136 Anna Kuzemko. Plant cover of the former Kakhovka Reservoir, Ukraine
16:00-16:15	OC128 Borja Jiménez-Alfaro. Measuring water stress in alpine ecosystems	OC137 Arianna Ferrara. Unraveling short-term changes in taxonomic and functional diversity within an old-growth forest
16:15-16:30	OC129 Clara Espinosa Del Alba.★ Seedling functional traits along alpine environmental gradients	OC138 Arthur Cupertino.★ Challenges in the monitoring of floodplain vegetation diversity with remote sensing
16:30-16:45	OC130 Flavia Landucci. Nomenclature revision and distribution maps of the syntaxa included in the orders <i>Phragmitetalia</i> and <i>Bolboschoenetalia maritimi</i> in Europe	OC139 Béla Tóthmérész. The importance of pristine grassland fragments supporting and/or restoring grassland biodiversity
16:45-17:00	OC131 Carsten Hobohm. European flora revisited	OC140 Charl Clarke. <i>Crinum bulbispermum</i> , a Medicinal Geophyte with Phytostabilization Properties in Metal-Enriched Mine Tailings
17:00-17:15	OC132 Milan Chytrý. Recent developments in the standard European vegetation classification	OC141 Daniel Gebler. Development and diversity of macrophytes in small urban freshwater ecosystems
17:15-17:30	OC133 Nina Fahs. Biogeography of angiosperm parasites in Europe	OC142 Małgorzata Raduła. Plant functional composition and ecological niche distribution across urban grasslands
17:30-17:45	OC134 Rossen Tzonev. Relict forest communities of the Balkan endemic <i>Aesculus hippocastanum</i>	
17:45-19:00	Poster session P3. Restoration, conservation, and vegetation management (II) Chairs: Miguel Sequeira, Manuela Gouveia, Guillaume Decocq	
17:45-19:00	EVS Business Meeting (Room Tóquio)	GrassPlot Working Group (Room Tóquio)
19:30-21:00	Symposium Dinner	

Scientific Programme – Friday 20

Friday 20 (full day)			
09:30-10:30	Plenary session 7 (Room Funchal): Alessandra Fidelis Chair: Martin Diekmann		
10:30-11:00	Coffee-break		
11:00-13:00	Session 7A. (Room Funchal) Alien Plant Species: Invasion Trends and Impacts Chair: Gabriella Damasceno	Session 7B. (Room Berlim) Molecular Approaches for Plant Communities Chair: Flavia Landucci	Session 7C. (Room Sidney) Ecoinformatics and Models in Vegetation Science Chair: Hang Sun
11:00-11:15	OC151 Judit Sonkoly. Nurseries and garden centres as hubs of alien plant invasions	OC158 Carlos Vila-Viçosa. Contributions from Natural History and Biogeography to the Evolution of the Iberian white Oak Forests (<i>Quercus</i> L. Sect. <i>Quercus</i>)	OC164 Valério Pillar. Plant community assembly emerging from environmental filtering and community feedback effects
11:15-11:30	OC152 Juliano Zardetto.★ The effects of white-poppinac on regenerating seasonal forests propagate across spatial scales	OC159 Mary Carmen Cobo. Role of facilitation/competition among Mediterranean plant life forms in soil-vegetation spatial pattern development under an increasing aridity	OC165 Zoltán Botta-Dukát. Confirmatory Factor Analysis: a new way to explore correlation structure of traits
11:30-11:45	OC154 Patricia Elizabeth Diaz Cando. The effect of <i>Sporobolus cryptandrus</i> litter versus native litter on grassland species	OC160 Jalil Noroozi. Population response of mountain species to past climate change is independent from their elevational zone	OC166 Eleonora Beccari.★ Plant Size: Unifying Above and Belowground Dimensions
11:45-12:00	OC155 Soizig Le Stradic. Variation in root functional traits and high root biomass allow African grass species to invade tropical open savannas in Brazil	OC162 Maral Bashirzadeh. Space-dependent phylogenetic signals in Palaeartic grasslands, role of space on phylogenetic diversity	OC167 Elham Ebrahimi.★ Shadows of the Past: How Historical Climates Sculpt Contemporary Plant Patterns
12:00-12:15	OC156 Viktoria Wawagner. Propagule pressure and soil disturbance diminish plant community resistance to invasion across habitat types	OC163 Szymura Tomasz. Genetic structure of common grassland species population at landscape scale and its consequence for grassland conservation	OC168 Teja Kattenborn. Deadtrees. earth - an open, dynamic database for accessing, contributing, analyzing, and visualizing remote sensing-based tree mortality data
12:15-12:30	OC157 Zdenka Lososová. Drivers of biotic invasion within and among cities in Europe	OC47 Naveen Babu Kanda.★ Tree-diversity patterns in a global biodiversity hotspot: Remote sensing and modeling approach	OC169 Tristan Ubaldi.★ Reassembling tree communities under anthropogenic climate change via assisted tree migration
12:30-12:45	OC171 David Schellenberger Costa. A systematic comparison of global checklists of vascular plants		
12:45-14:00	Lunch		
14:00-15:00	Plenary session 8 (Room Funchal): Pierre Legendre Chair: Milan Chytrý		
15:00-15:30	Coffee-break		
15:30-16:30	IAVS General Assembly (Room Funchal)		
16:30-17:00	Closing Ceremony (Room Funchal)		
17:00-17:45	Phytosociological Nomenclature Working Group (Room Tóquio)		

Posters List – Monday 16

Poster Session P1

P1-A | Chair: **Sandra Mesquita**

Biogeography and Evolution in Island Ecosystems

- 1 **Balázs Deák.** Environmental heterogeneity drives plant trait distributions in terrestrial habitat islands
 - 2 **Michele Mugnai.**★ Revisiting the small Mediterranean island of Pianosa (Italy)
 - 3 **Nenad Jasprica.** The review of the vegetation research on Eastern Adriatic islands (Croatia)
 - 4 **Francesco Boscutti.** Tracing vegetation dynamics on river islands by remote sensing
 - 5 **Catarina Gomes.** *Musschia wollastonii* Lowe (Campanulaceae): mixed-mating system and floral visitors communities do not corroborate outcrossing ornitophilous traits
 - 6 **Miguel Menezes de Sequeira.**★ Comments on the morphology and taxonomy of *Musschia aurea* (L.f.) Dumort. (Campanulaceae) an endemic species of the Madeira archipelago (Portugal)
 - 7 **Manuela Gouveia.** Genetic diversity and molecular taxonomy of *Andryala* (Asteraceae) based on ISSR markers
 - 8 **Carlos A. Góis-Marques.** How old is the presence of the Canary pine forests in the Canary Islands?
 - 116 **Manuela Winkler.** Drivers of changes in plant species diversity on Europe's mountain tops
- #### Future Ecosystems Climate and Land Change
- 9 **Slendy Rodriguez Alarcon.**★ Beyond drought: intraspecific variability in fine-root traits outpaces aboveground traits in herbaceous
 - 10 **Marco Chiminazzo.**★ Native vs. planted pastures: how is grazing affecting tropical savannas?

P1-B | Chair: **Zoltan Botta-Dukat**

Future Ecosystems Climate and Land Change

- 11 **Neuenkamp Lena.** The effect of plant functional diversity on dryland plant-soil interactions and functioning
 - 12 **Marie Vymazalová.** Drought legacies in the Central European mountains. Will subalpine grasslands disappear there?
 - 13 **Jules Segrestin.** A unified framework for partitioning the drivers of stability of ecological communities
- #### Ecoinformatics and Models in Vegetation Science
- 18 **Toshikazu Matsumura.** Developing automatic conversion system from printings into digital data by object detection
 - 20 **Gabriella Damasceno.** sPlotOpenR: an R package for accessing and working with the open versions of sPlot
 - 21 **Michela Perrone.** Chronicles of Spectral Diversity: Unraveling Plant Alpha and Beta Diversity in Grasslands through a Multitemporal Lens
 - 22 **Domas Uogintas.** KELVEG - the database of roadside vegetation in Lithuania
 - 23 **Aljaž Jakob.** 3D Terrestrial Laser Scanning for modelling and mapping of the distribution of *Paeonia officinalis*: case study of dolines on Kras Plateau
 - 24 **Jürgen Dengler.** Ecological Indicator Values for Europe (EIVE): version 1.5 and comparative test
 - 25 **Iwona Dembicz.** Macroecological modelling of multi-scale alpha diversity patterns of Palaeartic grasslands

P1-C | Chair: **Ricarda Pätsch**

Future Ecosystems Climate and Land Change

- 14 **Simone Eusebio Bergò.**★ Resurvey of grasslands vegetation in the Western Italian Alps
- 15 **Mária Šibíková.** Carbon Sequestration Showdown: Comparing Ecosystem Services in Native and Alien-Dominated Forest Habitats
- 16 **Oksana Tyshchenko.** Morphodynamics and Vegetation Changes in Azov-Type Spits Using Earth Remote Sensing Data
- 26 **Riccardo Guarino.** Functional and biological diversity of wild edible plants in Italy
- 27 **Olha Chusova.** Scale-dependency of grasslands niche dimensions varies with the harshness of environmental conditions
- 30 **Halime Moradi.** Dependency of seedling establishment on safe sites in the Alborz Mountains, N. Iran
- 31 **Sebastian Świercz.** Taxonomic and functional diversity of temperate grasslands affected by extreme climate events
- 33 **Sebastian Świercz.** How does passive warming affect the taxonomic diversity of semi-natural grasslands?
- 35 **Jan Wild.** Microclimate affects forest recovery pattern after stand-replacing bark beetle disturbance
- 36 **Ludovica Oddi.** Consequences of ten-year abandonment in a subalpine grassland: soil and litter decomposition changes
- 37 **Per-Ola Hedwall.** Two shades of green: tree species governs the drought effects on bilberry

Posters List – Tuesday 17

Poster Session P2

P2-A | Chair: Gianmaria Bonari

European Vegetation Survey

- 38 **Károly Penksza.** Endemic *Festuca* species of the sandy area in the Carpathian Basin
- 39 **Svitlana Iemelianova.** Database of Annual Wetland Vegetation of Ukraine
- 40 **Thomas Leclere.** Phylogenetic patterns among European threatened plant species
- 41 **Michele Di Musciano.** Abiotic factors shape plant co-occurrence affinities
- 42 **Liubov Borsukevych.** Classification of the floodplain forests and shrubs of the Dnieper river (Ukraine)
- 43 **Friedemann Von Lampe.**★ How gradients of climate and soil determine Mediterranean annual-rich dryland vegetation
- 44 **Dariia Borovnyk.** Benchmarks of species richness in Palaeartic grassland classes
- 45 **Andraž Čarni.** Classification of small-scale forest communities in geomorphological diverse landscapes of the Kras plateau
- 46 **Urban Šilc.** *Exsertotheco crispae-Ramondion serbicae* new alliance of chasmophytic communities of limestone crevices in deep continental gorges in submontane to montane altitudinal zone
- 47 **Rossen Tzonev.** Vegetation types and habitats with participation of local endemic plant species – a comparison between the silicate and carbonate parts of Northern Pirin Mts., Bulgaria
- 49 **Michaela Vítková.** Syntaxonomy of *Robinia pseudoacacia* stands across Europe: a revision, review, and reinterpretation
- 50 **Kalina Pachedjieva.** Host range and community preferences of *Cuscuta* species in Bulgaria
- 51 **Urban Šilc.** Ecological niche breadth changes along the continental gradient in European weed species

P2-B | Chair: Jozef Sibik

European Vegetation Survey

- 52 **Andrej Rozman.** Vegetation dynamics in the lowland old-growth forest Krakovo (Slovenia) from 1978 to 2023: A study of species composition and ecological changes
- 53 **Filip Kůzmič.** Geographic patterns in alpha diversity of European annual weed and ruderal vegetation
- 54 **Laure Sirvent.** An overview of Causse du Larzac grasslands (France)
- 55 **Vedran Šegota.** Sand dune and salt marsh vegetation diversity along the soil moisture and salinity gradients: Example from the Eastern Adriatic (Croatia)

Historical Vegetation Ecology

- 56 **Simona Sarmati.** Changes in biodiversity in coastal dunes after forty years
- 57 **Jan Divíšek.** The effect of long-term continuous habitat representation on current plant species richness in Europe
- 58 **Deborah Closset.** Do polemoforest plant communities remember pre-WWI land-use ?
- 59 **Sandra Mesquita.** Plant lists and altitudinal belts as 19th century approaches to vegetation science: examples from Madeira Island

Restoration, Conservation and Vegetation Management

- 60 **Lauma Keire.** Enhancing plant species diversity in urban lawns
- 61 **Mariana Prokopuk.** Satellite remote sensing of macrophytes and regional assessment of vulnerable aquatic habitats
- 62 **Orsolya Valkó.** The role of rodents and birds as ecosystem engineers in Eurasian grasslands
- 64 **Yuliia Rozenblit.**★ Assessing grazing intensity effects on phytodiversity in Podillia's meadow-steppe grasslands
- 65 **Lesya Zub.** Assessment of the environmental impact of hostilities on continental endangered habitats

P2-C | Chair: Carlos Vila-Viçosa

Human Disturbance In Islands

- 66 **Maria Câmara.** First record of *Heliethrips haemorrhoidalis* (Bouché, 1833) (Thysanoptera: Thripidae) on *Musschia aurea* (L.f.) Dumort. (Campanulaceae), an endemic species of the Madeira archipelago (Portugal)

Molecular Approaches for Plant Communities

- 67 **Remigiusz Pielech.** Patterns of genetic diversity of vascular plants in riparian forests

Alien Plant Species: Invasion Trends and Impacts

- 68 **Monika Myśliwy.** Effects of habitat condition on native and invasive *Impatiens* species fitness components
- 69 **Michiro Fujihara.** The stand-level influence of wild boars on an invasive bamboo forest
- 70 **Leticia Giacom.**★ Invasive grasses can lead to legacy effects through changes in belowground community
- 71 **Bruno Paganeli.**★ Where current and future alien species might come from?
- 72 **Michaela Vítková.** Monitoring native and alien species spread to alpine tundra: botanical research and airborne technology combined to assess conservation risk
- 73 **Greta La Bella.**★ Unravelling the effects of global change and native community functional structure on the spread of non-native species along mountain roads
- 74 **Valerijus Rašomavičius.** Methodology and key findings of the alien and invasive plant inventory: the case of Lithuania
- 75 **Marta Czarniecka-Wiera.** The importance of *Lupinus polyphyllus* for the biodiversity and productivity of grasslands
- 76 **Attila Lengyel.** Fine-scale dominance of invasive herbs does not alter landscape-scale diversity patterns of sandy old-fields
- 77 **Felipe Domínguez Lozano.** Urban native and non native plants in seminatural habitats: a trait and a rarity perspective

Posters List – Thursday 19

Poster Session P3

P3-A | Chair: Miguel Sequeira

Restoration, Conservation and Vegetation Management

- 78 **Raissa Iana Leite Jardim.**★ Woody encroachment viewed through trait integration in forest-grassland mosaics from southern Brazil
- 79 **Lyubov Felbaba-Klushyna.** Endemic communities of lilac alder in Carpathians: current status, prospects for conservation
- 80 **Tünde Irén Szabó-Szöllösi.** Seed germination of two sandy grassland *Festuca* species in various soil mixtures
- 81 **Jennifer Fill.** For plants under fire, it's all about survival
- 82 **Lyubov Felbaba-Klushyna.** Rare phytocoenofound of Ukraine
- 83 **Iryna Rabyk.** Peculiarities of bryophyte communities of the Ukrainian part Eastern Carpathians
- 84 **Katarína Hegedúšová Vantarová.** Changes in diversity of European and national important grassland vegetation in Slovakia
- 85 **Iveta Škodová.** Long-term impact of restoration management on dry grassland habitats
- 86 **Clement Cupido.** Botanical Conservation and Restoration Efforts in the Gouritz Cluster Biosphere Reserve
- 87 **Célia Bairos.** Georeferencing and mapping “Monte Palace Madeira – Tropical Garden” botanical collection: first results
- 88 **Anaclara Guido.** Cattle dung contributes restore degraded grasslands, but caution on invasive species transfer
- 89 **Magdalena Szymura.** Urban grasslands’ patches – islands in the cityscape
- 90 **Cecilia Ríos Mendaro.**★ Old-fields restoration in Uruguayan grasslands: the resilience of the native community

P3-B | Chair: Manuela Gouveia

- 91 **Dariia Borovyk.** Impact of mowing intensity on plant diversity of Central European broad-leaved grasslands
- 92 **Liubov Borsukevych.** Anthropogenic changes in the vegetation of Ermakiv Island (Danube Delta, Ukraine)
- 93 **Jokin Belmonte Torres.** Forest understory on the edge: unraveling diversity drivers in mesic-oak forests
- 94 **Vladimír Nemček.** Symphony of the Forest - Vegetation, Bat Activity and Acoustic Diversity
- 95 **Marcos Carlucci.** Natural regeneration enhances ecosystem multifunctionality, but species addition increases it during restoration
- 96 **Elielson Ferreira.** Beta-diversity patterns between adults and juveniles reveal the trajectory of forest expansion
- 97 **Raissa Iana Jardim.**★ Unveiling above- and below-ground ecological strategies underlying woody plant encroachment in grasslands
- 98 **Simona Sarmati.** A complex interplay shapes plant diversity patterns in Mediterranean coastal dunes
- 99 **Polina Dayneko.** Ploughing legacy in traditional Carpathian grasslands
- 100 **Andiswa Finca.** Drought mitigation strategies to promote sustainable livestock production in the grassland and savanna biomes in South Africa
- 101 **Martina Livornese.**★ Monitoring the health of global forest ecosystems
- 102 **Simonetta Bagella.** Unravelling the Biases: A Sardinian Perspective on Taxonomic, Spatial, and Temporal Biases in Vascular Plant Biodiversity Data from GBIF

P3-C | Chair: Guillaume Decocq

- 103 **Laiye Qu.** The plant and soil linkage during vegetation restoration at dump sites of open-pit mine in an alpine region in Inner Mongolia
 - 104 **Tae Kyung Yoon.** Predicting seed Dispersal by wind to support natural regeneration in pine and larch stands
 - 105 **Kacper Foremnik.** Differences in vertical patterns of ungulate browsing among functional groups of trees
 - 106 **Laura Godó.** My Wildflower Garden – A project to support native plant species in residential areas
 - 107 **Daniela Dúbravková.** How management practices shape grassland plant diversity in the Slovak borderland
 - 108 **Natalia Pashkevych.** Demutation of vegetation on industrial sites of sugar mills
 - 109 **Rut Sánchez de Dios.** Differences in functional diversity between recent and ancient forests
 - 110 **Stephni Van Der Merwe.**★ Ecological condition mapping in South Africa – the SBAPP project
 - 111 **Marco Dinis.**★ Towards rewilding: Estimating a restoration potential index for Iberian eucalyptus plantations
 - 112 **Andrea Mcintosh-Buday.** High species richness of sheep-grazed sand pastures is driven by disturbance tolerant and weedy short-lived species
 - 113 **Maria Pilar Rodríguez-Rojo.** Floristic and Functional analysis of Dehesa grasslands under different types of management
 - 114 **Małgorzata Raduła.** Biomass allocation and quality in grassland vegetation
- #### Alien Plant Species: Invasion Trends and Impacts
- 115 **Lado Kutnar.** Resurvey study revealed the proliferation of neophytes in oak forests in Slovenia



Vegetation of sea,
oceanic and ecological
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From local to global:
vegetation patterns
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Funchal, Madeira, Portugal

ABSTRACTS

Edited by Jorge Capelo, Miguel Sequeira & Sandra Mesquita

Plenary Talks

Oral Communications

Posters

Javier Loidi

Emeritus Professor at Universidad del País Vasco / Euskal Herriko Unibertsitatea, Spain



Javier Loidi has been Professor of Botany in the Complutense University of Madrid for 11 years and since 1989, in the Basque Country University for 35. Since 2023 he is Emeritus Professor in the last position. His field of interest is Vegetation Science and Geobotany, specifically vegetation classification and biogeography.

GLOBAL APPROACHES IN VEGETATION CLASSIFICATION

I have been Professor of Botany in the Complutense University of Madrid for 11 years and since 1989, in the Basque Country University for 35. Since 2023 I am Emeritus Professor in the last position. My field of interest is Vegetation Science and Geobotany, specifically vegetation classification and biogeography. Representing the terrestrial ecosystems at the global scale has been one of the most challenging tasks in vegetation science since its beginning. It entails adopting a limited number of synthetic units that can be recognized across the different continents, surpassing the biogeographical context. For this, units have been adopted that fit with the climatic types, such as zonal biomes, because they can be found on different continents. After all, the climate types are also repeated among them. It is important to highlight that, for biomes at a global scale, we do not consider it advisable to incorporate other ecological factors that would lead us to recognize azonal units, no matter how important and widespread they may be. Such factors would be linked to more contingent circumstances, such as human use of the territory (it changes across time and space), or are more linked to territoriality, such as topography or geology. In our opinion, zonal biomes, as entities linked to climate, are the right tool for a primary global scale representation of biodiversity. Therefore, it is necessary to adopt a climatic classification, which, in this case, would be bioclimatic. In another order of things, biogeographic territorial units have a different nature because they incorporate the historical and phylogenetic components of the biota they contain. This is the case of the classic entities of kingdom, region, province, and sector of the biogeographical provincialism. It is important to differentiate both approaches because they are conceptually different.

Keyword: bioclimates, biogeography, biomes, kingdom, region, subbiomes

Jonay Cubas

Professor at La Laguna University, Tenerife, Canary Islands, Spain



STRONG NEGATIVE EFFECT OF INVASIVE HERBIVORES ON ENDEMIC PLANT SPECIES ON OCEANIC ISLANDS. EUROPEAN RABBIT IN THE CANARY ISLANDS.

Oceanic islands constitute one of the largest reservoirs of endemic species and diversity of habitats of the world, but they have not been free from introduction of invasive species.

The invasion of ecosystems by these species is considered the most important cause of biodiversity loss in island ecosystems. Among the invasive species that have had the most successful establishment is the European rabbit (*Oryctolagus cuniculus* L.), responsible for important, even irreversible changes in island ecosystems.

The effects of European rabbit as an invasive species have been studied in different islands of the world, but in the Canary Islands, these studies have focused mainly on data about consumption of specific species and effects on pine forest and high mountain ecosystem of La Palma Island. However, there was a lack of comparative studies among different ecosystems and, studies that would allow understanding the extent of the effect of rabbit in the Canarian ecosystems. Thus, we analyse the abundance and distribution of the European rabbit in different habitats of the Canary Islands, comparing the effectiveness of different methods of density estimation. It analyses the factors that determine variations in rabbit density and the relationships between density and damage to the flora. The impact of rabbits on flora is analysed through direct analysis of damage in different ecosystems and indirect analysis by comparison of exclusion plots with their respective controls.

Thus, this begins by analysing the abundance and distribution of the European rabbit in different habitats of the Canary archipelago, comparing the effectiveness of different density estimation methods. It analyses the factors that determine variations in rabbit density and the relationships between density and damage to flora. The impact of the rabbit on the flora is analysed through the direct analysis of the damage in different ecosystems and the indirect analysis by comparing exclusion plots with their respective controls. This last aspect has been developed especially in the Canarian high mountains, since it is currently the one with the highest proportion of damage. The effect of rabbits on the structure and composition of the vegetation, as well as on soil nutrients, it is analysed using as a model two endemic structuring species that currently follow opposite patterns, “Retama del Teide” (*Spartocytisus supranubius*) and “Rosalito de cumbre” (*Pterocephalus lasiospermus*), using herbivore exclusion plots. In addition, the effects of this aging are evaluated through the analysis of the speed of the decline process of the Teide broom population, through the use of historical aerial images in different periods of time.

Overall, this work offers enough knowledge about the impact of the European rabbit on Canarian ecosystems to implement urgent improvements to control this invasive species in them. This demonstrates the effect of European rabbit as an ecosystem engineers in the Canary Islands, profoundly transforming ecosystems. It also, analyzes for a key species abundant, *S. supranubius*, the speed that can reach this transformation process which leads, in a short period of time, to considered it as a Vulnerable species following the criteria of the Red List of the International Union for Conservation of Nature.

Ladislav Mucina

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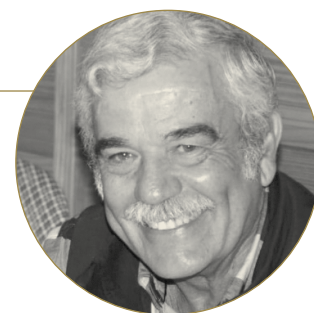
**EX AUSTRALIS SEMPER ALIQUID NOVI: SOUTHERN HEMISPHERE VIEW
OF THE ZONOBIOME SYSTEM**

Biomes are large-scale biotic communities (ecosystems) distinguished by specific ecological functionality and evolutionary origins. They can be studied and delimited using functional variables but also using physiognomic and vegetation-textural surrogates. Biomes are spatially explicit units, and as such, they can be seen as complexes of biotic communities at various hierarchical levels, each of these levels having its characteristic own set of ecological drivers (Mucina 2018, 2023). At least since 1975, the Heinrich Walter's zonobiome system has been known and used as perhaps the most scientifically robust and inspiring approach to explain the diversity of large-scale biotic communities on Earth. It is a bioclimatic approach, recognising the role of climatic factors driving the zonal biome patterns at large scales. It also provides for biomes driven by other factors, such as soils and hydrology, called azonal biomes. The Walter's system claims to be anchored in climato-genetic criteria, yet it falls short to honour this valid intention in several crucial realms, especially in the Southern Hemisphere. Indeed, the Walter's zonobiome system is poorly applicable in the Southern Hemisphere and therefore a new biome system needed to be developed. I call this alternative the Global Hierarchical Biome System (GHBS). This system features four tiers of complexity – zonobiome, global biome, continental biome, and regional biome. It is also more detailed than the nine-member Walter's zonobiome system and, most importantly, it is consequent in using clearly define climato-genetic criteria. The replacement of the Troll-Walterian Imperfect Asymmetry Paradigm, represented by Walter's zonobiome system, the GHBS marks a paradigm shift towards the New Asymmetry Paradigm, which translates the differences between the Northern and Southern Hemispheres into zonobiome structures more convincingly. Indeed, the revisiting the biome structure of the Southern Hemisphere has motivated the revision of the zonobiomes in the Northern Hemisphere too. The introduction of the GHBS also provides recognition of new zonoecotonal structures. The mapping of the biomes is an intricate matter because of the intangible nature of biomes as functional-ecological entities. Several attempts have been made to formalise the biome delimitation and mapping. These will be briefly discussed. Using the map WWF ecoregions is a quick yet reasonably robust fix, however using detailed vegetation maps seems as a more plausible and viable solution, as shown on examples of defining biomes of Western Australia, Europe and soon also of the Southern Africa. The second instalment of the GHBS, in shape of the 'Biomes of the Northern Hemisphere', is in pipeline. Watch the skies and perhaps also IPCC should start watching it more closely.

Arnoldo Santos

Former Senior Researcher at Instituto Canario de Investigaciones Agrarias (ICIA)

PhD in Biology, Extraordinary Doctorate Award; Degree in Geography and History (University of La Laguna). He has more than 57 years of experience in research on the flora of the Canary Islands and nearby areas. Since 1974, he was head of the Botany Unit and scientific head of the Acclimatisation Garden of La Orotava (ICIA). He has also published, as author or co-author, 18 new species of Canary Island flora, many syntaxa and with more than 20 new taxa yet to be published. He is a member of the Scientific Council of the La Palma Biosphere Reserve and of the editorial board of several journals.



VIAJE EN EL TIEMPO Y EL ESPACIO: FLORA CANARIA Y FITOSOCIOLOGÍA

Voyage in Time and Space : the flora of the Canaries and Phytosociology]

Se mencionan las principales comunidades fitosociológicas, integradas en distintas Clases, de las islas Canarias haciendo hincapié en las especies bioindicadoras más importantes. De ellas se presenta sus características más destacables y relaciones filogenéticas así como sus posibles áreas de origen. Además se hace mención de algunas comunidades relacionadas con el archipiélago canario presentes en otras áreas, próximas y distantes, en particular comparando las similitudes y diferencias entre islas volcánicas y continentales, en particular la isla de Sokotra (Yemen). The main phytosociological communities, integrated in different Classes, of the Canary Islands are mentioned, with emphasis on the most important bioindicator species. Their most outstanding characteristics and phylogenetic relationships are presented, as well as their possible areas of origin. In addition, mention is made of some communities related to the Canary Islands archipelago present in other areas, near and distant, in particular comparing the similarities and differences between volcanic and continental islands, in particular the island of Sokotra (Yemen).

Reginald Tang Guuroh

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& University of Cologne, Germany



INTERACTIVE EFFECTS OF CLIMATE AND LAND USE ON CARBON POOLS AND GREENHOUSE GAS EMISSIONS IN WEST AFRICA'S LANDSCAPES

Land use, land use change, and forestry, including agriculture, are major sources of direct greenhouse gases emissions. With predicted population growth, livelihood activities resulting in land use changes are expected to accelerate GHG emissions in West Africa. On the other hand, preserving soil and vegetation of all forms serve as carbon pools. Thus, it is highly relevant to quantify both carbon pool dynamics and GHG emitted under different land use practices, and to improve our understanding of GHG dynamics in the West African region.

Our study uses a crossed space-for-time substitution for climate change and land use change, taking advantage of steep natural gradients of climatic aridity and land use intensity in West Africa. The study area comprises six ecozones with different climatic aridity, from the moist semi-deciduous forest ecozone to the Sahel ecozone in Niger. Within each zone, we considered three land-use types (croplands, fallow lands, and near-natural vegetation). There were ten sample plots per land-use type. To quantify topsoil properties, a composite sample of five cores (0-5 cm) was collected per plot and analysed for chemical properties. Climatic variables were obtained from the WorldClim database.

Analysis of variance were used to examine effects of climate, land use, topography on carbon pools and GHG emissions. Linear mixed effect models were also used to examine drivers across climate zones and land use types.

The results show that irrespective of climate zones, forests recorded highest carbon stocks followed by the fallows while croplands recorded the least among the selected land-use types. When compared across climate zones, the results show higher carbon stocks in all land-use types in the moist semi-deciduous climate zone than in the dry savanna climate zone. There were no clear trends in relationship between mean CO₂ emissions and both soil temperature and soil moisture. Fallows recorded the highest CO₂ emissions followed in decreasing order by croplands and near-natural vegetation.

Vegetation type significantly affect carbon emissions and CO₂ equivalent emitted both for Sudanian and Sudano-sahelian zones with higher values in grass and shrub savannas while lower values were observed in tree savanna and woodland. The interaction between climate zone and vegetation type showed a significant influence on carbon emission and CO₂ equivalent emitted. Emission factors of CO₂, CO, and CH₄ were not significantly influenced by climate zone. Considering climate zone individually, vegetation types significantly influenced emission factors of CO₂, CO, and CH₄ in Sudanian and Sudano-Sahelian zones. When comparing the EFs of CO₂, CO, and CH₄, different patterns were recorded for the different vegetation types. The highest value of CO₂ was recorded in the tree savanna with $1658.17 \pm 11.13 \text{ g kg}^{-1}$ and the lowest was recorded in the grass savanna with $1557.94 \pm 10.7 \text{ g kg}^{-1}$. The highest CO (104.62 ± 0.78 g kg⁻¹) and CH₄ EFs (6.57 ± 0.05 g kg⁻¹) were obtained in the woodland while the lowest EFs of CO and CH₄ were found in grass savanna with $64.77 \pm 0.44 \text{ g kg}^{-1}$ and $2.54 \pm 0.02 \text{ g kg}^{-1}$, respectively. Furthermore, the interaction between climate zones and vegetation types revealed a significant influence on emissions factors.

The findings of this research highlight several key aspects that are useful for land-use management and planning in the region.

Keywords: Greenhouse gas; ecological zones; climate change; near-natural vegetation; fallow; cropland; land-use change

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PROPOSAL FOR A COMMON FRANCO-IBERIAN SYNSYSTEM OF MARITIME CLIFFS VEGETATION

On the Atlantic maritime cliffs, the more halophilic vegetation are rupicolous vegetation and halo-anemogenic grasslands. From a phytosociological point of view, many authors consider these vegetations as belonging to the maritime grasslands of salt-sprayed cliffs coastal cliffs of the Mediterranean *Crithmo maritimi-Limonietea pseudominuti* Braun-Blanq. 1947. If there is a consensus for placing chasmo-halophilous vegetations in this class, this is not the case for halo-anemogenous grasslands. They are placed either in *Crithmo maritimi-Limonietea pseudominuti*, within *Crithmo maritimi-Armerietalia maritimae* Géhu 1975 or in *Armerio maritimae-Festucetea pruinosa* Bioret & Géhu 2008. Mucina *et al.* (2016) consider *Crithmo-Staticetea* Br.-Bl. in Br.-Bl. *et al.* 1952 as a large class encompassing « rupicolous vegetation of salt-sprayed coastal cliffs of the Atlantic and Mediterranean sea-boards of Europe, North Africa and Middle East». By considering bioclimatological, geomorphological and edaphic determinisms of coastal rocky and grasslands vegetation, a common Franco-Iberian synsystem is proposed. Two separate classes are considered. The *Crithmo maritimi-Limonietea pseudominuti* concerning only the vegetation of rock fissures and sandy-loamy veneers vegetation. It gathers chasmo-halophytic and chomo-halophytic vegetation developed on lithosoils. The biogeographical optimum of this class is located in the Mediterranean, with a strong irradiation in the Atlantic domain, from the south of the Iberian Peninsula to the north of the Bay of Biscay; it decreases then gradually up to the north, with a limit in the southern part of the British islands. The *Armerio maritimae-Festucetea pruinosa* Bioret & Géhu 2008 gathers the halo-anemogenic grasslands on coastal ranko-soils, located at the upper contact of the *Crithmo-Limonietea*. The optimum of this class is located on the Atlantic coast, from the south-west of the British Isles to the north of the Iberian Peninsula, with a rapid impoverishment towards the south, from Galicia. Maritime cliffs vegetation of French and Iberic Atlantic islands are characterized by a high diversity of hyperhalophilous endemic plant communities.

Alessandra Fidelis

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DIGGING DEEP: UNEARTHING THE SECRETS OF BELOWGROUND COMPONENTS OF PLANT COMMUNITIES

Vegetation scientists explore various aspects of plant communities, such as responses to climate change, disturbances, and environmental gradients. However, most research focuses primarily on aboveground vegetation, often neglecting belowground components. For instance, disturbance-driven ecosystems like tropical savannas rely heavily on belowground structures for survival. Plants in these systems display various strategies to persist after frequent fires. Many resprout from basal or belowground buds, while woody species may have protected aboveground buds that facilitate regrowth. In contrast, herbaceous plants are more vulnerable to fire, as they are directly exposed to flames and may be consumed or damaged. For resprouting to occur, buds must be well-protected, either by plant structures such as bark or by being insulated belowground in storage organs. Consequently, a significant portion of biomass in tropical savannas is allocated belowground, serving as a crucial carbon storage even in the face of frequent fires. This underscores the importance of examining belowground aspects to fully understand plant community dynamics. In this context, I highlight the significance of investigating belowground features to appreciate their role in plant community regeneration after disturbances. This includes recognizing the diversity of belowground bud-bearing organs and the substantial biomass allocated underground, which supports recovery. Therefore, a comprehensive understanding of tropical savanna dynamics under varying fire regimes necessitates a thorough examination of belowground components, which are often overlooked. Without this perspective, our understanding of changes in aboveground plant communities may be incomplete, leading to potential misinterpretations.

Pierre Legendre

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**A BRIEF HISTORY OF THE DEVELOPMENT
OF NUMERICAL ECOLOGY**

Numerical ecology is the field of quantitative ecology devoted to the numerical analysis of [multivariate] ecological data, with emphasis on natural community composition data. Community ecologists, whose data are multivariate by nature (many species, many environmental variables), are the primary users of these methods.

The field of numerical ecology was officially founded in May 1975. The presentation will review the development of the field over the past 49 years. These developments are the result of a broad and fruitful international scientific cooperation.

Session 1A – Restoration, Conservation and Vegetation Management

OC1

LEATHERY OR HAIRY VS. SPINY: HOW ARE THE WOODY PLANTS IN FOREST-GRASSLAND ECOTONE COMMUNITIES ACROSS ENVIRONMENTAL GRADIENTS IN SOUTHERN BRAZIL?

Marcos Bergmann Carlucci (Brazil)¹; Elielson Lucas Ferreira (Brazil)¹; Raissa Iana Leite Jardim (United Kingdom)²; Rodrigo Scarton Bergamin (United Kingdom)³; Mariana Gliesch (Netherlands)⁴; Joice Klipel (Germany)⁵; Pedro O. Cavalin (Brazil)⁶; Ricardo A. C. Oliveira (Brazil)¹; Marta R. B. Do Carmo (Brazil)⁸; Leandro D. S. Duarte (Brazil)⁷; Marcia C. M. Marques (Brazil)¹; Valério D. Pillar (Brazil)⁷; Sandra C. Müller (Brazil)⁷

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Forest-grassland mosaics in southern Brazil have been studied based on a few sites over the past two decades. We still do not have a regional perspective on patterns underlying the functional composition of woody plant communities of forest- grassland ecotones in the Atlantic Forest (AF) and Pampa domains, encompassing major environmental gradients. Using novel data, we test the hypotheses that: (H1) Woody plant communities in the Pampa would be spiner because of higher influence of cattle grazing, while those in the highland grasslands of the AF would have higher bark thickness (BT) due to higher incidence of fires; (H2) Leaves would be more conservative (low SLA, high LDMC) under higher seasonality of temperature and precipitation to deal with cold or dry winters, respectively; (H3) Woody plant communities would be more pubescent under higher precipitation seasonality. We found evidence that corroborates most of our hypotheses. According to H1, we found a higher proportion of spiny individuals in the Pampa, where cattle incidence is higher; while higher BT where burnings are expected to be more frequent (AF), although our fire proxy did not capture this relationship. Moreover, we found more leathery leaves (high LDMC) under higher precipitation seasonality but not under higher temperature seasonality, partially corroborating H2. We found higher pubescence under higher precipitation seasonality, corroborating H3, but the high variability of this variable suggests a role of other factors such as frosts or insect herbivory. This study moves the knowledge on forest-grassland mosaics beyond, also showing ways to keep going forward.

Keyword: Atlantic Forest, Pampa, Functional composition, Environmental gradients, Forest-grassland mosaics, Southern Brazilian Grasslands

OC2

TRAIN YOUR COMMUNITY: BUILDING AN ONLINE DATABASE OF HABITAT POLYGONS FOR SATELLITE-BASED HABITAT IDENTIFICATION

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The use of remote sensing in ecology and nature conservation is highlighted as an essential tool. The availability of multispectral and hyperspectral data, along with advanced data processing techniques, has allowed for more profound insights into land cover categories. However, the complicated character of plant communities has made it challenging to achieve a detailed scale defined by diagnostic plant species composition.

To overcome this limitation, the concept of Natural Numerical Networks as a novel tool for identifying plant communities using satellite images was introduced within the NaturaSat project. The developed method shows excellent potential in distinguishing between next-standing mixed deciduous forests with similar species composition and even between two types of riparian forests. The method could be used to find new habitat locations as well.

The overall accuracy of different deep learning methods varies significantly, depending on used scales and target phenomena. The highest accuracy values were achieved for broadly defined landscape units and basic forest cover mapping. The classification using the Natural Numerical Network reached an accuracy of 99 % in the learning phase by using the Sentinel-2 multispectral data feature space and classifying Natura 2000 habitats. However, every AI tool is only as good as the knowledge and data it is trained on. Thus, we propose the IAVS community participation in the collection of verified polygons of defined plant communities and their input into the training phase. After the training phase, automatic detection of habitats on a European level becomes possible and available to the contributors.

Keyword: habitat identification, deep learning, monitoring, database

Session 1A – Restoration, Conservation and Vegetation Management

OC3

GRASSLAND RESEARCH AND CONSERVATION: AN INTERDISCIPLINARY JOURNEY

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While vegetation scientists often visit a study plot only once, capturing just a single moment in its development, re-sampling enables recording multiple moments. However, to capture the full temporal variability and trends in vegetation development in order to reach conservation targets, long-term observations are necessary. To address this limitation in grassland research and conservation, we propose integrated interdisciplinary research. By combining botany, ecology, remote sensing, history, and anthropology, we aim to underscore the importance of integrating social sciences to comprehend human impacts on semi-natural grasslands, while also utilizing remote sensing to evaluate temporal variations in management practices and their intensity. We studied plant diversity and grassland management practices in two villages (Radenka, Suvi Do) of the Serbian Carpathians, representing one of the biodiversity hotspots in the Carpathian Mountains. Our interdisciplinary approach offered a comprehensive understanding of recent land use and plant diversity patterns in the grasslands studied, including their temporal changes. The calibrated NDVI time series helped identify long-term variations in grassland management intensity, enriching our understanding of ecological patterns. However, accurate interpretation of remote sensing data required social insights from farmer interviews. Anthropological perspectives not only helped interpret remote sensing and biological data, but also revealed underlying causes, clarifying causal relationships. We argue that an integrated interdisciplinary approach is especially important in areas with limited study and inconsistent monitoring of local vegetation and land use. Furthermore, it has the potential to complement or even replace long-term ecological studies and experiments. Funding: VEGA 02/0065/23, APVV-21-0226, Biodiversa+ (G4B).

Keyword: Anthropology, NDVI, Plant diversity, Semi-natural grassland, Serbian Carpathians, Traditional agriculture

OC4

PROTECTED VASCULAR PLANT SPECIES AND HABITATS OF THE RESOLUTION 6 AND 4 OF THE BERN CONVENTION AT THE OLD CEMETERIES OF THE RIGHT-BANK OF DNIPRO GRASS STEPPE DISTRICT (SOUTHERN UKRAINE)

Nadiia Skobel (Ukraine)¹; **Natalia Velychko** (Ukraine)¹; **Olena Shchepeleva** (Ukraine)¹; **Ivan Moysiienko** (Ukraine)¹

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Steppes are among the most threatened and least protected habitats globally, and therefore, the conservation and restoration of steppe (Kotorchenko & Peregrym 2012). Steppe flora in Ukraine is preserved mainly in protected areas, ravines, gullies, river terraces and sea cliffs and cultural heritage sites (burial mounds, kurhans), old settlements, old cemeteries (Moysiienko 2017). We investigate flora of 50 old cemeteries located in Right-Bank of Dnipro Grass Steppe District (territory of Geobotanical Region of Ukraine).

We recorded 3 species of vascular plants listed in Resolution 6 of the Bern Convention: *Iris aphylla* subsp. *hungarica*, *Jurinea cyanoides*, *Paeonia tenuifolia*.

We recorded 3 habitats listed in Resolution 4 of the Bern Convention: E1.2 Perennial calcareous grassland and basic steppes, F3.241 Central European subcontinental thichets and F3.247 Ponto-Sarmatic deciduous thichets.

Main problem in preserving the biodiversity of OCs is the elimination of these sites, repurposing of the land, and reburials. OCs can play an important role in the conservation of steppe phytodiversity and could be added the already existing Emerald Network of Ukraine. The conservation of the Emerald Network areas is effectively limited to the prevention of economic activities that may have a significant impact on the environment, in particular on populations of species listed under Resolutions 4 and 6 of the Berne Convention, located in the Network areas.

Investigation supported IAVS Special grant to support the research of Ukrainian members. "Plant diversity and species-area relationships modelling of steppe enclaves within of Northern Prychornomoria Region (Northern Black Sea Region) of Southern Ukraine".

Session 1A – Restoration, Conservation and Vegetation Management

OC5

RESTORATION OF A SPECIES-RICH FLOOD MEADOW BY TOPSOIL REMOVAL AND GREEN HAY TRANSFER – LESSONS FROM 25 YEARS OF VEGETATION MONITORING

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Long-term monitoring of restoration success is of crucial importance to assess successional pathways and limiting factors in ecosystem restoration. However, such long-term data rarely available which is strongly limiting the prediction of restoration outcomes and successional trajectories under variable marginal conditions. Here we present data from a restoration project aiming at restoration of a species rich flood meadow on a former arable field by topsoil removal and diaspore transfer with green hay that was monitored over 25 years. During the period of observation several successional phases can be distinguished that are characterized by strong shifts in taxonomic and plant functional composition. Only towards the end of the observation period stress tolerant became absolutely dominant and the species composition resembled strongly to those of the source stands of the green hay. The massive reduction of soil nutrients by topsoil removal was of crucial importance for this strong environmental filtering observed over 25 years.

Keyword: grassland, restoration, succession, nutrients, environmental filtering

OC6

RESTORING HEATHLANDS AFTER CLEAR-FELLING OF SPRUCE PLANTATIONS ON TWO NEIGHBOURING ISLANDS IN WESTERN NORWAY

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The ongoing loss of coastal heathlands is a threat to biodiversity and cultural heritage legacies throughout the coastal regions of Europe. It is possible to restore degraded and afforested heathlands, but restoration interventions are often labour-intensive and costly, and the outcome of specific restoration actions is not well documented. We assess the efficiency of restoring coastal heathlands through natural succession (i.e. “passive restoration”) after the removal of spruce plantations. The study was replicated on two neighbouring islands in a Nature reserve in Western Norway, and low-intensity free-range sheep grazing was implemented as part of the reserve management plan. Furthermore, we tested the effect of leaving the clear-felled woody material as chips on site, this being a cost-efficient strategy on islands. Succession was monitored 1, 2, 4/5 and 8 years after clear-felling, and revegetation of vascular plants and bryophytes was compared to target heathland vegetation. Surprisingly, we found different successional trajectories on the two islands; Species composition on one island (NIL) approached target vegetation during succession, but not on the other (SIL). Management actions beyond clear-felling and introducing sheep grazing are necessary due to the establishment of regeneration of the woody species *Picea sitchensis* on NIL. Woody chips reduced species richness and slowed the restoration process, but these negative effects were only short-term. Differences in land use and soil conditions may explain the successional trajectories on the two islands.

Keyword: Conservation, Restoration, Succession, Species richness

Session 1A – Restoration, Conservation and Vegetation Management

OC7

BURN THEM ALL? USE AND EFFICIENCY OF FIRE AS A TOOL FOR GRASSLAND RESTORATION

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Globally, grassland ecosystems have suffered significant degradation due to factors such as land use change, the introduction of exotic species, and changes in endogenous disturbances regime. The ecological restoration of these ecosystems is fundamental to fight against climate change and biodiversity loss. Fire is an important component in the evolution and management of several grasslands around the world. Additionally, fire can be a tool to restore grasslands. In this paper, we present a systematic literature review to know how fire has been used as a tool in grassland ecological restoration and its efficiency. To do that, we collected the results (positive, negative, or null) of fire treatments considering five restoration objectives: (1) increase biotic diversity, (2) remove woody biomass, (3) control exotic species, (4) promote abiotic changes, and (5) improve ecosystem services. We discuss our results with the totality of data and considering major grassland types at a global scale. Our review shows that fire has been used mainly to restore temperate grasslands in North America. In general, there are more positive results than negative when using fire in grassland restoration, however, there are even more no-effect of fire. Fire is highly efficient in removing woody biomass, mainly in temperate and Mediterranean grasslands. Fire also is efficient in controlling exotic species but is more efficient when combined with another technique. This efficiency is low in tropical and subtropical grasslands. Fire can be used as a tool in grassland restoration, but its efficiency is highly context-dependent.

Keyword: Endogenous disturbances, Fire-prone ecosystems, Grassy biomes, Open ecosystem, Restoration ecology

OC8

ALKALINE AND LOESS GRASSLANDS WITH CONTRASTING RICHNESS AND BIOMASS PATTERNS ARE NOT SEPARATED ON THE CSR STRATEGY SPECTRUM

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Studying the relationship between biodiversity patterns and processes in vegetation has been at the centre of interest in vegetation ecology for several decades. By studying the biomass of loess and alkaline grasslands along a water and salinity gradient, we aimed to analyse species diversity and CSR functional type patterns. We aimed to test the following hypotheses: i) The biomass and species richness scores and the species composition are significantly different between the sampled grassland community types. ii) The sampled communities are well separated based on the CSR strategy spectrum. iii) The amount of green biomass and litter are positively correlated with competitiveness and negatively with stress tolerance. The biomass and species richness scores and the species composition of the sampled communities along the sampled gradients were significantly different; the highest species richness, evenness and Shannon diversity values were found in loess grasslands. The highest level of litter accumulation was found in alkaline meadows. The communities were well separated in the ordinations but surprisingly, calculation of coordinates for CSR strategy types have not shown clear separation of the grassland community types. Based on the results we can conclude that the current CSR classification is too robust to delineate grassland communities in alkaline landscapes which are markedly different in composition. We point out that the CSR classification is based on the magnitude of stress, and it is too robust to differentiate between the various forms of stress which might be responsible for the marked compositional differences.

Keyword: functional diversity, litter, ecological strategy, steppe, stress, dry grassland

Session 1B – Historical Vegetation Ecology

OC9

VEGTRENDS: ASSESSING LONG-TERM TRENDS IN EUROPEAN VEGETATION AND EVALUATING PROTECTED AREA EFFECTIVENESS

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Reliable estimates of long-term vegetation change are urgently needed as a benchmark for monitoring and reporting on the conservation status of terrestrial habitats, as well as to plan and undertake effective conservation measures. We introduce the EU-funded project VegTrends (“Assessing long-term trends in vegetation and evaluating protected areas effectiveness”) and illustrate results from its first work package. Building on an unprecedented number of previously-disconnected datasets now included in the ReSurveyEurope database, we assessed compositional shifts characterising the vegetation of European open habitats in the last decades. Besides quantifying community-level changes in taxonomic, functional and phylogenetic diversity metrics, we tracked trends in the occurrence and cover of individual species. We also identified the driving mechanisms (species gain vs loss) and tested for the exceptionality of observed changes. Our results suggest that, in the last decades, European open habitats underwent important changes in all the analysed diversity facets, with notable differences across vegetation types. At the community level, most habitats have experienced considerable shifts in both species composition and dominance structure, in most cases driven by species loss. Significant changes were also detected at the level of individual species. Although trends differed across vegetation types, our findings indicate an overall increase in generalist and competitive species at the expense of habitat specialists. While offering unprecedented insights into long-term vegetation dynamics at the European scale, our results highlight the importance of temporal analysis for an effective and targeted biodiversity conservation.

Keyword: temporal dynamics, vegetation change, European habitats

OC10

VEGETATION CHANGES ON A NORTH SEA ISLAND OVER FOUR DECADES – IMPRINTS OF NEOPHYTES AND CLIMATE CHANGE

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Helgoland is the only offshore island in Germany, situated ca 45 km from the coast of the Wadden Sea. The vegetation of the island was described in detail in 1983 and re-surveyed with 162 plots in 2023. Over this period, the mean annual temperatures had increased by more than 1 °C.

Over the 40 years, the mean plot species richness of vascular plants had increased from 10.5 to 13.3. A significant increase in species number was found in four of the five broadly defined vegetation types, *Ammophiletea*, *Juncetea maritimi* (& *Cakiletea maritimae*), *Crithmo-Staticetea*, and *Sedo-Scleranthetea*. No change was observed in the *Molinio-Arrhenatheretea* grasslands. Among the five taxa with the strongest increase in frequency were three neophytes, *Senecio inaequidens*, *Hippophaë rhamnoides* and *Rosa rugosa*. Generally, threatened species also showed positive trends, with the exception of *Cerastium diffusum* and some *Cladonia* lichens. Ordination analyses revealed significant shifts in species composition in all five vegetation types, especially in the *Sedo-Scleranthetea* grey dunes.

A comparison of mean Ellenberg indicator values between 1983 and 2023 suggested an overall decrease in light availability. Most vegetation types showed decreasing mean values also for the soil factors moisture, pH and nitrogen, whereas the opposite was found for the *Sedo-Scleranthetea*. Most interestingly, mean temperature values increased for the total of plots and for two of the five vegetation types, in accordance with the observed climate warming and spread of several coastal plant species with a southern and / or oceanic distribution.

Keyword: Neophytes, Species richness, Temperature increase

Session 1B – Historical Vegetation Ecology

OC11

HISTORICAL DEVELOPMENT OF VEGETATION BELT MODELS IN MADEIRA ISLAND FOLLOWING HUMBOLDT & BONPLAND'S 'ESSAI' (1807), THEIR INTERPRETATION AND COROLLARIES FOR LANDSCAPE ANALYSIS AND BIODIVERSITY CONSERVATION

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The idea of vegetation belts as the layering of ecosystems in mountains is symbolic for Physical Geography and Ecology and can be traced back to Gessner (1555), Haller (1768) and Giraud-Soulavie (1783). The interpretation of vegetation zonation as determined by climatic gradients, mostly of temperature, was introduced by Humboldt and Bonpland (1807) in the offprint of the Chimborazo Mountain, where they noted the correlation between temperature and occurrence of characteristic plants, both native vegetation and crops.

Humboldt first described the vegetation belts of Tenerife (1799), further inspiring others studying Macaronesia, such as Webb and Berthelot (1835-1850) and Seubert and Hochstetter (1843). Mid-19th century models of vegetation belts in Madeira Island are known from Bowdich (1825), Hartung (1860), Khul (1862) and Lowe (1868). 20th century descriptions include those of Vahl (1904), Romariz (1957), Dansereau (1966), Sjögren (1972) and Oberdorfer (1975). Early depictions followed Humboldt's use of both natural vegetation and crops, but later descriptions used mostly native vegetation typologies. Mesquita *et al.* (2004) is the latest re-definition of vegetation belts of Madeira, using geostatistics to produce a bioclimatic zonation, following the World Bioclimatic Classification of the Earth and the phytosociological typology of zonal vegetation by Capelo *et al.* (2004).

We present the historical evolution of Madeira Island's vegetation belts models and the corresponding rationales. We argue that the evolution of these models follows conceptual developments of Vegetation Science and Bioclimatology; and that they present invaluable historical evidence of human-induced change of the island's landscape.

OC12

FROM DURER'S LARGE PIECE OF TURF TO 20TH CENTURY VEGETATION PROFILES: PLANT COMMUNITIES IN BOTANICAL REPRESENTATION

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From the 16th century, plant depiction in art became extremely accurate, to the point of species and varieties being easily recognised by contemporary specialists. Contrariwise, vegetation was usually represented as an indistinguishable mass, of uniform texture and colour.

Attempts at representing vegetation were, and still are, scarce when compared to plant representation. With very few exceptions, the oldest known examples were produced to show the habit of some plants or to describe their habitat. Vegetation depiction was often relegated to the background or to frame a more complex scene, thus contextualizing the plant as the main subject.

Vegetation depiction, as subject, was first approached in the early 19th century by Alexander von Humboldt, with the purpose of representing the variation of plant distribution within altitudinal gradients. However, and despite some magnificent exceptions, sketching vegetation profiles only became a current practice well into the 20th century, often in combination with photography and vegetation mapping. Evolution of plant communities' representation diverged from that of plant representation, following in parallel with the description of these same communities. Depiction of vegetation complexes as the result of ecological succession and zonation also became part of scientific literature, following conceptual developments in vegetation science.

We present the preliminary results of ongoing research on the history and evolution of the graphical representation of vegetation phenomena in several levels of complexity, from the early 16th century paintings to the detailed vegetation sketches and profiles which accompany many of the 20th century texts describing plant communities and vegetation complexes.

Keyword: Vegetation representation, History of Botany

Session 1B – Historical Vegetation Ecology

OC13

46 YEARS OF VEGETATION SUCCESSION AFTER A FOREST FIRE IN SCOTS PINE PLANTATIONS – DECIDUOUS FORESTS ARE MAKING A COMEBACK

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Forest fires have been a rare disturbance agent so far in forests of Central Europe but will increase in frequency and magnitude in the future because of climate change. Coniferous forests such as Scots Pine plantations (*Pinus sylvestris*) will be mainly affected. Experiences on vegetation dynamics from former burnt sites are rare but will become increasingly important in the future to guide forest management decisions. Here we present a long-term data set from a former burnt site in northwestern Germany. A large forest fire hit the area dominated by *Pinus sylvestris* in 1975 and burnt ca. 8000 ha of forested land. Already in 1976 vegetation surveys on a permanent study site (2.4 ha), left for natural succession, started and have been repeated frequently since then (1977-79, 1981, 1983, 1985, 1987 and 1995). A last re-survey was conducted in 2021, 46 years after the fire event.

A tree layer was first recorded in 1981 and showed a continuous increase in cover and richness with a dominance of the deciduous tree species *Betula pendula* and *Quercus robur*. This indicates a natural succession towards a Betulo-Quercetum. In general, species of deciduous forests dominated over coniferous specialists in all vegetations layers supporting the intended transition to deciduous forests in Germany. The invasive alien species *Prunus serotina* also benefited from the disturbance and should be continuously monitored.

Such long-term studies can give important implications on the succession speed and trajectories after fire events and can inform forest management on suitable future management operations such reforestation.

Keyword: vegetation dynamics, natural succession, forest management, invasive alien species, reforestation, forest conversion

OC14

VEGETATION OF NW-IBERIA FROM LGM TO PRESENT BASED ON MODERN CLIMATIC ANALOGUES ★

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Temperate vegetation found refugia in the European southern peninsulas during the Last Glacial Maximum (LGM, 21ky BP) and experienced intense warming during the Holocene climatic optimum (6ky BP). To understand the spatial distribution of vegetation types in those periods, most studies have focused on paleopalynological data and distribution modelling of individual species. Here, we present a complementary approach based on modern climatic analogues and related vegetation types. We classified the Iberian Peninsula in bioclimatic regions using a k-means unsupervised classification of climatic data for the LGM, the Mid-Holocene and the present. In the three periods, the North-Western Iberia region was a consistent bioclimatic unit, and it could be subdivided into three subregions: Atlantic coast, Cantabrian coast and Cantabrian Mountains. Each subregion was then sampled to extrapolate its climate to modern analogues using the Mahalanobis distance. The most climatically similar areas of the present day were overlapped with Bohn's natural vegetation maps for Europe to quantify the current abundance of functional ecosystems as a surrogate of the vegetation that could occur in each subregion in a determined period. Our results support the role of the Atlantic and Cantabrian coasts as refugia for broadleaved deciduous and evergreen forests during the LGM, when coniferous forests and steppes likely dominated the Cantabrian Mountains. During the climatic optimum of the mid-Holocene, broadleaved forests expanded at the expense of coniferous forests, which in the present day are mostly relict vegetation. Our approach uses present vegetation to recreate the past, improving the understanding of climate-driven vegetation changes.

Keyword: Palaeoecology, Holocene, Last Glacial Maximum, Modern climate analogues, European vegetation, Cantabrian Mixed Forests ecoregion

Session 1B – Historical Vegetation Ecology

OC15

COMMUNITY THERMOPHILISATION RATE WITHIN RIPARIAN FORESTS IS FASTER THAN EXPECTED

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1 - UMR EDYSAN

Interfacing aquatic and terrestrial environments, riparian forests are remarkable ecosystems that deliver a number of essential ecosystem services to society, including climate regulation services. As such, riparian forests are able to buffer variations in air and water temperature via solar radiation interception and evapotranspiration. At the same time, they are vulnerable ecotones exposed to several global change drivers. Surprisingly, compared to other type of forest ecosystems, few studies have assessed their short-term (decadal) response to environmental changes. Here we aim at assessing the temporal dynamics of changes in riparian plant communities in North France, by resampling 68 georeferenced semi-permanent plots which were initially surveyed in 1995-1996 for vascular plants. We compared modern with historical plant community surveys using various metrics of taxonomic and functional diversity as well as multivariate statistics. We found an increase in species richness but a decrease in equitability within the herb layer. We evidenced a floristic homogenization among study sites over time. A number of functional traits were modified (SLA, Seed mass). We also found evidence for community thermophilisation reaching +0.14°C/decade, on average, suggesting a faster thermophilisation rate compared to former reports from French deciduous forest ecosystems ([0.08; 0.10] °C). These compositional and functional changes in plant communities coincide with a reduction in flood-related disturbances and a general increase in air temperatures.

Keyword: Riparian forest, plant community, Climate change, Historical ecology, North of France

OC16

FOILING SUSPECTED INVADERS WITH THEIR DNA: THE COLD CASE “VINCA MINOR L.” (RE)OPENED

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Plant invasions have become a global phenomenon which is increasingly regarded as a major threat to biodiversity. It is challenging therefore to get long-term data on biodiversity changes in invaded ecosystems. There is thus an interest in long-term retrospective analyses of “old invaders”, such as certain archeophytes (i.e. alien plant species introduced in prehistoric to medieval times) which are no longer considered as invasive (i.e. their distribution is considered at equilibrium with the environment). A prerequisite however is to demonstrate that an archaeophyte has been an invasive species in the past (i.e. that it used to spread rapidly in certain habitats, where it pre-empted space and resources at the expense of resident species). Using phylogeographical methods based upon molecular genetic structure and diversity of plant populations we aimed at showing that the lesser periwinkle (*Vinca minor* L., *Apocynaceae*) used to be an invader in North France during Ancient and Medieval times. The genetic variation and structure support the “invasive archeophyte hypothesis”. We show that *V. minor* likely used human-disturbed areas to invade North France, following the former Roman road network, from North-East France during the Roman times to North-West France during the Middle Ages. Since it is an ancient forest species which no longer invades new areas, comparing invaded vs non-invaded forest stands may reveal the (very) long-term impact of this species on biodiversity and ecosystem functioning.

Keyword: *Vinca minor*, Phytogeography, Archaeophyte, Plant invasion, Forest ecosystems

OC17

THE HITCHHIKER'S GUIDE TO TRAIT IMPUTATION: EMPIRICAL INSIGHTS FROM VASCULAR PLANTS

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Trait missingness hampers the assessment of biodiversity and ecosystem functions across scales. Trait imputation based on trait-covariance and/or phylogenetic information across species emerged as a promising tool to tackle this issue, especially for the construction of synthetic functional spaces. However, skepticism about the accuracy and effectiveness of trait imputation persists. Using an empirical set of complete traits from the global spectrum of plant form and function derived from the TRY database (3,043 species) and 1,376 communities from sPlotOpen, we simulated different scenarios of data incompleteness (from 10% to 80%) to test: i) imputation accuracy with and without phylogenetic information, ii) the effect of species pool spatial resolution (regional, continental, global scale) on imputation performance, iii) whether trait imputation artificially inflates correlations between functional (FD) and phylogenetic diversity (PD), and iv) relationships between observed and imputed trait dissimilarities. Our results showed that imputation error is halved in the trait space compared to single traits and that, on average, the larger the reference pool for imputing traits, the lower the imputation error. The use of phylogenetic information did not substantially enhance imputation performance nor inflate the correlation between PD and FD. Finally, we detected a strong correlation between observed and simulated plot-plot functional dissimilarities ($0.85 \leq \text{Pearson } r \leq 0.99$) and species pairwise dissimilarities ($0.84 \leq r \leq 0.98$). Our findings demonstrate the reliability of trait imputation in the case of missing trait data on plants, particularly in the context of synthetic functional spaces that make more efficient use of trait correlation.

Keyword: Functional traits, Imputation error, Functional space, Phylogeny

OC18

CLASSIFYING AND MAPPING THIRD-LEVEL EUNIS HABITATS AT FINE SCALE IN THE LAZIO REGION, ITALY

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Mapping the distribution of EUNIS habitats is an important tool to support conservation, management and monitoring activities at local and national scale. The European Space Agency (ESA) is promoting a program to evaluate the usefulness of satellite images for thematic application in Europe. Within this program, we obtained a 10 meters third-level EUNIS habitats map for the Lazio region, Italy. From a database of 8700 phytosociological relevés, through the Expert System algorithm of the Juice program, about 3000 plots were selected and assigned the corresponding EUNIS hierarchical value at the third level. The classification was carried out separately for forests (EUNIS – T), shrublands (EUNIS – S), grasslands (EUNIS – R) and coastal vegetation (EUNIS – N) macro-categories. At the same time a set of spatialized environmental predictors was produced: topographic (Tinitaly for Digital Elevation Model), climatic (ISPRA – SINANET network) edaphic (SOILGRIDS dataset), and spectral data (Sentinel - 2). All predictors were spatially resampled with a resolution of 10m. The third level EUNIS occurrences were used to train a Random Forests supervised machine learning algorithm to produce a map of the EUNIS habitat types. Habitats maps were produced separately for the four macro-categories (forests, shrublands, grasslands, and coastal) using masks obtained by combining several Copernicus Land Monitoring Service Products with different overall accuracies values, respectively (T - 75.05%, S - 62.08%, R - 54.74%, N - 80.11%). This study represents a pilot case study, which will be extended at national scale.

Keyword: EUNIS habitat types, Random Forest classification, Vegetation plots

Session 1C – Ecoinformatics and Models in Vegetation Science

OC19

GLOBAL DECOUPLING OF FUNCTIONAL AND PHYLOGENETIC DIVERSITY IN PLANT COMMUNITIES

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Plant communities are composed of species that differ both in functional traits and evolutionary histories. Understanding how species' traits and histories interact with the environmental conditions of a site and drive the assembly of ecological communities is the basis for predicting the impacts of climate change on biodiversity and ecosystem functioning. As species' functional traits partly result from their individual evolutionary history, the functional diversity (FD) of communities is expected, on average, to covary positively with their phylogenetic diversity (PD). However, this expectation has only been tested at local scales, for specific growth forms or specific habitat types, e.g. grasslands. Here, we compared the standardized effect sizes of FD and PD for 1,781,836 vegetation plots using the global sPlot database. In contrast to our expectations, the correlation between FD and PD was weak, not positive but negative, and these two facets of diversity were more often decoupled than coupled. While PD reflected recent climatic conditions and vegetation type, being higher in forests, FD depended on recent (1981-2010) and past climatic conditions (21,000 years ago). The independent nature of functional and phylogenetic diversity makes it crucial to consider both aspects of diversity when analyzing ecosystem functioning or prioritizing conservation efforts.

Keyword: Functional diversity, Phylogenetic diversity, Community Assembly, Biodiversity Big Data, Null Models, Macroecology of Vegetation

OC20

TRACKING PLANT FUNCTIONAL COMPOSITION COMBINING SENTINEL-2 AND THE TRAIT PROBABILITY DENSITY APPROACH

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Plant functional diversity (FD) assessment across large spatial scales and with high temporal resolution is challenging since it requires labour-intensive sampling campaigns for measuring plant functional traits (FTs). Satellite remote sensing has emerged as a promising tool to overcome this issue, but the relationship between FD and spectral diversity remains elusive. In this study, we employed Sentinel-2 images to predict FTs and FD metrics in 70 plots (32 species in total) in a large temperate forest ecological gradient in North-East Italy. Leaf area (LA), specific leaf area (SLA), leaf nitrogen content per area (N_{area}), leaf nitrogen content per dry mass (N_{mass}), leaf carbon/nitrogen ratio (CN), leaf dry matter content, stem specific density, leaf carbon isotope signature, water potential at turgor loss point (TLP) and water potential inducing 50% loss of hydraulic conductivity were retrieved for each species from online databases and through field measurements. Partial least square regressions were used to predict plot-level community weighted mean values of the above FTs using Sentinel-2 spectral bands. LA, SLA, N_{area} , N_{mass} , CN and TLP were predicted with an R^2 ranging from 0.30 to 0.52. Furthermore, we found a significant positive correlation ($\rho = 0.35$) between spectral richness and functional divergence, calculated using the "Trait Probability Density" approach. Plant spectral properties provided robust estimation of FTs related to leaf morphology (LA), resource allocation (SLA, N_{area} , N_{mass} and CN) and drought tolerance (TLP), and captured variation in the functional composition of forest communities, highlighting the potential of remote sensing to monitor ongoing biodiversity changes.

Keyword: Functional traits, Functional diversity, Remote Sensing, Spectral diversity

Session 1C – Ecoinformatics and Models in Vegetation Science

OC21

IRANVEG VEGETATION DATABASE; WITH A PHYTOSOCIOLOGICAL SURVEY SYNTHESIS OF IRAN ★

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Iran, situated in Southwest Asia, showcases a diverse landscape intersecting three phytogeographical regions and two global biodiversity hotspots. This diversity is attributed to its intricate geology, mountainous terrain, wide altitudinal range, and heterogeneous climate, fostering a rich flora characterized by a significant proportion of endemism. Here we have endeavored to collect all the available vegetation plot data in Iran and present an updated version of the Vegetation Database of Iran (IranVeg). In addition, all published syntaxa from Iran have been compiled to present a comprehensive phytosociological scheme. IranVeg database hosts 13,676 plots, including 10,698 phytosociological relevés and 2,978 biodiversity plots, spanning various major vegetation groups. These encompass steppes and other grasslands (48.6%), deciduous forests (18.4%), wetlands (13.2%), saline depressions (11.0%), woodlands and shrublands (6.0%) and man-made habitats (2.8%) derived from 95 published and unpublished sources. Review of all available phytosociological studies, shows that so far, 62 classes, 54 orders, 98 alliances, 570 associations, 103 subassociations have been identified from Iran. These syntaxa encompasses a spectrum ranging from those that are validly published to those undergoing validation for future reference. IranVeg stands as the first national-level vegetation database in Iran, promising valuable insights into biodiversity patterns and facilitating the assessment of future environmental and anthropogenic changes. This comprehensive database holds significant potential for advancing vegetation classification and survey efforts in Iran and beyond.

Keyword: Iran, macroecology, phytogeography, Syntaxonomical scheme, vegetation-plot database

OC22

HOW DO RELICT VEGETATION OF HYRCANIAN FORESTS RESPOND TO CLIMATE CHANGE?

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This study investigates vegetation responses to bioclimatic and edaphic variables in the UNESCO world heritage Hyrcanian forests. Using ecological niche modeling (ENM) and generalized dissimilarity modeling (GDM), we evaluated changes in the distribution of vegetation alliances under two emission scenarios and the role of environmental drivers in compositional variation within alliances. Models were developed using data from 1110 vegetation plots. Results indicate that the *Parrotia persicae*-*Carpinion betuli* (including *Alnion subcordatae*) in submontane areas is highly vulnerable to climate change, with an anticipated loss of over 99% of its distribution range. The *Smilaco excelsae*-*Alnion barbatae* (including *Alnion glutinosae*) in lowland areas and *Solano kieseritzkii*-*Fagion orientalis* (SF) in montane areas are also expected to face substantial reductions, with declines of 98.3% and 81.6% respectively. Interestingly, the *Quercion macrantherae* (including *Centaureo hyrcanicae*-*Carpinion orientalis* (QM)) in upper-montane areas exhibits comparatively lower vulnerability, with reductions of 39.7% and 40.4% under different scenarios. These findings suggest that the Hyrcanian ecoregion may serve as a refuge for drought-resistant forests in response to climate change. GDM results show that compositional variation is more strongly influenced by climatic variables than edaphic factors. Specifically, precipitation seasonality (bio15) is the primary driver for the QM and SF alliances, while temperature seasonality (bio4) is the main driver for the other alliances. In conclusion, the unique climatic conditions of the Hyrcanian ecoregion, distinct from other temperate forest habitats in the Northern Hemisphere, probably lead to saving more upper-montane vegetation than other plant communities in lower altitudes in the future climate change.

Keyword: Hyrcanian temperate forests, ecological niche modeling, generalized dissimilarity modeling, climate change, plant communities

OC23

SEPARATING LEAF AND PLANT AREA INDEX THROUGH SEMI-SUPERVISED HEMISPHERIC PHOTOGRAPHY CLASSIFICATION

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Canopy gap fraction (*Pgap*) models are commonly applied to measure leaf area index (LAI) indirectly (using optical sensors), and form the basis of most satellite LAI product validation. However, quantifying the impact of woody elements on indirect *Pgap* measurements has previously relied on destructive manual sampling and is a significant source of measurement error. In this study, we present a novel framework for separately measuring LAI and plant area index (PAI) from digital hemispheric canopy photographs (DHCP) using semi-supervised image classification. We then applied this framework to 201 DHCP images collected in vegetation typical of semi-arid Australia to a) quantify the relationship between LAI and PAI and b) explore potential sources of LAI model error. Utilising a random forest (RF) classifier, leaf, wood, and sky pixels were separated with a mean accuracy of 93.6% ($\pm 0.03\%$) when captured under clear sky conditions. Plant area index (PAI) was a strong overall predictor of LAI ($r^2 = 0.97$; $p = 0.001$; NRMSE = 13-16%) and accounting for the dominant vegetation type reduced directional biases in PAI to LAI conversion by up to 3%. However, accurately convert PAI to LAI necessitated individual image specific RF classifiers, accounting for canopy clumping, and *Pgap* measurements from angles close to Nadir. Our findings suggest LAI measurement error can be minimised by considering the influence of woody material on *Pgap* measurements at finer spatial scales, with the proposed method providing an effective means for estimating LAI from DHCP without paired destructive harvests.

Keyword: Semi-arid, Canopy photography, Leaf area index

OC24

CHANGES IN MULTIFACETED BIODIVERSITY ACROSS SPATIAL SCALES AND GRASSLAND TYPES

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Assessing biodiversity requires considering various aspects, including the multiple facets of biodiversity and the spatial scale at which it is measured. Whether different biodiversity facets exhibit the same patterns across spatial scales for various vegetation types remains unclear.

We aimed to observe patterns of biodiversity changes across scales and facets in different grassland types. Specifically, we asked: 1) How does biodiversity change in different grassland types across scales from the perspective of different facets of biodiversity? 2) Can hotspots at smaller scales become coldspots at larger scales, and vice versa? 3) Are there situations where a vegetation type is rich in one biodiversity facet but not in others? 4) What causes shifts in biodiversity richness: rare or common species?

We used a dataset of nested-plot series of grasslands in Ukraine, with seven grain sizes ranging from 0.001 to 100 m², and assessed metrics of taxonomic, phylogenetic, and functional diversity. By considering species presence/absence and relative cover in the community, we evaluated the influence of common and rare species.

Our results showed various shifts in hotspots and coldspots for different facets of biodiversity and grassland types across spatial scales. This was particularly evident for functional diversity, where communities were poor at small scales but rich at larger scales in meso-xeric grasslands and vice versa in steppe depressions. We also observed the significant role of rare species in biodiversity rankings. Incorporating multiple facets of biodiversity and varying spatial scales is important for accurately assessing biodiversity and prioritizing grassland conservation efforts.

Keyword: biodiversity, grassland, functional trait, Hill numbers, hotspot

Session 2A – Restoration, Conservation and Vegetation Management

OC25

FIRE ECOLOGY, PERCEPTION AND OPEN QUESTIONS

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In 1951, Heinrich Walter published a book on the Fundamentals of Plant Distribution (“Grundlagen der Pflanzenverbreitung”). Since then at the latest, it has been recognized that plant species and ecosystems in certain climate zones are adapted to and benefit from wildfires.

The Intergovernmental Panel on Climate Change (IPCC) produces reports not only on what is known about climate change, its causes and ways of mitigation, but also on ecological relationships, biodiversity and social interactions. These reports are acknowledged worldwide and influence cognition, policy and environmental management.

A comparison between empirical data on fire ecology and the analysis of IPCC reports can show the extent to which reality is reflected and perception is influenced.

The extent and severity of wildfire depends, among other things, on the amount of combustible material. This in turn is affected by the use of the ecosystem, e.g. forestry, and grazing by livestock. Unfortunately, there is little empirical data on the relationship between grazing, i.e. number of large herbivores per region, and the extent of fires. However, it can be assumed that the decline in grazing and the accumulation of flammable material in many regions, inter alia, is an important factor favoring fires.

Keyword: Global fires, climate change, flammable material and grazing

OC26

RECOVERY OF GRASSLAND FUNCTIONING AND BIODIVERSITY AFTER LARGE-SCALE RESTORATIONS

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For centuries, European landscapes have been heavily influenced by human activity and open grassy habitats have co-evolved with moderate human influence. As a result species-rich communities have developed that are now threatened by agricultural intensification, abandonment and secondary succession or afforestation of the historical low-intensity grasslands. Recent trends are showing we are experiencing a sixth mass extinction in Earth’s history with significant decrease in biodiversity, especially in the taxa adapted to open habitats.

Given the concerning state of biodiversity coupled with climate change and an increased demand for ecosystem service provision, large-scale restorations and long-term impact monitoring are essential to decelerate this trend of extinction. Considering this, the LIFE grassland restoration project “LIFE to alvars” was launched in Estonia accompanied by extensive biodiversity monitoring. By comparing biodiversity recovery, especially plant species richness in different scales in the grasslands pre- and post-restoration, we evaluated how restoring overgrown and afforested semi-natural grasslands impacts biodiversity, ecosystem service provision and the relationship between ecosystem multifunctionality (ability to simultaneously provide multiple services) and plant species richness. We found that already few years post-restoration, grasslands were characterized by quickly increasing biodiversity, with mostly characteristic and specialist plant species re-emerging. The overall ecosystem multifunctionality increased significantly post-restoration in previously overgrown and afforested grasslands. We also found there is an association between plant species richness and ecosystem multifunctionality and the relationship strength had increased post-restoration. Semi-natural grasslands are both biodiversity and ecosystem service “hotspots” in European landscapes and restoration in vital for the maintenance of important ecosystem services.

Keyword: grassland restoration, biodiversity recovery, ecosystem services, plant species richness

Session 2A – Restoration, Conservation and Vegetation Management

OC27

PREDICTING CHANGES OF AQUATIC FLORA TO GUIDE RESTORATION EFFORTS IN HUMAN-DISTURBED RIVERS

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Aquatic plants in rivers are impaired worldwide by multiple pressures, including river damming, land-use and land cover change, eutrophication, invasive species and climate change. Research around changes in freshwater plants is frequently directed to the assessment of the overall communities, both in functional and species composition. However, the prediction of aquatic flora responses to alteration of flow dynamics due to climate change and damming are understudied, and especially at mesohabitats (runs, riffles, pools). The present study is focused on the effect of altered flow regimes on aquatic plants of a Mediterranean river impaired by a hydropower plant. We sampled the aquatic vegetation in June-July 2019 in diverse mesohabitats along 17 sampling sites in the Lima River, North of Portugal, downstream of the Touvedo dam. Aquatic plants present a set of indicator taxa of specific river mesohabitats. Expected flow regime scenarios were computed from the Hydrological Predictions for the Environment (HYPE) model according to the IPCC scenarios (RCP2.6, RCP4.5, RCP8.5) and adjusted by the expected hydropower production changes forecasted for Portugal. Results showed that climate change-driven flow regimes will influence river hydraulics towards less contrasting flow conditions, and alter mesohabitats availability towards runs over riffles and pools. Variations in indicator taxa ranged from a 15% decrease to a 38% increase in abundance/coverage, corresponding proportionally to the severity of the climate change scenarios. Despite their negative impacts, dams may become important allies in counteracting climate change effects on downstream communities through the maintenance of more sustainable river flows.

Keyword: aquatic plants, ecohydraulics, climate change, regulated rivers, Portugal

OC28

CATTLE GRAZING IMPACTS BELOWGROUND PLANT COMMUNITY DIVERSITY IN TROPICAL SAVANNAS

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Negative consequences on biodiversity resulting from agricultural expansion are evident on a global scale. In tropical open ecosystems, the conversion of native vegetation into pastures for cattle grazing stands out as one of the most prevalent land use practices. Strategies based on the use of native grasslands/savannas as pastures have been suggested as a low-impact alternative to maintain beef production and preserve these ecosystems. Despite being a promising strategy, little is known about the effects of low-impact production systems in the belowground component of plant communities e.g. belowground organs and their bud bank, which are crucial for vegetative propagation and biomass regeneration. Thus, we assessed the belowground bud bank (BBB) and bud-bearing organ diversity composition across different cattle production systems in tropical savannas of the Cerrado. We investigated: a) planted pastures with exotic grasses (heavy-impact systems), b) native pastures (low-impact systems), and c) native open savannas where cattle grazing is excluded within the traditional Kalunga community territory in the Cerrado. Our findings indicate that heavy-impact cattle grazing reduces the BBB density and bud-bearing organ diversity in comparison to both low-impact systems and areas without cattle grazing. Yet, the low-impact system also had a low BBB density compared to the native open savannas. Therefore, it is evident that cattle grazing systems significantly affect the belowground component of plant communities, underscoring the necessity of considering this aspect in decision-making processes given the key importance of belowground structures on tropical open ecosystem's resilience.

Session 2A – Restoration, Conservation and Vegetation Management

OC29

PREDICTING CHANGES IN ECOSYSTEM FUNCTIONING IN COASTAL DUNES USING LONG-TERM CENSUS DATA ★

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Predicting changes in ecosystem functioning in coastal dunes using long-term census data Protected areas are generally designed to conserve biodiversity. However, how well they also contribute to maintaining ecosystem functions and services that plant diversity supports has been rarely explicitly tested. Here, we used a trait-based approach to reconstruct past ecosystem functioning and examine changes in ecosystem functions occurred over the last 15 years in protected and unprotected coastal dune ecosystems, which are among the most threatened ecosystems in Europe. First, we resurveyed vegetation in quasi-permanent plots and collected several ecosystem function variables related to erosion control, productivity, carbon, water, and nutrient cycling, across six coastal dune sites in Central Italy. Second, using these data, we assessed Biodiversity-Ecosystem Function (BEF) relationships and employed them to hindcast past ecosystem functioning based on historical vegetation surveys. Finally, we assessed temporal changes in ecosystem functioning under three protection regimes: national protected areas, Natura 2000 sites, and non-protected areas. Productivity, carbon, and water cycling increased in non-protected areas, likely due to an expansion of productive and non-native species. Within Natura 2000 sites communities showed a decrease in erosion control potential, due to the loss of important dune-building species. Only within national protected areas functions did not undergo significant temporal changes. These results suggest that on coastal dunes only high levels of protection effectively maintain ecosystem functioning stable over time.

Keyword: ecosystem functioning, protected areas, coastal dunes, functional traits, BEF, ecosystem services

OC30

VARYING PATTERNS OF PLANT COMPOSITION AND DIVERSITY IN URBAN AND RURAL GRASSLANDS

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The goal of this study was to evaluate the taxonomic and functional plant composition and diversity of urban and rural grasslands (100 km-wide buffer, Wrocław, Poland). Using the frequency-positive fidelity index as a similarity measure, we assigned vegetation plots sampled from urban grasslands to broadly defined vegetation types of semi-natural grasslands (rural grasslands). About half of urban plots were most similar to rural pastures. About one-third and one-fifth of urban plots corresponded to rural mesic hay meadows and rural alluvial meadows, respectively. In each of the three types of grasslands, we looked at the differences in ecological gradients, taxonomic and functional composition, taxonomic diversity (richness and Shannon-Wiener), and functional diversity (functional richness, functional evenness, and functional divergence) between urban and rural grasslands. For functional trait-based analyses, we used traits of the leaf-height-seed scheme. Urban and rural grasslands in each group shared a large number of species, showing that a significant amount of the diversity supported by rural grasslands is also harboured in urban grasslands. We demonstrated both parallels and differences in various aspects of diversity between urban and rural grasslands. In general, rural pastures and their urban counterparts showed higher taxonomic and functional similarity than in the case of mesic hay meadows, alluvial meadows, and their urban counterparts. We should utilise the potential of urban grasslands to preserve species diversity, thereby enhancing ecosystem functioning and services, all while ensuring sustainable urban development. This process can be enhanced with the knowledge gained from ecological studies using species-based and trait-based approaches.

Keyword: conservation, grassland management, urbanisation, species diversity

Session 2A – Restoration, Conservation and Vegetation Management

OC31

A SUMMARY ON SEED-FOCUSED REGENERATION STRATEGIES IN THE CERRADO ★

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Fire is a frequent disturbance in the Cerrado, impacting aspects of vegetation ecology, from species distribution to community dynamics. Plants in fire-prone ecosystems employ various strategies to persist and regenerate in the face of fire. Our objective is to explore how fire influences seed regeneration strategies in the Cerrado. To achieve this, we summarize key findings on seed responses to fire and post-fire regeneration strategies. Our data reveals distinct responses compared to other fire-prone ecosystems, e.g. Mediterranean vegetation. In the Cerrado, we observe species-specific responses, with limited dormancy breakage due to high temperatures and less than 30% germination stimulation by smoke. Although some species show increased germination responses when multiple factors are combined, the overall significance remains low. However, many Cerrado species possess fire-tolerant seeds, while others benefit from post-fire conditions. Forbs demonstrate notable benefits from fire, exhibiting higher percentage, faster and more synchronized germination. Additionally, seed bank studies indicate greater recruitment in burned areas, with twice as many seedlings compared to unburned areas. Although resprouting is the main strategy in the Cerrado, seeds respond to fire influence plant recruitment and contribute to post-fire regeneration success. By comprehending how fire impacts plant community regeneration, we can plan conservation actions, especially for species in the herbaceous layer, which is critical for Cerrado diversity. Moreover, understanding seed regeneration's influence on plant communities allows us to enhance germination and establishment success in restoration areas. It also informs the development of fire management plans focused on preserving plant diversity and protecting species in post-fire environments.

Keyword: seed ecology, fire ecology, germination, fire, tropical savanna

OC32

DRIVERS OF BIOTIC INTERACTIONS IN GLOBAL DRYLANDS ★

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Session 2A – Restoration, Conservation and Vegetation Management

Plant-plant interactions strongly structure dryland plant communities and contribute to diversity. Despite the importance of these interactions to ecosystem functioning in drylands, there is no consensus on whether interactions change in a predictable way along environmental gradients or in response to functional traits. It is expected that higher stress and increased trait dissimilarity leads to higher importance of facilitative interactions. Here, using a global dataset encompassing 27 sites from 10 countries, I investigate whether: (1) grazing and aridity affect interactions with dominant plants, (2) community functional diversity affects interaction outcomes, and (3) interaction outcomes are influenced by the traits of the dominant plant and the associated community. The results show that neither aridity nor grazing pressure influence the effect of dominant plants on species richness, however grazing pressure increases the positive effect of dominant plants on vegetation cover. When explicitly considering functional traits at the community level, the functional diversity of the community does not influence interaction outcomes. However, the traits of dominant plants do influence interaction outcomes, with traits indicative of conservative resource-use strategies more likely to lead to facilitative interactions. In contrast to expectations, the trait dissimilarity between dominant and subordinate species do not influence interaction outcomes. Therefore, in drylands, higher aridity and grazing is not associated with strong facilitation, despite several hypotheses that predict an increase in facilitation with environmental severity. However, the traits of dominant plants are important in determining interaction outcomes, regardless of the traits of subordinate species.

Keyword: facilitation, dryland, plant-plant interactions, functional traits, stress gradient, grazing pressure

OC33

FUNCTIONAL SUCCESSION OF FIELD MARGINS AND THE ROLE OF SUB-ORDINATE SPECIES

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Species richness and trait-based functional indicators are widely used to assess ecosystem services and policy measures of restoration. However, indicators are method-specific, affecting the interpretation and policies. We test the difference between two robust estimation methods of indicators on functional succession in newly formed grassy field margins. We asked, does the ecological functionality of expanded grassy field margins improve over the decade of succession and how much subordinate species affect the functional interpretation. The status of ecosystem service-related functional traits was estimated in parallel using different precision levels in the data for 435 field margin releveés. The interpretation of functional succession depended on the estimation method. Trends were more evident when only abundant species were considered. When we used the data set of all species data, various richness-based indices only fluctuated between years. Among abundant species, some functional traits stabilized after five years, and others became more prevalent only during the last years. Changes in functional diversity became evident only when abundant species were used. The abundance weighting (community-weighted mean) had a minor adjusting effect relative to the results using the occurrence data of all species. We conclude that during the 12 years of grassy margin succession, observed trends of functional indicators depended on the precision level of species data. The sub-set of abundant species should be preferred as more relevant to the intensity of ecosystem services.

Keyword: functional traits, vegetation succession, landscape management, functional indicators, ecosystem services

Session 2B – Historical Vegetation Ecology

OC34

A NEW CHECKLIST OF THE WESTERN IBERIAN OAK FORESTS AND TALL-SHRUB COMMUNITIES (*QUERCUS* L.)

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The western Iberian Peninsula emerges as a hotspot for oak diversity. The plethora of contrasting edaphoclimatic envelopes promotes the coexistence of distinct potential oak vegetation series, across the Landscape. We revised and compiled all the geobotanical information, retrieved from 160 works, since 1956 to the present, including biogeography, diagnosis, and species composition.

Broad results encompass a total of 1171 georeferenced sites and 1581 plant species, distributed across 123 botanical families, which are ruled by Asteraceae (11.7%), Fabaceae (9.5%), and Poaceae (9%). Biological types include Hemicryptophytes (626), Phanerophytes (298) and Therophytes (252) as dominant. We updated the name of one alliance, one sub-alliance and thirteen phytosociological associations, deeply related with recent phylogenetic and nomenclatural updated of oak species (*Quercus orocantabrica*, *Q. faginea* and *Q. pseudococcifera*), with deep implications for the syntaxonomy of class *Quercetea ilicis* in Western Mediterranean Sub-Region.

Finally, this work provides a strong foundation for developing a contemporary analysis of the Portuguese Potential Natural Vegetation and will feed most-needed niche ecological modelling exercises. These will forecast species and forest associations turnover in response to future climatic scenarios. Forwardly, this work will give practitioners thematic and biogeographically informed data where to apply tailored floristic casts, to serve as base for habitat restoration initiatives from local to the national level.

Keyword: Phytosociology, Potential Natural Vegetation, Biogeography, Mediterranean Forests

OC35

60 YEARS OF MACROPHYTE VEGETATION CHANGES IN STANDING WATERS OF NORTHWEST GERMANY ★

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The last century has brought profound changes to freshwater habitats, marked by anthropogenic eutrophication and landscape alterations. To understand how these environmental changes affected aquatic macrophyte communities, we investigated their richness and composition changes over more than 60 years across different types of standing waters in Lower Saxony.

We compiled historical vegetation data from 125 water bodies out of 13 sources, collected between 1921 and 1968. We resurveyed 100 of the 106 today existing waters during the years 2019 - 2021 and compiled data from current monitoring programmes for the remaining six water bodies. For each period the data were aggregated into a presence/absence scale per water body. We analysed a set of 83 species that were assumed to be recorded consistently across all surveys.

The total macrophyte species pool and the mean number of species per water body decreased by 18% (from 79 to 67 species) and 26% (from 8.9 to 6.6) respectively between the historical and the recent period. Both, red-listed and common species, were among the species most affected by decline. Species loss and compositional turnover resulted in considerable change in species traits, showing a shift towards pleustophytic and emergent vallisnerid growth forms and a clear increase of mean nutrient indicator values (from 5.33 to 5.72). This development is pointing out a continuous increase in nutrient loads, causing higher water turbidity. We will further consolidate our data and add records from an intermediate period, to analyse the causes and consequences of the detected changes more precisely.

Keyword: freshwater macrophytes, historical changes, vegetation dynamics, species traits, eutrophication

Session 2B – Historical Vegetation Ecology

OC36

PLANT SPECIES ECOLOGICAL PREFERENCES REFLECT TWO-CENTURY-OLD LAND-USE IN CENTRAL EUROPEAN HERBACEOUS VEGETATION

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Historical land-use legacies are thought to influence contemporary plant communities through the local persistence of remnant taxa and the enduring ecological conditions from the past. We tested the effects of historical land-use legacies on contemporary species richness, composition, and ecological preferences of vascular plants in the herbaceous vegetation of Central Europe. We analyzed 7,193 vegetation plots across four main habitat categories (dry, mesic, wet grasslands, and woodland fringes) surrounding the border between Austria and the Czech Republic. Using military maps from the former Austrian Empire (1807 to 1870), we assigned each plot to a historical land-use category (arable land, forest, grassland, settlement, permanent crop, and water body). We modeled the response of species richness, composition, and plant ecological preferences to historical land use. Historical land use overall explained little variation in species richness and composition, whereas more variation was explained by contemporary environmental conditions. However, we found a clearer signal of species ecological preferences: species-level indicator analyses revealed consistent patterns associated with specific land-use categories. For example, species associated with past forested sites showed overall lower light and disturbance frequency indication, and those associated with settlements displayed higher disturbance and nitrogen indication. Our findings suggest that local historical land-use legacies affect plant species' ecological preferences but exert moderately low influence on plant diversity and composition. Conservation and management practices promoting heterogeneity in environmental conditions and disturbance regimes reflecting historical land-use conditions may be relevant for maintaining functional and niche diversity in herbaceous plant communities.

Keyword: bioindication, Ellenberg indicator, European history, grassland conservation, hemeroby, historical landscape, species richness, variance partitioning

OC37

GRASSLANDS RESURVEY ALONG AN ELEVATION GRADIENT OF THE ALPS

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Alpine valleys have faced escalating land-use changes in recent decades combined with a remarkable decline in traditional management. Grasslands are likely the most affected by these transformations. This study investigates the multifaceted changes in communities and species over the past three decades in a major valley of the Italian Eastern Alps, and examines whether changes occur uniformly across different elevations. In 2022, we resurveyed 133 vegetation plots (including vascular plants, mosses and lichens) originally sampled in 1986-1988. Plots were mostly in grasslands and span along an elevation gradient ranging from 430 to 2408 m a.s.l. We analysed the variation in life forms, species richness and beta diversity along elevation gradient and over time. We also quantified the number of winning, stable and losing species, and woody and alien species. We observed elevation-dependent changes in community and floristic composition. Many grassland types were transformed into different grassland types or different vegetation types such as forests and man-made habitats. Species richness varied along the elevation gradient over time, with a marked change at low and high elevation. Therophytes increased in the lowest elevation belt, while hemicryptophytes increased in the highest belt. Overall, we noted significant increases in thermophilic, nitrophilous and generalist species. In the middle elevation belt, many dry grassland species were replaced by alien, nitrophilous and woody species. High elevations witnessed species loss, primarily of mountain specialists. Communities and flora of sampled grasslands have undergone substantial changes over three decades due to land-use alterations.

Keyword: elevation gradient, grasslands, grazing, plant diversity, land-use changes, species richness, vegetation change, vegetation resurvey

Session 2B – Historical Vegetation Ecology

OC38

CLASSIFICATION OF SUBALPINE TALL HERB UMBELLIFEROUS VEGETATION OF THE IRANIAN PLATEAU

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In this study we aim to present the first comprehensive syntaxonomic overview of subalpine Umbelliferous vegetation of the Iranian Plateau. Based on our vegetation plot data and published data from different mountain systems of the region, we provide a dataset of almost 300 vegetation plots. They usually cover steep slopes with high proportion of scree in the subalpine belt of the region. The plots were analyzed by modified TWINSpan with four cut levels of 0, 5, 25, and 50. Diagnostic species were identified by constancy measure and phi coefficient as a fidelity measure. DCA was used to find the relationship between the associations and environmental variables. Analysis of the plots resulted in 14 meaningful groups. We assign the communities of this vegetation type to the class *Pangetea ulopterae* which was introduced before and verified in this study. We describe two new orders, *Ferulagetalia angulatae* (distributed over Zagros-Kerman mountains) and *Prangetalia ulopterae* (distributed over the whole study area), three alliances (*Ferulagion angulatae*, *Ferulion persicae*, *Ferulion ovinae*) and 14 associations. Geographic distribution, proportion of scree, and slope degree were the main factors determining the species composition of the vegetation units. Our study expands the knowledge about the syntaxonomic classification and diversity of this vegetation type in Iran. Further studies are necessary to fill the gaps and find the syntaxonomic relations/links of the Iranian *syntaxa* to other adjacent regions.

OC39

BIODIVERSITY AND COMPOSITION CHANGE IN SWISS GRASSLANDS OVER MORE THAN ONE CENTURY

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European grasslands are among the global alpha diversity hotspots, but many types are now threatened. Due to a lack of high-quality historic data the amount of biodiversity loss was unclear. We resampled 416 historic vegetation plots (1884 to 1931) of 0.09 m² from a wide range of grassland types across Switzerland. This allowed us to assess the changes of taxonomic, functional, and phylogenetic diversity and species composition in an unprecedented comprehensiveness. Specifically, our objective was to test whether the magnitude of change in diversity or composition measures varied with elevation.

For each historic plot, we resampled 3-5 randomly distributed new plots in the area where the historic plot was most likely located. We used mixed models to compare the diversity and composition variables between the historic and the new plots, and linear models to test whether the magnitude of change varied with elevation.

Taxonomic, functional, and phylogenetic diversity were significantly lower in the new than in the historic plots. The loss in all three diversity metrics decreased with elevation. This was linked to higher increases in mean ecological indicator values of nutrients, mowing tolerance, and hemeroby at low than at high elevations. By contrast, mean temperature indicator values increased less and at a similar rate throughout the elevational gradient. Among the c. 800 species, 102 significantly gained and 41 lost frequency. Our study suggests that during the study period, land-use change was the major driver of grassland changes, while climate change played a subordinate role only.

Keyword: biodiversity, climate change, ecological indicator value, global change, grassland, land use change, macroecology, quasi-permanent plot, resurvey, species composition, Switzerland, vegetation plot

Session 2B – Historical Vegetation Ecology

OC40

NATURAL DISTURBANCES MODULATE CHANGES IN TEMPERATE FOREST VEGETATION OVER THE LAST CENTURY ★

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The development of vegetation resurvey methods using historical data has provided great opportunities for long-term studies of ecosystem changes. Research on quasi-permanent plots is particularly important for examining vegetation responses to accelerated environmental changes in recent decades. It is generally believed that the most important driving force behind recent changes is related to global changes.

Climate change is a key component of global change that increases the frequency of extreme phenomena, resulting in large-scale natural disturbances. The individual impacts of natural disturbances on forest vegetation have been well studied. However, resurvey studies on forest ecosystems usually exclude plots that have been affected by stand-replacing disturbances and therefore focus on other drivers, including climate warming and nitrogen deposition. Therefore, little is known about the joint effects of global changes and natural disturbances on forest ecosystems.

In this research, we examined two alternative scenarios of changes in forest dynamics over the last century, including undisturbed old-growth forests and forests affected by natural disturbances. This study was conducted in the Tatra Mountains (southern Poland) based on historical plots from 1920s. In 2022-2023 we resurveyed these plots using a twin-plot approach, that is, locating one new plot in an undisturbed forest and one plot in forests that were disturbed by windthrow. This was possible because the study area constituted a dense mosaic of forest succession stages: old-growth forests, regeneration stages, and recent windthrows. Our initial results suggest that forests affected by recent natural disturbances are more diverse and show greater functional and taxonomic variability.

Keyword: vegetation resurvey, forest disturbances, twin plots, global change, species composition

OC41

ACCELERATING CHANGE OF TEMPERATE FOREST VEGETATION IN THE CARPATHIANS OVER 55 YEARS

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Rapid vegetation change is expected as a consequence of increasing anthropogenic pressure on ecosystems and synergistic effect of multiple interacting drivers. Various trajectories of understorey vegetation development were already identified in the European temperate forests. However, their dynamics is still unknown. To reveal the temporal developmental patterns during the last five decades in Carpathian forests, we analysed 133 relevés of twice resampled (in 2005–2008 and 2019–2023) permanent plots (set between 1958–1976) in oak and beech dominated forests across Slovakia. The mean annual rates of vascular-plant understorey properties were compared and tested to demonstrate an acceleration of vegetation change.

Species richness decreased in the oak dominated stands while remained unchanged in the beech forests. Species pool decreased in oak forests and a species homogenization was found in the understorey of the beech stands. The most rapid change was detected in a total herbaceous species cover which significantly decreased in both community types and resampling periods. Expected acceleration was approved especially in the species turnover. Its annual rate expressed by Bray-Curtis index was significantly higher in the period between 2005 and 2023 in all regions and community types, and it was recognized as an effect of climate and management change. Magnitude of changes was higher in the oak forests where novel communities formed largely by eutrophic forest generalists were observed in the latest decade. In the montane mixed forests, a shift towards the submontane beech forest understoreys was observed during the three decades of the climate warming.

Keyword: Anthropogenic changes, homogenisation, Slovakia, species turnover, vegetation dynamics

Session 2B – Historical Vegetation Ecology

OC42

HISTORICAL DEVELOPMENT OF AN ALPINE MEADOW – THERE AND BACK

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In the Jeseníky Mountains in the North of the Czech Republic, the grassland above the timber line has been used since the Middle Ages. The alpine meadows were used for grazing, the latter for harvesting hay. The mountain hay was of high quality due to high content of forbs – plants other than graminoids.

However, since the 19th century and due to the increased demand for timber, there have been various attempts to rise the timber line. This led to the introduction of *Pinus mugo* in hopes that it would ease growing spruces (*Picea abies*). The timber line did not climb up but *Pinus mugo* stayed. However, after more than hundred years, it spread widely and possibly due to various environmental impacts, it started to behave invasively. In 2022, the administration of the Jeseníky Nature Reserve decided to fell the dwarf pine growths and remove the biomass, leaving just tree stumps and a thick layer of fallen needles which impede plant growth somewhat.

My aim is a throughout review of historical documents and I hope to find a more detailed description of the alpine meadows flora. Along the archival research, I have set up observation areas to follow the succession of the original grassland after the removal of *Pinus mugo*.

There is a long term plan to reintroduce historically attested flowers from nearby areas to those from where *Pinus mugo* has been removed, should the administration of the Nature Reserve permit.

Keyword: grassland

OC43

ESTIMATING SPECIES RICHNESS IN A COMMON LANDSCAPE: INSIGHTS FROM STRATIFIED RANDOM SAMPLING IN CZECH GRASSLANDS

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Large vegetation-plot databases gather data from various sources, recorded for different purposes and with different sampling designs. Therefore, the density of vegetation-plot records varies considerably across space as more attractive areas and habitat types are sampled more intensively than others. Preferential sampling or different sampling approaches can also lead to an over-representation of plots from either species-rich or species-poor vegetation types in certain regions. This can cause significant biases when using vegetation-plot databases for modelling and mapping local species richness in a common landscape. By implementing the environmental stratification approach based on the intersection of phytogeographic region, habitat type, bedrock type and conservation status of an area, we aimed to collect representative data on grassland vegetation across the Czech Republic. Over the last two years, we have recorded vegetation plots at 347 of 809 randomly selected sites within the above-mentioned strata and compared them with vegetation plots from the same regions and vegetation types stored in the Czech National Phytosociological Database. Our preliminary findings show a similar distribution of species richness across the country, but indicate that the stratified random sampling design results in vegetation plots with higher species richness compared to the plots in the database. However, these plots exhibited a lower proportion of habitat specialists, lower Shannon diversity and a higher presence of alien species. These differences underscore the importance of using systematic sampling strategies to obtain more balanced data and better understand the distribution of local species richness.

Keyword: grasslands, environmental stratification, systematic sampling, vegetation-plot database, species richness

OC44

PREDICTING THE POTENTIAL AREA OF OCCUPANCY OF HABITAT TYPES AND THEIR SUCCESSIONAL STAGES AT A BIOGEOGRAPHICAL SCALE ★

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Understanding the spatial distribution of ecosystem types across large regions is crucial for monitoring and conserving biodiversity. Within Europe, ecosystem mapping is generally based on the EUNIS habitat classification system, which considers diagnostic plant species to describe ecosystem types. We used 14755 vegetation plots classified into EUNIS groups to predict the potential area of occupancy (AOOp) of habitat types in the Ibero-Atlantic biogeographic region (NW Spain and N Portugal). We evaluated model performance across 70 different habitat types: 20 forests, 27 shrublands and 23 grasslands, also testing whether early- and late-successional habitat types differed in their edaphic and climatic drivers. The models were computed with Random Forest using geographically stratified cross-validation, after preliminary tests computed with Generalized Linear Models, Generalized Additive Models and Gradient Boosting Models.

Our models showed high predictive performance values (mean ROC-based AUC = 0.82 in forests and grasslands, and 0.83 in shrublands). We detected noticeable differences in the variability of variable importance between early- and late-successional habitats, with late-successional habitats showing greater variability and being more strongly influenced by climatic factors. The models computed for late-successional habitats outperformed the early-successional ones (ROC-based AUC = 0.86 and 0.75, respectively). Our results suggest that correlative models based on the occurrence of ecosystem types are useful to understand spatial patterns of biodiversity and to test hypothesis about the climatic drivers of early- and late-successional habitats. Modelling the AOOp of habitat types is also a preliminary step for establishing a long-term monitoring system for the conservation status of different ecosystems.

Keyword: ecosystem modelling, habitat modelling, biodiversity, ecological succession

Session 2C – Ecoinformatics and Models in Vegetation Science

OC45

ARTIFICIAL INTELLIGENCE FOR HABITAT MAPPING: EVALUATING STRENGTHS AND WEAKNESSES AT A REGIONAL SCALE

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A demand for accurate, efficient, and up-to-date habitat mapping methods is a pressing concern in the field of ecology and conservation. Deep learning holds immense promise in meeting these demands, pushing the boundaries of traditional mapping techniques. By leveraging the power of deep learning, ecologists can unlock unprecedented insights, ultimately fostering more informed and effective strategies for preserving our planet's biodiversity and natural resources.

This work assesses the benefit of modelling not only the spatial distribution of biodiversity patterns but also its temporal variability thanks to the high temporal resolution available of satellite imagery (e.g. Sentinel 2) of the Copernicus Programme. Here, we build a 3-dimensional CNN to classify 27 habitat types in northern Spain. The model is trained with more than 20000 in-situ observations sampled and validated with expert criteria and then generalised for the entire Cantabria region with a spatial resolution of 10 metres.

Resulting models were post processed following a framework for mapping the area of occupancy (AOO) of habitat types, providing a standardised and affordable approach for estimating the AOO at different spatiotemporal scales. Accuracy metrics and the spatial distribution of error allowed comparing performance and predictive capabilities of data mining and AI algorithms for habitat mapping.

The synergy between ecological information, RS-based predictors, and AI modelling capabilities opens up new frontiers in ecological research. It empowers researchers to extract valuable insights from complex and diverse datasets, enabling a more holistic understanding of ecosystems and facilitating informed decision-making for sustainable management strategies.

Keyword: Habitat Mapping, Remote Sensing, Essential Biodiversity Variables, Copernicus, Natura 2000, Conservation Status

OC46

CONTRIBUTION OF THE URBAN RUDERAL VEGETATION TO N, P AND S CYCLES ★

Miriam García (Spain)¹; José Ramón Quintana (Spain)¹; Raquel Pino (Spain)²; Jose Antonio Molina (Spain)¹

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Urbanization is experiencing a significant growth and urban greenspaces are important for the development of cities. Vegetation is one of the most relevant component of urban greenspaces within which ruderal plant-communities have a relevant role by their contribution to supporting ecosystem services including biodiversity maintenance. However, their role in macronutrient cycles is barely known. Our study was focused on four of the most widespread ruderal vegetation types in the Mediterranean cities (annual grasslands, annual herbs communities on roadsides, perennial herbs communities and perennial grasslands). Our main objective was to study N, P and S content in plants and soils and their relationship to enzyme activities related to their cycles.

Plant biodiversity and productivity were determined in 48 plots. N, P and S soil content was determined in each plot, besides in the leaves and roots of plant species identified as faithful taxa for the study plant-communities. A GLM was used to determine the influence of community type on vegetation structure and macronutrient content. Preliminary results showed that roadside vegetation was related with a high alpha-diversity and soil aryl-sulfatase activity. Besides, *Diplotaxis virgata*, had a high N and S content in their leaves. Perennial herbs showed the highest primary production and were related to a high soil N content. *Malva* species showed a high N content in leaves. Annual grasslands had the higher abundance. We conclude that ruderal vegetation provides supporting ecosystem services according to the community type, which should be considered in the conservation and management of Mediterranean urban greenspaces.

Keyword: Urban flora, Ruderal vegetation, Nutrients cycles, Ecosystem services

Session 2C – Ecoinformatics and Models in Vegetation Science

OC48

LAND SURFACE PHENOLOGY APPLICATIONS TO MEDITERRANEAN PERMANENT GRASSLANDS VEGETATION

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Mediterranean permanent grasslands play a key role in biodiversity conservation and offer a range of ecosystem services [1, 2]. However, they are under threat in southern Europe due to abandonment and environmental pressures [3, 4]. In this study, we explored the hypothesis that a set of Land Surface Phenology (LSP) parameters derived by high spatial and temporal resolution Copernicus Sentinel-2 satellite data, can provide a fine characterization and long term monitoring of a variety of vegetation and management systems of permanent grasslands, to support the design of conservation and agronomic improvement programs. We focused on LSP parameters against ground proofs based on vegetation and agronomic surveys, to obtain useful information from agronomic and ecological perspectives. Forty-nine polygons, representing eleven sites characterized by different grassland vegetation, soil, climate, and management types, were selected in Sardinia (Italy). Six years Sentinel-2 satellite images were processed to derive NDVI, and LSP parameters were obtained using TIMESAT 3.3 software. The results showed a clear correspondence between LSP parameters and a set of indicators relevant from the vegetation and agronomic points of view including 1) grassland vegetation as described by a principal component analysis, 2) managed vs. abandoned grasslands, 3) wooded vs. open grasslands, 4) climatic gradients (altitude) and specific management practices (mown vs. unmown). In conclusion, the LSP provides a promising proxy to characterize relevant vegetation and agronomic features of Mediterranean permanent grasslands, useful to support conservation and improvement programs, as well as the monitoring of grassland-related habitats threatened by management or environmental pressures.

Keyword: NDVI, TIMESAT, Land abandonment, Grassland management, wooded grasslands

OC49

PALEOBOTANICAL DATA ENHANCES PAST PREDICTED DISTRIBUTION OF AN EVERGREEN WOODY GENUS (*ARBUTUS* L.)

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1 - University of Porto; 2 - Sapienza University of Rome; 3 - BIOPOLIS; 4 - CIBIO; 5 - IPVC; 6 - Universidad De Cordoba; 7 - INBIO; 8 - Uppsala University

Hindcasting is a widely used method to predict the past distribution of plant species. However, the general lack of past observations hampers the accuracy of the predicted suitable areas. Here we provide the modelled distribution for the genus *Arbutus* in the Macaronesian-Mediterranean region, including confirmed paleobotanical occurrences to calibrate the ecological model for seven bioclimatic periods from the Last Glacial Maximum to the late Holocene and to compare them with the traditional hindcast method. The ensemble distribution model was based on high-resolution occurrence records and bioclimatic variables respectively retrieved from literature and databases. The Spearman indicator enabled the selection of variables with lower correlation. Past data consist of calibrated pollen and macrofossil records. First, we trained the model for current conditions and then generated hindcasts for each past period. We evaluated the accuracy of hindcasts for each period using a confusion matrix (modelled vs observed). Secondly, we trained models with fossil occurrences for each past period and then validated them through the same matrix. We also assess the Spatial Coherence among different methods over time by applying Jaccard's similarity index.

Results show differences in predicting the suitable area among the different methods. The Balanced Accuracy shows a high magnitude discrepancy between Hindcasted projections and projections calibrated for each period (Presence-Only; Presence-Absence; Presence-Absence+ pseudoabsence), and accordingly, the Spatial coherence presents a chronologically increasing reliability.

This work highlights the importance of including paleobotanical records to increase the accuracy of species' past projections and improve the quality of historical biogeography questions.

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Keyword: Hindcast, Ecological modelling, Biogeography, Postglacial dynamics

OC50

UNVEILING SUSTAINABILITY: INSIGHTS FROM VEGETATION ASSESSMENT IN SOUTH AFRICAN RANGELANDS

Clement Cupido (South Africa)¹; **Igshaan Samuels** (South Africa)¹; **Julius Tjelele** (South Africa)¹; **Gilbert Pule** (South Africa)¹; **Andiswa Finca** (South Africa)¹; **Letsoalo Ngoako** (South Africa)¹

¹ - *Agricultural Research Council*

The South African Long-term Rangeland Vegetation Assessment Project is a pivotal endeavour aimed at comprehensively understanding vegetation dynamics, particularly within South Africa, where 70% of the land is classified as rangeland. This project encompasses 1,500 sites across seven distinct biomes, aiming to assess vegetation dynamics and inform sustainable rangeland management practices. At its core, the project seeks to evaluate the current health status of South Africa's rangelands and analyse how it has evolved over time and space. To accomplish this overarching goal, the project delineates a series of specific objectives. Firstly, it seeks to develop and standardize rangeland indicators tailored to the diverse biomes present within the region. Additionally, the project aims to ascertain the level of plant diversity within various rangeland ecosystems, shedding light on the intricacies of biodiversity within these dynamic landscapes. Furthermore, it seeks to identify the drivers of land degradation and document the extent of such degradation across the surveyed areas. Through rigorous evaluation, the project aims to discern patterns of rangeland change over time, discerning the influence of both management practices and environmental factors, including climate change. Finally, the project endeavours to establish a robust long-term vegetation monitoring database and interactive system, ensuring the continuity of monitoring efforts and facilitating ongoing research and analysis. By adopting a multifaceted approach that integrates ecological and agricultural perspectives, the project enriches our understanding of ecosystem dynamics and resilience, laying a solid foundation for informed management strategies and policies aimed at preserving the integrity of South Africa's rangeland ecosystems.

Keyword: vegetation assessment, rangeland monitoring, biomes, data management, sustainability

Session 3A – Restoration, Conservation and Vegetation Management

OC51

SAGEBRUSH RESTORATION AND THE QUESTION OF SEED PROVENANCE

Scott Franklin (United States of America)¹; **Michell McLaughlin** (United States of America)¹; **Emily Schumacher** (United States of America)²; **Gwen Wion** (United States of America)³; **Jordan Conley** (United States of America)¹; **Raymond Erskine** (United States of America)¹

1 - University of Northern Colorado; 2 - USFS; 3 - Institute of Applied Ecology, NM

The Seeds of Success (SOS) program focuses on restoring habitats using locally collected seeds assumed to be better adapted. However, this assumption has not been widely tested. We hypothesize that local seeds germinate and survive better than non-local seeds, which we tested within the Sagebrush Steppe ecosystem near Kremmling, CO, USA. We examined seeding success via counts and relationships of germination and genetics. Seed of seven target species were obtained from the SOS program from three spatial scales: 1) local – within 100 km of the restoration site; 2) regional – within 200-400 km of the restoration site; and 3) global →400 km from the restoration site. Experiment trials were organized into a randomized block design. Each block contained eight 2 x 2 m² plots with one of eight treatments (all combinations) of 36 total seeds per plot. Central sites had the greatest seedling density and diversity, particularly with the local accession. Control sites were the lowest in density and diversity, suggesting the influence of planted accessions, at least for the first two years. Among seven target species, the interpretation was the same. Local accessions generally had higher diversity, composition, and survivorship. Plots with local seeds developed different communities than those with non-local seeds, but less so for only target species. Genetics data show weak relationships among germination potential and genotype. While heterozygosity was positively related to germination variables, Inbreeding was negatively related, suggesting selection for outcrossing and plasticity. Our data partially support the importance of local seeds in restoration.

Keyword: sagebrush, restoration, provenance, local seed

OC52

LITERATURE REVIEW ON SEED DISPERSAL BY WIND TO ENHANCE NATURAL REGENERATION PRACTICES

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1 - Sangji University

The research team consists a biogeographer and forest ecologists working together to discover the interaction between seed dispersal, wind, and forest management. The research occurs with field observation, experiment, geospatial analysis, and modeling of seed dispersal and aims to support natural regeneration and plant conservation in the field. Seed dispersal is a factor that affects plant succession, importance of natural regeneration using seed dispersal increases due to the climate change agreement. This study aims to identify the current status of seed dispersal, investigate seed dispersal according to morphological characteristics of various species through meta-analysis, and suggest improvements to increase the utility of seed dispersal in natural regeneration. Key variable data was collected by reviewing the global plant databases and previous literatures. We analyzed seed dispersal by the morphological features and derived a method to improve the usability in natural regeneration. As a result of the study, the only available data was seed mass and terminal velocity. In the relationship between seed mass and terminal velocity, types with relatively large diaspores area was likely to have lower terminal velocity due to longer residence time in the air. If the terminal velocity relative to the mass is low, its dispersal could be more affected by the wind. Therefore, under the same conditions, as the area of diaspores becomes wider, the probability of dispersal distance increases. However, because most studies are focused on specific species and there is insufficient data, the utility of natural regeneration which is composed of various species was found to be low. To overcome these limitations, 1) improvement of the data collection system, 2) production of morphological data on diaspores, 3) establishment of scientific basis through cross-validation on the same species, and 4) development of a general model applicable to various species are required.

Keyword: forest regeneration, seed dispersal by wind, terminal velocity, seed mass, morphological characteristics

Session 3A – Restoration, Conservation and Vegetation Management

OC53

LAND USES AND NUTRIENTS DIFFERENTLY MODIFY PLANT COMMUNITY TEMPORAL AND SPATIAL STABILITIES

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Land uses and increases in nutrient loads are global change drivers that modify the diversity and biomass of grasslands, with unknown consequences on the temporal and spatial stability of various attributes of plant communities. We aim to understand the interactive effect of land uses and fertilization on the stability of plant alpha diversity (species richness), beta diversity (composition dissimilarity), and live biomass, and if their responses differ in terms of temporal vs. spatial stability. In a temperate grassland (Flooding Pampa, Argentina), we manipulated land uses (grazed, mowed, or abandoned) and nutrients (unfertilized or fertilized with nitrogen, phosphorus, and potassium) in a factorial design (n = 6-block, 10-yr). We found that land uses and nutrients differently modified the temporal and spatial stability of plant diversity and biomass. Abandonment reduced the temporal and spatial stability of alpha and beta diversity but increased the temporal stability of biomass, compared to grazing and mowing. Fertilization reduced the temporal and spatial stability of biomass and the spatial stability of richness. The stability responses of both diversity measures covaried positively, but biomass stability was non-related to them. Additionally, the stabilities of each diversity metric were positively correlated between time and space, while this was not observed for biomass stability. Our results reveal the complexity of plant attributes responses to global change drivers. This highlights the necessity of considering various community attributes and the underlying mechanisms of their responses to fully understand global change impacts across both time and space in grasslands.

Keyword: Aboveground plant biomass, Composition dissimilarity, Flooding Pampa, Argentina, Grazing, Land abandonment, Mowing, Fertilization, Species richness

OC54

ARE PEAT TRANSLOCATIONS BENEFICIAL TO THE DEVELOPMENT OF ALDER CARRS (EUROPEAN HABITAT)

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The construction of dikes along large waterways implies the use of large amounts of sand, used in the core of the dike, and clay, used as cover layer. In general clay is available in limited amounts. If possible it is extracted locally. Besides, peat is often found in the underground where dikes are constructed. Since peat isn't the ideal basis to build a dike on, this material is often excavated. The digging of clay and refilling of the arisen pits with peat could be a solution for the shortage of clay and the excess of peat. Furthermore, an earlier small experiment along the Schelde (Belgium) demonstrated that forest development on these sites is possible. In a renewed experimental design the preconditions for soil translocations were determined to develop alder carrs specifically. To achieve this, peat and mineral soils were whether covered by peat or not. The presence of a shallow peat layer in the eastern part of the project site and the specific hydrologic preconditions for the development of alder carrs were also taken into account. Ultimately, four different treatments were selected with four replicas per treatment. The vegetation development was observed in permanent quadrats and compared with the vegetation development in the reference areas from 2010 until 2018. Since those alder carrs are a priority habitat type, we attempted to determine if this vegetation type could develop on peat translocation sites.

Keyword: alder carrs, restoration experiment, soil translocation

Session 3A – Restoration, Conservation and Vegetation Management

OC55

MICRO-SCALE PLANT DIVERSITY IN TRADITIONAL WOOD PASTURES ★

Thuy Hang Le (Germany)¹; **Stefan Zerbe** (Italy)^{1,2}; **Adrian Indreica** (Romania)³; **Alessandro Bricca** (Italy)²; **Gabriel Tofan** (Romania)³; **Johann Janssen** (Germany)⁴; **Martin Sauerwein** (Germany)¹; **Gianmaria Bonari** (Italy)^{5,6}

1 - University of Hildesheim; 2 - Free University of Bozen-Bolzano; 3 - Transilvania University of Braşov; 4 - Leibniz University Hannover; 5 - University of Siena; 6 - National Biodiversity Future Center

Wood pastures are characterised by open grasslands with isolated solitary trees. Particularly the solitary trees create diverse micro-environments beneath tree canopies that influence plant communities. However, the impact of micro-environmental gradient variation below tree canopy on plant diversity has not been adequately addressed yet. This research investigates the influence of solitary tree canopies on plant community diversity and composition in Romanian wood-pasture systems. We conducted stratified random sampling at 30 sites in Transylvania, investigating 360 plots along a micro-gradient of tree canopy projections—from under to outside—as a proxy for varying shadow conditions. Data on solitary tree structures, species cover, plant traits and ecological variables were collected. We found distinct shifts in vascular plant community composition along micro-environmental gradients from under the canopy to outside areas, primarily due to changes in light availability and nutrient conditions. Decreasing light availability reduces species and functional diversity in line with the filtering effect of canopy cover. Lastly, the establishment of seedlings of woody species under the canopy projection suggested a reduction of competition with grassland species and a facilitation process exerted by adult trees. Solitary trees play a crucial role in creating favourable conditions for shade-tolerant and woody species within wood pastures. Our findings underscore the importance of solitary trees in promoting different plant communities at a microenvironmental gradient. We suggest the application of patchy management of wood pastures with scattered maintenance of woody species and simultaneous cutting of shrubs at places to prevent succession in case of abandonment.

Keyword: agroforestry system, ecological filtering, solitary tree, vascular plant diversity, Romania, wood pasture

OC56

INFLUENCE OF A VIRULENT SOIL PATHOGEN ON UNDERSTOREY SAPLING POPULATION DYNAMICS

Bruce Burns (New Zealand)¹; **George Perry** (New Zealand)²; **Peter Bellingham** (New Zealand)³; **Toby Elliott** (New Zealand)¹

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Forest tree pathogens can affect the population dynamics of canopy or emergent (overstorey) tree species, likely impacting co-occurring understorey sapling populations. The regeneration potential of infected susceptible species populations and competing resistant allospecifics will depend on the direct impacts of the disease on sapling populations and the changes associated with the declining overstorey. We aimed to assess the likely impacts of a soil-borne pathogen *Phytophthora agathidicida* (PTA), on the sapling population dynamics of the disease-susceptible, locally dominant canopy tree, the conifer kauri (*Agathis australis*, Araucariaceae), and of likely resistant allospecific trees, split by their shade tolerances. We conducted this analysis in four kauri-dominated permanent plots in warm temperate New Zealand rain forests, two of which had adult kauri showing intense visual PTA symptoms. We examined the association between kauri adults and saplings using point-pattern analysis and the relationship between the level of crowding around kauri saplings and their growth and survival rates. We also compared the growth and survival rates of kauri and allospecifics, split by their shade tolerances as saplings, between these sites. Kauri forms sapling banks under conspecific adults that reduce in number as the forest matures and through infection by PTA. The sapling growth rates, however, of kauri and light-demanding allospecifics were higher in symptomatic stands, with more minor differences for more shade-tolerant species. PTA changes the impact of kauri-dominated canopies on co-occurring saplings, and understanding these effects can help us understand the population-level implications of PTA on kauri and how it affects infected forest stands.

Keyword: pathogen, conifer, sapling, competition, disturbance, *Phytophthora*, kauri

Session 3A – Restoration, Conservation and Vegetation Management

OC57

MODELLING ECOLOGICAL STATE AND CONDITION MAPS TO SUPPORT KNOWLEDGE-BASED DECISION-MAKING IN AREA MANAGEMENT AND SPATIAL PLANNING (ECOMAP)

Vigdis Vandvik (Norway)¹; Liv Velle (Norway)²; Joachim Topper (Norway)³; Joseph Chipperfield (Norway)³; Alistair Seddon (Norway)⁴; Rune Halvorsen (Norway)⁵; Adam Klimes (Norway)⁴; Adam Naas (Norway)⁶

1 - University of Bergen; 2 - NIBIO; 3 - NINA; 4 - UiB; 5 - UiO; 6 - University of Oslo

The global biodiversity and climate crises pose major threats to ecosystems and human lives and livelihoods. Despite a solid global understanding that land-use changes are a major driver of these dual crises, and that policies and actions to halt and reverse the loss and degradation of nature are urgently needed, society is still far from delivering on these goals. We argue that this policy failure stems from a lack of relevant knowledge and understanding at the scale, and in a format, of relevance to the local and regional decision-makers that hold the key to land-use transformation. Here we report on progress in the ECoMAP project, which aims to bridge knowledge and implementation gaps by bringing together stakeholders from science, nature management, local spatial planning, and the private and public sector to develop a joint cross-disciplinary understanding of needs and opportunities for strengthening biodiversity and ecosystem conservation and restoration. Together, we are developing tools for high-resolution maps of biodiversity and nature types of relevance for ecological state and condition assessments and accounting. We quantify resilience to understand ecosystem vulnerability to environmental perturbations. These tools and data will be validated and communicated through the public Ecological Base Map infrastructure. In this talk we will discuss how combining and integrating state-of-the-art applications of biodiversity, ecodiversity, and resilience modeling provide a much-needed evidence base for spatial planning and lay a foundation for a better shared understanding of why and how local decision-making could better support and safeguard biodiversity and ecosystems.

Keyword: Ecosystem state and condition, Ecosystem accounting, Species distribution modeling, Ecodiversity modeling, Resilience modelling, Spatial planning

OC58

INSECT-POLLINATED PLANTS ARE FIRST TO DISAPPEAR FROM OVERGROWING GRASSLANDS

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1 - University of Tartu; 2 - Estonian Association for SeminatURAL Grassland Conservation

Loss and fragmentation of natural and seminatural grasslands threaten the persistence of numerous species and the associated interactions. Awareness of possible biotic filters generated by overgrowth of grasslands, and related shifts in functional trait composition are crucial for restoring ecosystem functions. Yet, changes in the patterns of pollination-related plant functional traits in response to changes in local land use have been largely overlooked.

We explored shifts in the functional trait composition and diversity of herbaceous plants in 28 paired sites of open and overgrown seminatural grasslands in Western Estonia, Northern Europe. We tested whether patterns of pollination-related functional traits were associated with the stage of succession (open vs overgrown grassland sites), accounting for the effects of the geographic location of sites and the phylogenetic relationships among species.

The successional overgrowth of grasslands caused a significant decline in species richness of herbaceous grassland plants and resulted in substantial changes in the functional composition of plant communities. Grassland species retained in overgrown sites were less likely to be (i) insect-pollinated, (ii) reproducing by seed and (iii) shorter-lived than species in open grasslands.

The observed pattern has significant implications for restoring functional grassland ecosystems. As insect-pollinated plant species are first to disappear during grassland overgrowth, the consequences for the ecosystem pollination function may be substantial. Moreover, a relatively fast and effective restoration of the pollination function in grassland ecosystems may be achievable only before the significant loss of insect-pollinated species, as insect-pollinated species have been shown to recover more slowly than other plants.

Keyword: Plant diversity, extinction debt, habitat loss, plant-pollinator interactions, land use change, restoration of ecosystem functions

Session 3B – Future Ecosystems Climate and Land Change

OC59

BIODIVERSITY-MEDIATED MECHANISMS OF ECOSYSTEM'S RESPONSE TO COMPOUND DRY-HOT EXTREME EVENTS

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Extreme climatic events are increasing in frequency and intensity due to climate change. These phenomena disrupt the stability of ecosystem functions, thereby affecting the provision of important ecosystem services. Biodiversity is thought to increase ecosystems' capacity to resist (i.e. maintain their properties) and recover (i.e. return to functioning) after extreme events. However, studies on the biodiversity-stability relationship under extreme events have produced mixed results.

Here, we used LOTVS, a global dataset of vegetation time-series, to investigate how biodiversity relates to ecosystem's resistance and recovery under compound dry-hot extremes (CDHE). We computed indicators of resistance and recovery based on plant biomass and cover, as well as metrics summarising taxonomic diversity (species richness), functional composition (community weighted means) and functional diversity (Rao's index). We then tested if and how biodiversity was associated with resistance and recovery under increasing intensity of CDHE and under different management treatments.

Results suggest that taxonomic diversity promotes resistance under CDHE. However, such a positive effect was more pronounced when resistance was computed from biomass. In this case, higher species richness resulted in a larger dissimilarity of leaf traits, thereby pointing to the 'insurance effect' as the biodiversity mechanism underpinning resistance. Concerning recovery, results indicate a positive effect of biodiversity when a CDHE is followed by average climatic conditions. Our findings stress the importance of maintaining sufficient biodiversity to reduce the impact of CDHE on ecosystem functioning, especially in man-managed landscapes.

Keyword: Resistance, Recovery, Extreme climatic events, Ecosystem stability, Plant biomass

OC60

CLIMATE FUTURES NOW: EXPERIMENTALLY SIMULATING THE IMPACT OF DROUGHT ON MEDITERRANEAN ECOSYSTEMS

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Understanding the responses of terrestrial ecosystems to global environmental change is a major challenge of current ecological research. Major research efforts are currently being invested to produce reliable scenarios for future plant communities and ecosystem functioning under the uncertainties imposed by global climate change. Here, I will present the results obtained from a long-term experiment established in 2001, where we implemented rainfall manipulations to a Mediterranean shrubland ecosystem simulating drought conditions and changes in rainfall patterns. Data collected ranged from plant population dynamics to ecosystem function and properties. The results showed that moderate drought did not significantly change ecosystem properties of the Mediterranean shrubland. However when the ecosystem is exposed to extreme drought the productivity and biodiversity of the natural ecosystem was significantly reduced. Changes in rainfall distribution showed to have significant effects, but were only evident with time indicating ecosystem resistance to short-term changes. Plant community attributes and functional traits allowed the ecosystems to withstand moderate drought levels, close to natural variability in which these systems have evolved, however when exposed to continuous and consecutive dry years the system may reach its tipping point beyond the ecological resistance threshold. I will discuss what I have learnt from setting this long-term climate change experiment and my understanding of key factors regulating ecosystem functioning in Mediterranean ecosystems, opened knowledge gaps and challenges for future studies.

Keyword: Drought, Rainfall Manipulations, Species Diversity, Primary Production, Ecosystem resistance

Session 3B – Future Ecosystems Climate and Land Change

OC61

INTRASPECIFIC PLANT TRAIT PLASTICITY IN ESTUARINE CONSTRAINTS

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Trait-based ecology has changed the way plant ecologists study community-level processes, among other advances through the description of the plant economics spectrum, resulting from the consistent correlation across spatial scales of functional traits related to resource investment. Between species, these trait correlations have revealed trade-offs in the way available resources are allocated in a given set of environmental conditions, and that these trade-offs impact community assembly rules and ecosystem processes. Within species however, uncertainties remain around the importance of intraspecific trait variation (ITV), and its potential upward repercussions on higher-order processes. As a matter of fact, ITV has been observed to impact species distribution and the biotic interactions within species. With rapidly changing climatic conditions, ITV might help in determining species response to adverse conditions, and to infer an ecosystem's tolerance to these conditions. Coastal wetlands are at the forefront of climate change, with short environmental gradients of inundation frequency and salinity that are bound to shift in the following decades. In an *ex situ* experiment mimicking estuarine constraints of salinity and inundation frequency, we have observed substantial shifts in intra-specific growth and resource allocation strategies of isolated plant individuals without competition. Across the two interacting stress gradients, the plant species' traits related to resource acquisition correlated to reveal the acquisition – conservation strategies of the plant economic spectrum. Each of the three species displayed distinctive ITV, highlighting the importance of individual variability, that should be taken into account when studying community-level responses to stress gradients.

Keyword: intraspecific trait variation, inundation, salinity, non-destructive growth monitoring, controlled conditions

OC62

ATMOSPHERIC WATER DEMAND AFFECTS FOREST PLANT COMMUNITIES MORE THAN SOIL WATER SUPPLY

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The increasing frequency and magnitude of droughts followed by large-scale forest diebacks highlight the need for a better understanding of forest vegetation sensitivity to soil water supply and atmospheric water demand. In this study, we disentangled the influence of soil water supply and atmospheric water demand on forest plant species distribution across central Europe.

Atmospheric water demand represented by vapor pressure deficit was a much more important predictor of forest plant species composition than soil water content. Both variables were correlated, but vapor pressure deficit had a strong independent effect even after controlling for this correlation.

In contrast to the often highlighted importance of soil water supply, we found that atmospheric water demand is a more important driver of plant species distribution in temperate forests. Future climate warming will inevitably increase atmospheric vapor pressure deficit even on sites with stable soil water supply. Given the sensitivity of forest plant distribution to atmospheric vapor pressure deficit, increasing vapor pressure deficit can lead to major redistribution of forest plant communities and associated changes in forest ecosystem functioning.

Keyword: microclimate, temperate forests, soil moisture, vapor pressure deficit, species composition

Session 3B – Future Ecosystems Climate and Land Change

OC63

MACROECOLOGY OF ABIOTIC STRESS TOLERANCE IN WOODY PLANTS OF THE NORTHERN HEMISPHERE

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Understanding the diversity and distribution of abiotic stress tolerance strategies in plants is a central topic in ecology. These strategies are expected to be constrained by environmental drivers and species adaptations, but the exact nature of these interactions has largely not been explored. By employing a multidimensional modelling approach that combines functional traits and environmental variables at a species habitat, we explored the determinants and spatial distribution of abiotic stress tolerance strategies related to drought, shade, cold and waterlogging in woody plants across the Northern Hemisphere. We evaluated these trait-environment-tolerance relationships using random forest models at the plant functional type level (PFT, deciduous and evergreen angiosperms, and evergreen gymnosperms). Trait syndromes and soil fertility predominantly determined drought and waterlogging/cold tolerance strategies, while climatic factors were more important in defining shade tolerance. To summarize the discovered patterns, we introduce the concepts of 'stress tolerance biomes' and 'polytolerance hotspots', which are geographic areas where woody plant assemblages have converged toward specific tolerance strategies. Our results provide the first macroecological angle to study the diversity of abiotic stress tolerance strategies in woody plants and to understand the nature of the trade-offs limiting this diversity facet. The proposed parallelism with macroecological concepts calls for expanding already described patterns for this plant group by including an aspect of species adaptations to the environment that has often been ignored in previous macroecological analyses.

Keyword: polytolerance hotspots, stress tolerance biomes, adaptive strategies, woody plants, drought tolerance, shade tolerance, waterlogging tolerance

OC64

REVISING THE GLOBAL BIOGEOGRAPHY OF ANNUAL AND PERENNIAL PLANTS

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1 - The Hebrew University of Jerusalem; 2 - Tel Aviv University

There are two main life cycles in plants—annual and perennial. These life cycles are associated with different traits that determine ecosystem function^{3,4}. Although life cycles are textbook examples of plant adaptation to different environments, we lack comprehensive knowledge regarding their global distributional patterns. Here we assembled an extensive database of plant life cycle assignments of 235,000 plant species coupled with millions of georeferenced datapoints to map the worldwide biogeography of these plant species. We found that annual plants are half as common as initially thought, accounting for only 6% of plant species. Our analyses indicate that annuals are favoured in hot and dry regions. However, a more accurate model shows that the prevalence of annual species is driven by temperature and precipitation in the driest quarter (rather than yearly means), explaining, for example, why some Mediterranean systems have more annuals than desert systems. Furthermore, this pattern remains consistent among different families, indicating convergent evolution. Finally, we demonstrate that increasing climate variability and anthropogenic disturbance increase annual favourability. Considering future climate change, we predict an increase in annual prevalence for 69% of the world's ecoregions by 2060. Overall, our analyses raise concerns for ecosystem services provided by perennial plants, as ongoing changes are leading to a higher proportion of annual plants globally.

Session 3B – Future Ecosystems Climate and Land Change

OC65

FINE-SCALE DELIMITATION OF OPEN ECOSYSTEMS THROUGH VEGETATION GROWTH INDEXES: A PROPOSAL

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In the last decades, the understanding of Open Ecosystems has allowed to better understand the nature of alternative states of vegetation, and the influence of disturbances in sustaining them. Their characterization by Robert H. Whittaker, based on mean annual temperature and precipitation, and its further mapping by William J. Bond, allows for important applications in sustainability science. Such characterization, although connected with potential plant productivity, is empirical in nature. It therefore faces important constraints for environments placed at high latitudes and with marked contrasts in seasonal productivity, particularly when limited by winter cold.

Improving the mechanisms that drive the evolution of Open Ecosystems is essential to understand their naturalness. Herbivory being one of the two main disturbances that shape them, this has in turn important implications for ecosystem management, assumptions for natural herbivore densities, and attributions of climate change impacts. Advancing the mechanistic understanding of Open Ecosystems distribution will allow for their application in such important sustainability questions.

In this work we propose the application of Papadakis' Vegetation Growth Index as a descriptor of potential plant productivity. We show its potential for fine-scale description of Open Ecosystems and for capturing seasonal productivity challenges in boreal areas. Its further refinement needs, however, to incorporate phytosociological information to understand in which conditions plants have evolved. The borders of areas will be delimited according to critical plant productivity levels, where disturbances during the last million years would not have sufficed to hinder the development of closed-canopy ecosystems.

Keyword: Open Ecosystems, disturbances, herbivory, plant productivity

OC66

PLANT DIVERSITY PATTERNS ALONG WOODY PLANT ENCROACHMENT GRADIENT IN SUB-MEDITERRANEAN GRASSLANDS ★

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¹ - *University of the Basque Country*

The increasing rate of shrub encroachment on grassland has become a global concern due to its impact on grassland habitat diversity and conservation. This phenomenon, known as woody plant encroachment (WPE), is mainly driven by climate change and land use changes. The main objectives of this study are: a) assess which environmental factors influence the diversity of sub-mediterranean grasslands in the process of succession to shrubland, b) examine the effect of WPE on diversity and on different functional categories of plant species (forbs, graminoids, legumes and chamaephytes), c) analyse floristic composition, encroaching woody species composition and species turnover from grassland to shrubland. The study was carried out in sub-mediterranean grasslands at four sites in northern Spain, selecting 3 zones in each site and exploring 4 levels of WPE (from open grassland to closed scrub). When modelling the response variables of diversity and plant categories, it is observed that some environmental factors and their interactions with shrub cover appear as explanatory variables, such as annual temperature and the interaction of the ombrothermic index with shrub cover. When analyzing the WPE gradient, we observe a decrease in heterogeneity of floristic composition from grassland to shrubland and a peak of species richness at intermediate stages in some study sites. Plant categories remain without major changes in terms of richness; however, there is a species turnover in some categories, especially in graminoids.

Keyword: woody plant encroachment, grassland, shrubland, diversity patterns, environmental factors, floristic composition, species turnover

Session 3C – Alien Plant Species: Invasion Trends and Impacts

OC67

UNDERSTANDING INVASION PATTERNS AT THE ECOREGIONAL SCALE ★

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Biological invasions are causing massive ecological, social, and economic impacts worldwide. Understanding the ecological factors that affect invasion patterns at the ecoregional scale is critical to improving action plans that limit the establishment and dispersal of invasive species within biogeographically meaningful regions. We developed a comprehensive assessment of invasive plants in the Cantabrian Mixed Forests ecoregion, a region with high biodiversity value and optimal conditions for the spread of invasive plants in Europe. Using a combination of scientific literature and expert knowledge, we identified an invasive species pool of 175 species, for which we evaluated invasion level, population trends, range size, local abundance, environmental and socio-economic impacts, and invaded habitats. We also combined a hierarchical modeling framework of habitat suitability with species dispersal simulations to predict future spread of the invasive species pool within the study ecoregion. Species dispersal potential was approached by estimating geographical barriers, dispersal kernel, and frequency of long-distance dispersal events. We found that dispersal rates across the study ecoregion were species-specific and dependent on species ecological requirements and dispersal limitations. Lastly, we compared phenological traits of the invasive species pool with the co-occurring native species, considering functional variability of the plant species and habitats where they occur. The analyses show that invasive species flowered later and had longer flowering periods than natives, especially in man-made habitats. Overall, our results demonstrate how a complete assessment of the ecoregional invasive species pool provide information useful for understanding the impact of invasive plants on a biogeographical basis.

Keyword: Biological invasions, Invasive species pool, Ecoregion, Invasion trends, Habitat suitability, Spread dynamics, Invasion risk, Phenology

OC69

WILDFIRE SEVERITY TRIGGERS ALIEN PLANT INVASION IN TEMPERATE KARST FOREST ★

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Wildfires are increasingly impacting ecosystems worldwide especially in temperate dry habitats, often interplaying with other global changes (e.g. biological invasion). Understanding the ecological consequences of wildfires is crucial for effective conservation and management strategies. The aim of this study was to investigate the impact of the severity of wildfire on alien plant invasion, also in relation to the main shift induced in native plant community structure, composition, and functional identity. We conducted an observational study in the protected broadleaves Karst forests affected by large wildfire in 2022. Fire severity was assessed using satellite imagery-derived indices, while plant communities were surveyed in 35 plots (200 m²). All vascular plants and their cover were recorded in each plot, while functional traits were associated using existing trait database. Results revealed significant shifts in plant community composition and diversity, triggering biological invasion. Areas subjected to high-fire severity areas exhibited higher species richness than low-severity or unburned areas. Total alien plant cover increased with fire severity while native cover remained constant. We also found shifts in species and functional composition, particularly for traits related to germination potential and growth strategy (i.e. belonging to ruderal or alien species). This study contributes to the understanding of post-fire ecological processes in temperate protected forests, highlighting the fragile state following a wildfire. The work highlights how increasing fire severity can lead to new vegetation assemblages that favour non-native species.

Keyword: Biological invasion, Conservation, Functional traits, Karst forest, Plant diversity, Wildfire

Session 3C – Alien Plant Species: Invasion Trends and Impacts

OC70

IDENTIFYING POTENTIAL HABITATS FOR RESTORATION IN THE CENTRAL EUROPEAN GREEN BELT

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The Central European Green Belt (CEGB) represents a unique network of ecologically important habitats and protected areas that often host high biodiversity. However, like other valuable landscapes, it is under threats from increasing land use pressure on one hand and landscape abandonment on other, fragmentation and climate change, which lead to a decline in biodiversity and habitat degradation. To tackle these issues, a transnational cooperation is essential. This is reflected in an international project “ReCo”, which aims to restore ecosystems to enhance their connectivity and support biodiversity of CEGB.

One of the main tasks in the project is to identify localities for potential restoration in six pilot regions in Poland, Germany, Czech Republic, Austria, Slovenia and Italy, which cover different types of habitats (from dry grasslands to alpine meadows, from inland wetlands to coastal wetlands) and species and their respective habitats (from wild cat to European bison). Identification of these localities is based on combining present (in the form of satellite and other available habitat data) and historical land cover data. The combination of present and historical data shows significant changes from natural/semi-natural habitats to degraded habitats. Degradation of habitats in terms of their intensified human use (change into arable land or sealed surfaces) was captured predominantly in two pilot regions with coastal wetlands in Slovenia and Italy, resulting mainly to drying out these habitats. Degradation by overgrowing with woody vegetation concerned all pilot regions – this process was especially unfavourable for grassland habitats in mountainous regions of Slovenia.

Keyword: degraded habitats, biodiversity, land cover, historical maps, Central Europe

OC71

THE BIOGEOGRAPHY OF ALIEN PLANTS IN THE RÍO DE LA PLATA GRASSLANDS

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Detailed alien species inventories are important to assess strategies for its management. We built a vascular alien plant species list from published papers available for the Río de la Plata grasslands (RPG). Species were described regarding their geographic origin, life form, photosynthetic pathway (only Poaceae), human use, and invasion status according to legislation of Brazil, Argentina and Uruguay. Occurrence records were obtained from Global Biodiversity Information Facility and rasterized into grid-cells of 10 arc minutes resolution.

The alien flora of the RPG comprises 592 species, among which 317 are considered invasive and 275 naturalized. Alien species can be sourced to all continents, although most species have their native range from Temperate Asia (n = 413), Africa (n = 382), and Europe (n = 362). Herbs are the most frequent life form (n = 332), followed by graminoids (n = 125) and trees (n = 72). However, 86% of alien tree species are invasive. Regarding invasive species, only 8 species are common to three countries. We registered 235 exclusive invasive species in Argentina, 40 in Brazil and 9 in Uruguay. Alien species richness was higher in areas closer to major cities. Even so, we highlight higher alien species richness in Argentina. There is no clear spatial pattern regarding geographical origin, reflecting favourable conditions for alien species from different ecological contexts in the region. Our results have implications for long-term conservation management of native biodiversity. Efforts to control alien species should surpass political boundaries and encompass all ecological units of the RPG.

Keyword: alien species, biological invasions, Río de la Plata grasslands, invasibility

Session 3C – Alien Plant Species: Invasion Trends and Impacts

OC72

ALIEN PLANTS IN EUROPE - A NEW OPEN DATASET IN THE FLORAVEG.EU

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The public is concerned about the recent biodiversity crisis, with alien plant invasions considered one of the main drivers. Despite long-lasting research focused on alien species, there are still gaps in our knowledge, and syntheses across different scales are needed. For these, we inevitably need comprehensive checklists, ideally at regional, national or finer scales. However, the completeness and quality of information varies across regions, even in Europe, where alien species research has a long tradition.

To overcome this, we have compiled alien plant inventories, checklists, existing databases and scientific literature (131 sources to date) for 55 European regions (countries, their parts and islands). We harmonised species taxonomy and nomenclature, and standardised categories of residence time and invasion status. We started to revise and gap-fill regional lists of alien plants using information from checklists and additional sources, including the Euro+Med PlantBase, GloNAF database, and GBIF database. We involved local experts to resolve conflicting status assignments. For each alien species, we also added information on its region of origin. This data will be made freely available and regularly updated in the FloraVeg.EU database.

To visualise the content of the database, we mapped geographical patterns of alien species numbers in different categories. Further, using vegetation data from EVA and occurrence data from GBIF, we calculated and mapped several metrics of invasion levels. We compared patterns of alien hot spots identified by different approaches, including several corrections for uneven sampling density across Europe.

List of all co-authors will be provided in the presentation.

Keyword: alien plants, residence time, European database, biogeography, invasion status, checklists, open dataset

OC73

LONG-TERM CHANGES IN PLANT SPECIES COMPOSITION DURING SOLIDAGO INVADED SITE RESTORATION

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Restoring invaded lands is one of the biggest challenges in biodiversity conservation. We present the effects of an 8-year experiment on restoring grassland invaded by alien *Solidago* species (*S. gigantea* and *S. canadensis*). We investigated the effect of different invaders removal methods (rototilling, turf stripping, herbicide application) and seed application methods (commercial seed mixture, fresh hay) on changes in the effect of grassland restoration. The results indicated a favorable effect of grassland restoration on taxonomic diversity and species composition. We found a decrease in *Solidago* cover and an increase in cover and richness of graminoids and forbs. The seed application methods had a longer effect than the *Solidago* removal treatments. The effect of *Solidago* removal treatments did not differ from each other after the first years of the experiment. Fresh hay increased the cover of grassland species (e.g., *Arrhenatherum elatius*, *Poa pratensis*); in turn, higher coverage of *Lolium perenne* and *Schedonorus pratensis* was observed after using a commercial seed mixture. Interestingly, the cover of species introduced with the seed mixture was higher at the beginning of the experiment and then decreased. The unexpected result was fresh hay with herbicide application—in the first years of the experiment we observed the lowest *Solidago* cover and the highest cover of grassland species; however, after years, this effect was comparable with the effects of non-chemical methods. In conclusion, our study may be helpful in effectively restoring species-rich grasslands in *Solidago*-dominated areas.

Keyword: restoration, invasive *Solidago* species, grasslands

Session 3D – Dark Diversity

OC74

DARKDIVNET EXPLORES THE DARK DIVERSITY OF PLANT COMMUNITIES AT THE GLOBAL SCALE

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The global research collaboration DarkDivNet was started in 2018 during an IAVS meeting. This consortium is exploring the dark diversity of plants – species which ecologically fit to a study site and are present in the surrounding region, but are currently absent from the site. The sampling within DarkDivNet has resulted in 121 regions and more than 5000 vegetation descriptions across the world. Dark diversity is bridging biodiversity across spatial scales by filtering taxa from the region that can potentially inhabit a local study plot. DarkDivNet is unique among global research networks by simultaneously sampling at different spatial scales. With DarkDivNet data, we have detected an overlooked global tendency that regions with high human impact have impoverished natural vegetation. This alarming result was hidden when only locally observed taxa were counted, evidently due to a high natural variation of the species pools. However, we found a strong negative anthropogenic effect on local biodiversity when we included all suitable species in the region and calculated community completeness as a proportion of observed and dark diversity. Currently, the DarkDivNet Consortium is exploring several other aspects of plant diversity. It includes works to improve dark diversity methods, incorporating large vegetation databases (sPlot and others) to analyze species habitat suitabilities, and detecting the role of soil biota for diverse vegetation. This new knowledge is vital for understanding biodiversity in vegetation and improving plant conservation. Species in dark diversity are still present in the surroundings, and options exist to restore their populations.

Keyword: biodiversity, dark diversity, species pool, human influence

OC75

OBSERVED AND DARK DIVERSITY PATTERNS IN DIFFERENT ECOSYSTEMS

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¹ - *University of Tartu*

To protect or restore biodiversity, it is essential to understand which factors influence species diversity in different parts of the world. These factors may vary between habitat types and regions owing to different biogeographical histories. Considering both observed and dark diversity (i.e. absent part of the species pool) can give us further insights into why some suitable species are missing from local communities, and allows us to compare the processes shaping local diversity in different habitat types and regions. The global research collaboration network DarkDivNet has collected standardized vegetation data from >120 study areas and >5000 10x10 m plots. For each plot, we counted the observed vascular plant species richness and estimated dark diversity using species co-occurrences in the neighboring plots. We then compared how current and historical environmental factors influence species diversity in forested and open habitats. We found that both observed and dark diversity are higher in open habitats. Observed and dark diversity in open habitats is mainly influenced by current climate conditions, but forested ecosystems are also impacted by historical climate conditions (i.e. climate change velocity and glaciations). In previous analyses using the same data, we have found that local species diversity is threatened by large-scale anthropogenic disturbances. To mitigate these negative effects, it is also important to consider that local diversity in forests and open habitats have been shaped by different environmental conditions in the past.

Keyword: dark diversity, community assembly, grassland, forest, global

Session 3D – Dark Diversity

OC76

GLOBAL PATTERNS OF VASCULAR PLANT DARK DIVERSITY AFFINITY

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Exploring the underlying mechanisms that shape biodiversity, previous studies have highlighted specific species traits and site conditions responsible for dark diversity patterns, thus identifying key factors driving local extinctions. A newly developed approach scales the significance of such roles of species and site characteristics in dark diversity formation, so-called dark diversity affinity (DDA). DDA is estimated through the species-site unified modeling, exploring species- and site-level mechanisms in one model. Recent studies of DDA indicated that both species and sites can simultaneously influence the tendencies of species being absent from suitable sites, while the significance and direction of their roles depend on the study systems, such as taxonomic groups and ecosystem settings. This further implies that the governing mechanisms of dark diversity vary geographically, and questions about where and which drivers of dark diversity are activated remain open. Here, we applied the DDA approach to the DarkDivNet dataset, where its consistent sampling scheme enabled inter-regional comparisons of DDA. From the global patterns of ON-OFF of dark diversity drivers on plant communities, we saw a good agreement with previous studies regarding certain species traits and site conditions, such as plant height and short-term environmental stability, avoiding species absence from suitable sites. Nonetheless, exceptional patterns always occur due to antagonistic ecological consequences of their roles in specific ecosystem settings. This study provides the first evidence of where and how generalizations do and do not apply to the mechanisms of dark diversity formations and, thus, local species extinctions.

Keyword: dark diversity, community ecology, biodiversity conservation, functional traits, DDA

OC77

FUNCTIONAL INSIGHTS INTO GLOBAL DARK DIVERSITY: FINDINGS FROM DARKDIVNET

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Dark diversity, the portion of regional biodiversity suitable for a site but absent at sampling, has enhanced our understanding of biodiversity changes over space and time. However, most analyses have been limited to taxonomic diversity. Including functional diversity in dark diversity analyses allow determining which features cause some species to be absent and how community functions vary.

We present results from DarkDivNet, an initiative to characterize dark diversity in over 100 globally distributed study regions. Each region included 30-90 10x10m vegetation plots, totaling over 4,000 plots, where we collected traits, including plant height and leaf length and width, and identified the species present. We estimated probabilistic dark diversity for all absent species from the region. Combining in situ collected traits with information from databases, we assessed different aspects of functional structure for observed and dark diversity in each plot.

We found notable differences between observed and dark diversity in terms of average trait values and the extent of functional space occupied. Observed diversity exhibited consistently higher functional richness, likely due to functional redundancy among species. Anthropogenic impacts were more pronounced in functional diversity compared to taxonomic diversity. In particular, anthropization favoured smaller species across both observed and dark diversity and promoted species with conservative leaf traits in observed diversity. These results indicate that human activities contribute to functional homogenization by selecting for smaller species. Understanding the differential impacts of environmental and global change factors on the traits of observed and dark diversity is crucial for predicting future biodiversity trends.

Keyword: dark diversity, functional diversity, traits, DarkDivNet, global patterns

Session 4A – Restoration, Conservation and Vegetation Management

OC78

WILDFIRE AS AN INTERPLAY BETWEEN WATER DEFICIENCY, MANIPULATED TREE SPECIES COMPOSITION AND BARK BEETLE. A REMOTE SENSING APPROACH

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During 2022, Bohemian Switzerland NP was affected by the largest wildfire in the Czech Republic throughout its modern history. This landscape of sandstone towers was traditionally occupied by pine and beech forests, however from the 19th century onwards, Norway spruce and non-native *Pinus strobus* were massively planted here. A series of weather extremes in the last years caused an exceptional drought and consequent massive bark beetle outbreak and spruce die off, followed by the catastrophic event. Wildfires of such a dimension are rather uncommon in Central Europe, and this event therefore serves as a perfect model situation to study the role of species composition, bark beetle and water availability on the fire dynamics, impact on biodiversity and natural regeneration. Pre-fire vegetation state, fire severity and post-fire regeneration were assessed using a combination of remote sensing sources (satellite, aerial and drone multispectral and Lidar data) and field surveys (species composition, fire severity). High resolution remote sensing data enable us to study both disturbance and post-fire regeneration in sufficient detail relevant for the underlying ecological processes. Our research revealed that fire severity was lower at native deciduous tree stands and waterlogged sites, severe at standing dead spruce and the strongest at dry bark-beetle clearings covered by a thick layer of litter. Derived information on fire severity, detailed 3D stand structure and health status are to be used as a proxy of the fire disturbance impact on biodiversity and to explain patterns of fast regeneration.

Keyword: wildfire, remote sensing, spatial analysis, disturbance, fire severity, Bohemian Switzerland NP

OC79

ECOLOGICAL AND MANAGEMENT OF WOODY PLANT ENCROACHMENT: A PARADIGM SHIFT

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¹ - Agricultural Research Council

Climate change exacerbates land degradation and desertification by increasing frequency and intensity of heat related events. Tree and shrub densities have increased by approximately 30-50% in many areas of southern Africa, which alter ecosystem services such as forage production for livestock; and thereby increase associated costs of livestock management. The expansion of woody plants in communal and commercial systems is attributed to local and global drivers. We explored research ranging from the causes and consequences of *woody plant* encroachment in South African semi-arid rangelands, optimal tree density that will maximize forage production and exploring the use of encroaching woody species as fodder and their effect on animal performance, methane emission and meat quality. These studies concluded that 1) seed scarification in the gut of herbivores in combination with their indirect effects (dung fertilization) and removal of grass competition (either by fire or mowing) may lead to woody plant encroachment, 2) overgrazed and/or burned areas with well-drained poor quality soils in the semi-arid grassland communities are most likely to be encroached by *Seriphium plumosum*, 3) mechanical- and chemical -control, as well as fire application influences the structure and functioning of savannas, 4) *Senegalia caffra* resulted in nearly 100 % mortality of internal parasites in cattle after just 2 hours of application, and lastly 5) the encroaching woody plants can be used as fodder for livestock without adversely affecting animal performance, improve carcass characteristics and reduce methane emission. This research laboratory contributed immensely to the ecology and management of woody plant expansion.

Keyword: woody plant encroachment, plant-herbivore, fodder, savanna, seed dispersal

Session 4A – Restoration, Conservation and Vegetation Management

OC80

LARGE-SCALE RESTORATION OF NATURAL FORESTS BASED ON THE MIYAWAKI METHOD

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The G20 Global Land Initiative of the UN was established in Riyadh (COP 16) because deforestation accounts for about 10% of global warming. The G20 GLI group realized that creation of mini-forests by the Miyawaki method (using potted saplings of potential natural forest species, planted in dense mixtures by local people, with mulching) is effective since the dense planting encourages competition, coexistence, and endurance of saplings, promoting early growth and accumulation of carbon. Such forests also have other functions: habitat for mammals and birds; mitigation of disasters (fire, tsunami, flood, etc.); protection against wind, salt spray, sand, noise, dust, etc., meeting various SDG objectives. Such mini-forests are also effective in urban areas. There are about 2900 examples in Japan and worldwide. Nowadays broad-scale restoration of forests is required too, but forestry people have identified several problems: 1) Huge amounts of preparation involving seedlings of natural forest species (that should be obtained from nurseries: 3 individuals per square meter); 2) Costs for plowing and soil preparation on the planting sites; 3) Organizing people to do the planting; and 4) Huge amounts mulch. These can involve large costs. Examples of several types of large-area plantation will be introduced here, from China, Nepal, Malaysia (Borneo), Thailand and Kenya.

Keyword: Dense planting, Global warming, Large-Scale Restoration, Potential natural forest species

OC81

TREE PLANTATIONS HAVE LOW CONSERVATION VALUE DESPITE HIGH TAXONOMIC AND FUNCTIONAL DIVERSITY

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Tree plantations are spreading rapidly in many regions around the globe but their ecological and conservation importance is still not fully understood. In this study we compared near-natural forests and tree plantations in the Deliblato Sands (Serbia). Vegetation samples were prepared in the following habitat types: (1) near-natural *Quercus robur-Tilia tomentosa* forests, (2) near natural *Populus alba* forests, (3) *Pinus sylvestris* plantations, and (4) *Robinia pseudoacacia* plantations. We found that the species composition of the four habitat types differed significantly; *Quercus-Tilia* forests were dominated by mesic forest specialists, *Populus* forests hosted many species related to dry forests and grasslands, while the two plantation types contained several weeds and indifferent species. Among the ecological indicator values, light values showed the most conspicuous differences, with the *Quercus-Tilia* forests having the lowest light availability. Interestingly, there were no significant differences among the four habitat types regarding the richness of native species, Shannon diversity, and functional diversity. However, the richness of non-native plants was significantly higher in plantations than in near-natural forests. The assessment of habitat degradation revealed that *Robinia* plantations were in the worst condition and *Quercus-Tilia* forests were the least disturbed. The open canopy and the resulting favourable light conditions of the two types of plantations may be the reason why they reached species richness, Shannon diversity, and functional diversity values comparable to those of the near-natural forests. However, plantations have low ecological value due to the high number of non-natives, weeds, and indifferent species.

Keyword: non-native plantations, near-natural forests, ecological indicator values, degradation, diversity patterns, conservation importance

Session 4A – Restoration, Conservation and Vegetation Management

OC82

MEASURING CANOPY STRUCTURAL COMPLEXITY THROUGH UAS-BASED PHOTOGRAMMETRIC POINT CLOUDS TO ASSESS ITS EFFECTS ON UNDERSTORY VEGETATION OF RIPARIAN FORESTS

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Riparian areas are environmentally heterogeneous zones between terrestrial and aquatic ecosystems. These zones, rich in plant diversity, face disturbances like unregulated cutting, landscape fragmentation, and flooding, resulting in structurally varied riparian woodlands. Light availability, influenced by canopy structure, is a key driver of understory plant species richness and composition. Traditional methods of assessing canopy structure often rely on visual inspections and simple metrics, which are useful but limited. This study investigates the impact of canopy structural complexity on these variables. We employed a multi-dimensional approach, using small Unmanned Aerial Systems (UAS) and Structure from Motion Multi-View Stereo methods, to capture detailed 3D spatial arrangements of the riparian canopy. Our study focused a Mediterranean river in Siena (Italy). Aerial surveys were conducted using a DJI Phantom 4 Advanced drone with a 20MP RGB camera. Surveys included nadir, oblique, and horizontal imagery, conducted at different altitudes and overlaps to maximize coverage and detail. Ground Control Points ensured survey accuracy within 10 cm. Entwined with the aerial survey, we performed a plot-based vegetation survey with 44 plots (50 m² each) across the river's length. Dominant tree cover exceeded 50% in each plot centre. The 3D point clouds generated from UAS flights allowed accurate measurement of canopy and gaps metrics such as deep gap fraction, mean gap area, mean outer canopy height, and top canopy rugosity. These metrics will be analysed to determine their influence on understory plant species richness and diversity, providing novel insights into the effects of canopy structure in riparian ecosystems.

Keyword: 3D point clouds, canopy gap analysis, riparian vegetation, canopy rugosity, Unmanned Aircraft System (UAS)

OC83

FROM TAXONOMIC, THROUGH EVOLUTION TO FUNCTIONALITY: PLANT COMMUNITIES IN ALPINE PASTURES

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In this study, we provide an understanding of how anthropogenic disturbance (i.e., pastoral activities) and natural successional processes occurring in post-disturbed communities (i.e., grazing abandonment) determine plant communities' composition in alpine semi-natural grasslands. Since grasslands are highly heterogeneous systems, these habitats are suitable for the advancement on the knowledge on vegetation dynamics. The relative importance of the process defining the species pool composition in a community can vary according to the intensity and frequency of disturbance (grazed lands), and the rate of advancement of succession which, in turn, is affected by environmental conditions and time since disturbance's cessation (abandoned lands). To elucidate these complex dynamics, we used vegetation data from alpine pastures in the southern western European Alps to implement a complementary approach exploring taxonomic, phylogenetic and functional trait diversity. This approach enables us to identify patterns of species convergence/divergence, unveiling mechanisms and processes driving community assembly. We detected the highest values of diversity in extensively grazed plots, whereas intensive grazing resulted in a reduction in phylogenetic diversification, functionality and species richness, in line with the 'intermediate disturbance hypothesis'. Moreover, cessation of grazing lead to a reduction of diversity due to the dominance of strong competitors. Biotic processes ('competitive exclusion hypothesis') seemed to dominate extensively grazed and abandoned plots, and abiotic ('habitat filtering hypothesis') processes intensively grazed ones, leading to community homogenization.

Keyword: Plant community ecology, Functional traits, Phylogeny, Conservation management

Session 4A – Restoration, Conservation and Vegetation Management

OC85

REPORT ON THE EVOLUTION OF 6 MIYAWAKI FORESTS IN BELGIUM

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¹ - *Urban Forest Europe*

As human habitat expand and natural areas degrade, requirement to restore natural habitat become increasingly necessary. Urban greening requires much maintenance, usually bringing exotic plants which do not stop the collapse of biodiversity. Soils are increasingly eroded and compacted, negatively impacting soil fertility, moisture retention and healthier growth of plants. Part of the population is also demanding more proximity with nature, healthier living conditions and nature restoration. How can we shift from artificially greening our cities to building back native ecosystems which grow quick, reducing temperature, protecting soils, absorbing moisture, and increasing biodiversity?

The Miyawaki method for restoring native urban forests is receiving interest in Europe with an increasing number of Miyawaki forests being created in different countries. The methodology is attracting attention from a broad range of stakeholders who are looking for solutions and to take action. This presentation aims at presenting evidences asserting that the Miyawaki method bring positive ecological changes.

Urban Forests is a company that specialises in creating Miyawaki forests. To date, we have established over 100 such forests, planting over 160000 trees with over 12000 volunteers. Our team conducted a detailed study of 6 Miyawaki forests aged between 3 and 6 years old in Belgium. Our findings show average growth rate of 74.8cm per year, average mortality rate of 24%, soil water infiltration rate 6 times quicker in Miyawaki forests compared to urban grassland, temperature up to 35°C cooler. Maintenance requirements are also much lesser compared to conventional urban greening.

Keyword: Miyawaki method, forest ecology

Session 4B – Future Ecosystems Climate and Land Change

OC86

FUNCTIONAL CONSTRAINTS TO ABIOTIC STRESS POLYTOLERANCE IN NORTHERN HEMISPHERE WOODY PLANTS

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Trade-offs among tolerances to different abiotic stressors limit polytolerance in woody plants, but the trait syndromes underlying them remain elusive. Can the trait dimensions of the global spectrum of plant form and function (GSPFF) capture these trade-offs? Using a dataset of 779 Northern Hemisphere woody plants spanning deciduous and evergreen angiosperms, and evergreen gymnosperms, we linked the GSPFF with drought, shade, cold and waterlogging tolerance syndromes. Drought-tolerant angiosperms showed denser wood (SSD), larger seed mass (SM), lower specific leaf area (SLA) and leaf nitrogen content per mass (LN), compared to cold/waterlogging tolerant species. Shade-tolerant angiosperms displayed greater SSD and SM and lower SLA and LN compared to intolerant angiosperms. Drought- and shade-tolerant evergreen gymnosperms also displayed contrasting trait adaptations. Our findings identify some leading functional constraints on polytolerance in woody plants and provide a framework to integrate additional trait dimensions to fully elucidate such constraints.

Keyword: Abiotic stress, Woody plants, Functional traits, Plant strategies

OC87

GRASSLAND RECOVERY AFTER AN EXTREME DROUGHT: WHAT LONG-TERM MONITORING AND FIELD EXPERIMENTS CAN TEACH US

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Intact vegetation may be resistant to even substantial changes in climate, but extreme climatic events may catalyse a vegetation shift to a new state that is in equilibrium with an already altered mean climate. But are the recent changes in mean climate large enough to prevent recovery after extreme events? We have studied sand grasslands in an inland sand dune system in Central Hungary, where the 2022 extreme drought caused a huge dieback of the dominant species, with a mortality rate of about 95% for *Festuca vaginata* tussocks and 75% for *Stipa borysthenea* tussocks, the two dominant species in the community. However, a long-term annual vegetation monitoring since 1999 showed that such a dieback is not unprecedented: the drought year of 2003 caused a dieback of similar degree. After the 2003 drought, *S. borysthenea* recovered fast and took over dominance between 2004 and 2015. In 2016, though, a high number *F. vaginata* seedlings survived the critical first summer, which paved the way to a shift back to *F. vaginata* dominance by 2019. Overall, these results from long-term observations coupled with results from precipitation manipulation experiments suggest that extreme droughts may regularly cause mass diebacks in these grasslands, but as long as mean precipitation remains similar to present levels, these grasslands can recover. Our results also emphasize the importance of rare and largely unpredictable demographic event, mass establishment, in grassland recovery.

Keyword: climate change, grassland, drought, long-term, recovery, experiment

Session 4B – Future Ecosystems Climate and Land Change

OC88

HOW DO CHANGES IN HYDROLOGICAL REGIME AFFECT FOREST STRUCTURE IN RIPARIAN ECOSYSTEMS? ★

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Floodplain forests are very dynamic ecosystems, dependant on the natural flow regime variability. Thus, hydrological alterations may affect their plant diversity, structure and regeneration, and therefore jeopardize their future shape and function. Our aim is to evaluate the effects of river regulation caused by a dam on the forest structure and woody plant regeneration. The study area is the Irati river basin in Navarre (northern Spain), where the Itoitz dam regulates the hydrological regime of the main river since 2004. In this work, forest structure and woody plant recruitment were sampled in 54 locations, distributed across the four main rivers of the study area, in both, river sections affected and not affected by the dam. At each locality, a 200 m² permanent plot was established. Within that plot, four subplots of 1m² were systematically placed to count all the woody plant seedlings and saplings. Additionally, in the 200 m² plot, tree and shrub individuals were measured and the deadwood was quantified. Various metrics were calculated for structural analyses, including basal area and volume for each species, deadwood volume, tree density, stem density, tree mortality ratios and more. The recruitment of woody plant species were compared among river stretches. Both, recruitment and forest structure data were analysed together, to evaluate whether the Itoitz dam has changed the general shape of the riparian forest. Our exploratory analyses showed that the dam impacted locations have experienced higher levels of tree mortality and debris wood accumulation compared to the others.

Keyword: floodplain forest, structure, recruitment, dam, river regulation, Spain

OC89

PLANT FUNCTIONAL DIVERSITY THROUGH SPACE AND TIME: WHAT HAPPENED IN THE SHALLOW PONDS OF THE ILES KERGUELEN FOR FIVE YEARS? ★

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These processes may change through time, resulting in the plant community dynamics (modification in plant species composition) and in variations in plant species strategies (intraspecific trait variations). Ultimately, this should affect the functional diversity of the plant community. In this context, we aim here at determining the process that most influence the functional diversity of aquatic plant communities through space and time.

We then conducted an analysis of a five years dataset compiling traits measured on all aquatic plant species encountered in temporary freshwater ponds of the Iles Kerguelen (South Indian's Ocean), as well as environmental parameters measured at fine spatial scale, descriptors of pond size and locations, and plant species richness and abundances. As sub-polar regions are subject to rapid climate changes, environmental parameters are likely to vary significantly through short periods of time. We computed a path-analysis based on a Structural Equation Modeling approach, to link variations in the functional diversity of plant communities and all the above parameters.

Preliminary results reveal an effect of environmental filtering through the distance with the sea, pH, and conductivity on plant functional diversity. All these variables appeared to be structured by temporal or geographical distances. Also, variability in pH was positively correlated with the mean water temperature. Ecological drift was detected through the positive correlation between time and functional diversity. Surprisingly, results opposite to those expected in the case of dispersal limitation were found.

Keyword: beta functional diversity, path analysis, macrophyte, dispersal limitation, ecological drift, environmental filtering

Session 4B – Future Ecosystems Climate and Land Change

OC90

REVEALING THE HIDDEN TAPESTRY: EXPLORING BIODIVERSITY INTERACTIONS IN EUROPEAN FORESTS UNDER DIFFERENT MANAGEMENT

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In the context of the current climate crisis and the urgent need to address biodiversity loss, it is crucial to adopt a comprehensive approach to studying ecological systems. However, most ecological studies tend to focus on single taxonomic levels or groups, which limit our understanding of the underlying mechanisms shaping communities and the impact of environmental change. In European forests, the effects of land-use history on biodiversity and ecosystem functioning are deeply intertwined. To gain insights into the complex interactions between organisms and their environment, our project aims to investigate the biodiversity responses to non-native forest plantations compared to native forest stands. We employ a comprehensive multitaxa approach, analyzing five groups – plants, mites, spiders, saproxylic fauna, and birds (including acoustic diversity) – to assess the impact of growing monocultures of non-native tree species on biodiversity across various taxonomic groups and scales. This innovative perspective, based on structured biodiversity information, provides a holistic understanding of the ecosystem. Additionally, we record acoustic diversity in both planted and native forests and employ terrestrial laser scanning (TLS) technique to gather precise information on stand structure, including tree cavities and dead wood. By utilizing these advanced and innovative techniques, our study aims to bridge the critical gap in our understanding of complex biodiversity responses to forest management. Ultimately, this research can help overcome sectoral biases and contribute to better-informed decision-making at the local, regional, and national scale in forest management practices.

Keyword: Acoustic diversity, Multitaxa approach, Vegetation, Alien trees plantations, Land use, Biomass, Climate

OC91

BIODIVERSITY LOSS DISRUPTS SEASONAL CARBON DYNAMICS IN A SPECIES-RICH TEMPERATE GRASSLAND

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Biodiversity loss poses a significant threat to ecosystem functioning, yet the effects on the carbon dynamics in natural communities remain poorly understood. We conducted field experiments in a species-rich meadow ecosystem to investigate the effects of long-term removal (> 6 years) of (i) a dominant species, and (ii) subordinate and rare species on carbon pools and seasonal fluxes. Dominant removal led to substantial reductions in aboveground phytomass and litter production and altered the annual C fixation capacity of the vegetation, highlighting the pivotal role of dominant species in driving ecosystem functioning. Despite high species diversity, other species could not fully compensate for the loss of a single dominant, challenging assumptions about functional redundancy. However, complementarity effects were evident outside peak vegetation periods, with subordinate and rare species contributing to ecosystem functions in early spring and autumn, likely due to phenological complementarity. Surprisingly, belowground phytomass and soil organic carbon content were not significantly affected by species removal, suggesting complex interactions in belowground processes. These findings underscore the importance of dominant species in maintaining ecosystem functioning and emphasize the need for nuanced approaches to studying biodiversity loss in real-world communities. Comprehensive seasonal measurements are essential for accurately discerning the effects of biodiversity on ecosystem dynamics and informing effective conservation strategies that maintain ecosystem functioning.

Keyword: Ecosystem functioning, Biodiversity loss, Seasonal carbon dynamics, Net ecosystem C exchange, Phenological complementarity, Soil organic carbon, Litter decomposition, Belowground biomass

Session 4B – Future Ecosystems Climate and Land Change

OC94

MICROBIAL EFFECTS ON HOLM OAK (*QUERCUS ILEX*) GERMINATION

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Germination is a critical process influenced by multiple abiotic and biotic factors and that depends on the interaction between microorganisms and the environment. As plants select specific sets of microbes that evolve together in response to local conditions, we looked at the role of microorganisms on holm oak (*Quercus ilex*) germination to test whether soil microbial communities enhanced germination of seeds from its own habitat more than soil communities from other habitats, in accordance to the home-field advantage (HFA) hypothesis reported for litter decomposition. In a growth chamber experiment, we used sterilised seeds from two localities sowed on sterilised substrate, and added inocula containing the microbiome extracted from several soils with a factorial design, recording seed germination over two months. Overall, germination of sterilised seeds sowed on sterile soil without extracts was similar in both localities. However, soil extracts from Somiedo enhanced *Q. ilex* seed germination more than other extracts, pointing to soil microbes as an important controlling factor. There was a significant difference in HFA between the two localities, being positive in Somiedo and negative in Ronda, suggesting that plant-soil coevolution was more difficult in harsher than in milder environments. Our results evidence the critical role of soil microbial communities on *Q. ilex* germination.

Keyword: Holm oak, home-field advantage, local adaptation, seed germination, soil microbial communities

OC170

HABITAT-SPECIFIC TEMPORAL CHANGE OF VEGETATION IN GERMANY

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The ResurveyGermany dataset presents a unique source of information on terrestrial biodiversity change, with records reaching back about one century. A past analysis of changes over time from the species perspective revealed that not only there were more losers than winners, but the amounts of cover losses and gains were also not distributed equally within both groups. Overall, fewer species increased in dominance and frequency, whereas more species decreased in cover and sometimes disappeared locally. Our present analysis focuses on the habitat-specific changes in the composition of functional traits, revealing large differences in changes of community characteristics such as richness, diversity and community-weighted mean trait values among habitats. Specifically, open formations such as grasslands and coastal habitats show different trajectories than those of closed vegetation, such as forests. The results demonstrate that diversity change has many functional dimensions that are dependent on habitat type. For supporting future monitoring, this points to the need to stratify vegetation monitoring by habitat type and to use habitat-specific changes in trait syndromes as warning signs for biodiversity loss.

Session 4C – European Vegetation Ecology

OC95

SPECIES DISTRIBUTION MODELLING TO IDENTIFY HABITAT ISLANDS FOR NARROW ENDEMICS CLIMATE RELICTS: AN UPDATE

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Ptilostemon greuteri is one of the most intriguing narrow endemic plant species of the Mediterranean Basin and is considered among the most endangered and poorly studied woody vascular plants of this area. This broad-leaved woody thistle survives in two microrefugia in the North-Western coast of Sicily (Italy) and can be considered a climatic relict. It thrives in habitat islands consisting of NE-facing calcareous cliffs and ledges as well as at the bottom of narrow, steep and shaded gorges, which benefit from the sea humidity. To identify suitable habitat islands for conservation purposes, we performed a species distribution model using high resolution DEM and other DEM-derived microtopographic variables. The species distribution model identified very few sites suitable for the species; further field vegetation surveys validated the reliability of the model and unexpectedly enabled us to discover a second population of *Hieracium lucidum*, another narrow endemic species previously known only from Mount Gallo. Monitoring data from translocation activities using both survival and growth rate of newly introduced plantlets and seedballs showed that species distribution modelling can be an effective tool to identify suitable habitat islands for narrow endemics.

Keyword: climate relicts, narrow endemics, *Ptilostemon greuteri*

OC96

FRESHWATER MACROPHYTES OF MEDITERRANEAN RIVERS. RESULTS FROM AN EXTENSIVE RIVER MONITORING CAMPAIGN

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Aquatic macrophytes, (vascular plants, bryophytes, macroalgae, ferns, etc.) play a substantial role in maintaining biodiversity and ecosystem functioning in freshwaters. In Mediterranean type-rivers macrophytes form dynamic assemblages adapted to the high seasonal and annual variability of the hydrological regime. Multiple pressures, including human influences, climate, and land use change, negatively affect aquatic biodiversity and human wellbeing worldwide. Over recent decades, extensive national and international regulations have been adopted to protect inland water resources. In Europe, the EU Water Framework Directive (WFD 2000/60) has promoted ecological monitoring with biological quality elements to assess freshwater ecological quality and to restore a good ecological state of all EU member states. In this context, the macrophyte monitoring network of Greek rivers was established in compliance with WFD requirements and includes information on an extensive network of 490 river reaches. The main objective of this work was to examine relationships between species composition and environmental stressors along longitudinal gradients in more than 220 river reaches of mainland Greece, by means of multivariate analyses (PCA, CCA, and RDA). The main findings showed that the hydromorphological modifications have a defining role in shaping macrophyte assemblages, and it seems that at moderate disturbed reaches, species richness would be higher. Bryophytes dominate the upper part of the rivers, while emergent plants, amphibious, and hygrophilous species were abundant in both middle and downstream reaches. Overall, the links between macrophyte assemblages, environmental factors, and human alterations are critically important in improving freshwater biodiversity management and environmental conservation in east Mediterranean rivers.

Keyword: ecological quality, Greece, environmental changes, aquatic plants, freshwaters

Session 4C – European Vegetation Ecology

OC97

REVIEWING 30 YEARS OF BIASES, ANALYSIS, AND TRENDS IN VEGETATION RESURVEY STUDIES ★

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Vegetation resurvey has gained increasing attention in the last decades as a cost-effective but powerful methodology for the direct study of fine-scale vegetation dynamics. With an appropriate time interval, it can detect dynamical changes in community diversity and composition and provide elements to understand long-processes but also the effects of management and conservation strategies, providing valuable insights for policy development. Resurvey studies include a variety of different sampling designs, plot types, analyses, and biases so researchers need to be particularly cautious.

We conducted a systematic literature review of 197 vegetation resurvey studies to determine the most applied sampling designs, biases, and mitigating techniques used, as well as variables, indices, and analysis techniques according to the hypothesis of the study. Our results show that the most accounted bias is related to spatial relocation, when considering semi-permanent plots, but only a few studies reported a measure of uncertainty over the relocated plots or use replicas to ensure the quality. Other type of biases such as observer bias have only been considered in recent years.

The utilized analysis differs according to the hypothesis, data type, and transformation. Simple measures of change such as paired t-test or chi-squared are the most common, followed by ordination techniques such as PCA, PCOA, RDA, etc. Most of the studies considered biodiversity indicators as well, as plants' functional traits, with Ellenberg indicators as the most common.

Finally, the majority of the studies indicate a diffuse anthropogenic impact on vegetation communities underlining the need of increasing conservation efforts.

Keyword: vegetation dynamics, vegetation resurvey, literature review, bias

OC98

EVALUATION OF REMOTE SENSING METHODS FOR THE MONITORING OF SUBMERGED AQUATIC VEGETATION

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The development of sensors with fine spatial and spectral resolutions has considerably accelerated the monitoring of vegetation by remote sensing. However, the use of such methods in aquatic environments remains limited due to the scattering, the reflectance and the absorption of the light induced by the water surface and column. The aim of this study is to assess the efficiency of using satellite images (Planet, 3m) to monitor submerged aquatic vegetation (SAV) at different spatial and temporal scales using very high-resolution airborne images (15cm) as ground truth. For this purpose, both aerial and Planet images were acquired at similar dates between 2017 and 2023 on ~20km river reaches exhibiting distinct environmental conditions (water clarity, hydrology). To map SAV, control points were determined by photointerpretation on each aerial image and a machine learning algorithm was applied on different satellite spectral datasets: a first including all spectral bands (the first and the second generations of Planet's satellite include the red, blue, green, near-infrared bands while the third generation include four new bands: coastal blue, green l, yellow and red-edge) and a second excluding the near-infrared for which the signal is strongly altered by water level variations. For each site, the best model was applied on the other images to test the ability to map SAV with a single model. The results indicated that remote sensing methods could be useful for mapping SAV at a given date, while the application of a single model to another date greatly reduced the classification accuracy.

Keyword: Planet images, Remote sensing, Spatio-temporal scales, Submerged aquatic vegetation, Rivers

Session 4C – European Vegetation Ecology

OC99

A FULLY MAPPED COMMUNITY APPROACH TO UNVEIL THE EFFECTS OF BIOTIC INTERACTIONS ★

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At small scales where biotic interactions are strongest, constraints on coexistence can drive similarity or dissimilarity in functional traits, according to the theories of weaker competitor exclusion, and limiting similarity, respectively. Neighbourhood density can also be correlated with functional traits, reflecting the demands of a more competitive environment. While previous studies in grassland communities have found evidence of limiting similarity, little attention has been given to scales under 20 cm, where interactions could be strongest.

To fill those gaps we treated the community as a marked point pattern, by fully mapping the position of each functional individual in two semi-natural dry grasslands (“open” and “closed”) using 10 50 × 50 cm quadrats. We collected trait information for 1094 functional individuals, namely height, leaf area and specific leaf area, covering independent axes of variation in plant size and resource economics.

Having individual-level trait measurements allows for estimation of intraspecific trait variability (ITV), which is often neglected and potentially high, and to conduct a purely functional analysis, without relying on species-level mean trait information.

Overlap-based dissimilarity between species and grassland type confirmed the large contribution of ITV. Many point pattern functions didn't deviate from the null model, but in the closed grassland, significant trait similarity and negative density correlation was found for traits related to plant size; the multivariable approach considering distances in the trait space showed trait similarity in the open grassland. The point pattern approach proves to bring new insights into assembly rules and scales of interest for grasslands.

Keyword: point pattern analysis, assembly rules, mark correlation, mark variogram, density correlation, functional traits, ITV, TPD

OC100

BIASES IN SPECIES RICHNESS DATA IN LARGE PHYTOSOCIOLOGICAL DATABASES

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The advent of phytosociological databases, and especially their integration into the European Vegetation Archive (EVA), was an unprecedented achievement that stimulated numerous fascinating large-scale studies. For this reason, EVA datasets have become a main resource for studies of various components of plant diversity, including taxonomic, functional, and phylogenetic diversity.

A recent study on plant alpha-diversity in Palaearctic grasslands (Biurrun *et al.* 2021) found unexpected strong differences in mean species richness between EVA and GrassPlot, the latter being a multi-scale plant diversity database of Palaearctic grasslands and other open habitats focused on comprehensive sampling in precisely delimited plots to record reliable diversity indices. We followed these findings by detailed comparisons of species richness between EVA and GrassPlot. We used phytosociological classes as the main units and plots ranging from 1 to 100 m². In addition, for the GrassPlot dataset, we distinguished between the nested series recorded with the EDGG sampling protocol and the entire dataset.

We found significant differences in the species richness of most phytosociological classes. The mean species richness was higher in the GrassPlot dataset for most combinations of grain size and class except for some species-poor classes in the smaller grain sizes. In addition, the magnitude of the detected differences increased towards larger grain sizes and varied among regions and countries, probably resulting from different traditions and phytosociological schools.

We conclude that studies that specifically aim to investigate fine-scale plant taxonomic diversity need to be aware of the potential bias in phytosociological databases and the resulting limitations.

Keyword: alpha diversity, species richness, GrassPlot, European Vegetation Archive (EVA), grassland, Palaearctic, phytosociological database, vegetation-plot database, vascular plant, phytosociological class

Session 4C – European Vegetation Ecology

OC101

COASTAL DUNES IN THE NORTHWEST OF IRELAND: ANALYSING VEGETATION AND FUNCTIONAL TRENDS

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The Northwest of Ireland represents an extremely dynamic environment, where high wave and wind energy continuously shapes the features and aspect of the coastline. Coastal dunes are unique habitats in which species are strongly influenced by physical and biotic filters and simultaneously threatened by human disturbance. The projected increase in storm frequency, anthropic pressures and sea level rise is expected to intensify the vulnerability of dune systems and potentially reduce their ability to react to changes. Exploring the mechanisms that drive plant adaptations and assemblages is essential to work with natural processes and prevent habitat loss. We selected 13 sites in the Northwest of Ireland and used 409 random vegetation plots and multivariate analyses to quantify vegetation patterns and identify habitats of conservation interest. Functional traits (extracted from the TRY database) and functional diversity indicators are applied to evaluate the strategies utilised by plants to survive and to explore the presence of trends in various disturbance and vulnerability scenarios. Plants in coastal habitats are expected to adopt diverse strategies in response to the environmental gradient and the harsh abiotic conditions. Investigating how functional traits change and influence the structure and stability of communities has the potential to support more informed decisions in coastal dunes management. Furthermore, there are no studies with a functional approach that focus on the distribution of species along Ireland's coastline, which can also influence the ability of dune systems to respond to future changes.

Keyword: functional traits, Ireland, coastal dune habitats, Dune ecosystems

OC102

SYNTAXONOMICAL OVERVIEW OF THE *CRYSIETEA ACULEATAE* CLASS IN EUROPE

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Crypsietea aculeatae Vicherek 1973 is a class of pioneer vegetation of periodically flooded saline habitats in Eurasia. This vegetation has an ephemeral nature and develops in the draining phase temporary in temporary brackish water bodies. It includes mainly annual salt-adapted plant species, accompanied by some perennial plants. Increasing human impact on this habitat requires developing effective conservation planning based on comprehensive unified pan-European vegetation classification which is still missing. We aimed to provide the first large-scale classification system of the class *Crypsietea aculeatae* in Europe and outline its biogeographical patterns. Using agglomerative clustering with Ward's linkage method, we analyzed 730 vegetation plots from the EVA (Chytrý *et al.*, 2016) and private sources. We interpreted the resulting clusters and used them for developing formal definitions of the vegetation associations. Our data suggest that the class *Crypsietea aculeatae* is represented by three vegetation associations in Europe: *Crypsietum aculeatae* Wenzl 1934, *Crypsietum schoenoidis* Topa 1939 and *Cyperetum pannonicum* Wendelberger 1943. Based on the data analysis and nomenclature revision, we propose to combine all vegetation of the *Crypsietea aculeatae* in Europe within one phytosociological alliance *Cypero-Spergularion salinae* and update the syntaxonomy of the class accepted in EuroVegChecklist (Mucina *et al.* 2016). Our study showed that the *Crypsietea aculeatae* vegetation is distributed across the Pannonian, Continental and Mediterranean biogeographical regions of Europe with more or less equal frequency without any patterns of biogeographical differentiation. The physiognomic structure and floristic composition of studied vegetation are quite similar throughout the entire range.

Keyword: syntaxonomy, vegetation, Europe

Session 5A – Future Ecosystems Climate and Land Change

OC103

CHANGES IN INTRA-/INTERSPECIFIC COMPETITION DRIVE STABILITY AND ASYNCHRONY OF DOMINANT SPECIES

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Changes in land use, agricultural intensification, and climate shifts accelerate the species loss from ecosystems. Many studies based on artificially assembled communities have shown that species loss impacts various ecosystem functions like productivity or its temporal stability. Conversely, results from real-world experiments have demonstrated that the biodiversity role in functioning is less pronounced and only a few dominant species can maintain these functions. However, there is little evidence of how species diversity loss affects the relative roles of intra- and interspecific competition and how changes in this affect the behavior of the key dominant species. In a highly species-rich meadow, we created a biodiversity experiment where we simulated realistic species loss by removing subordinate and rare species and created gradients of intraspecific and interspecific competition. We assessed the effect of changes in competition on spatial and temporal stability, mobility, and asynchrony of the most dominant species. Our findings indicate that both temporal and spatial stability of dominant species is significantly higher in plots with reduced interspecific competition, pointing to the destabilizing role of co-occurring species on the dominants. Furthermore, higher interspecific competition limits dominant species production, but when relieved from competition, they can successfully compensate for the missing species. Regardless of diversity (or prevailing competition), the dominant species tended to behave more synchronously in time and their mobility was consistent. Our results point to the crucial role of dominant species in maintaining ecosystem functions after species loss and that changes in competition hierarchies strongly affect their key properties.

Keyword: intraspecific competition, interspecific competition, dominant species, species loss, stability, mobility, asynchrony

OC104

CLIMATE CHANGE IMPACTS ON BIODIVERSITY AND MULTIFUNCTIONALITY ACROSS A BOREAL LANDSCAPE

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Climate change impacts biodiversity and ecosystem functioning by altering plant, animal and microbial distributions, composition, and food webs, as well as affecting complex interactions and feedback between organisms and functional groups. Most climate change studies to date explore focus on the response of single or few species, functional groups, trophic levels, or ecosystem characteristics and do not capture the interplay between the key trophic levels and functional groups in the plant-soil food web. This knowledge gap limits our ability to both scale up to a general understanding of climate effects on entire ecosystems, and to predict future responses of climate change. In addition, species and interactions responses to climate change are often context-dependent and these relationships are often poorly understood. Here we use a powerful macroecological experimental approach, by replicating a plant functional group removal experiment across factorial broad-scale temperature and precipitation gradients, to assess how climate change and biodiversity loss affects multifunctionality. We combine data across different organismal groups (plants, microbes, mesofauna), functions (carbon capture, cycling, storage), and biodiversity metrics (taxonomic, molecular, functional). Preliminary results show that biodiversity loss reduced multifunctionality, but these responses differ across climate gradients. The results from this study will improve process understanding on climate change impacts on the multifunctionality of the plant-soil food web of mountain ecosystems, and how this varies along climate gradients and in response to different climate change drivers.

Session 5A – Future Ecosystems Climate and Land Change

OC105

HOW PERENNIALS EXPLOIT VEGETATION SEASON IN TEMPERATE CLIMATES

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Plants in temperate climates must cope with a limited window of favourable conditions for growth. While annuals fit their whole life cycle into this window and woody species maintain living tissue aboveground, perennial herbs are truly perennial only belowground and their aboveground parts are as a rule annual. They start growing in spring using resources stored in their belowground organs, develop shoots aboveground, capture carbon by photosynthesis and invest it in growth, reproduction and in building belowground resources for the next year. As any field naturalist would know, there are tremendous differences among species of temperate floras how they handle this problem. We examined strategies that perennials use to exploit the limited time of one growth season, by linking data on growth and flowering phenological niches, senescence onset, final height, storage organ size and overwintering bud development, in 200 temperate species. Using these data, we identified several major growth strategies, showing a strong gradient from extreme “capital growers” that rely on belowground storage in their growth, to extreme “income growers” that rely on growth maintained by continuous carbon capture throughout the season. Each of these strategies are associated with specific habitats. These differences are phylogenetically conservative, implying that key innovations in exploitation of the seasonal window are fairly rare; diversification analysis showed that really fast diversification events are linked with marginal positions in the phenological strategy space.

Keyword: climate seasonality, phenology, comparative species ecology, temporal niches, belowground storage

OC106

SPECIES LOSS AND EMERGENT METACOMMUNITY DYNAMICS

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This research aims to deepen our understanding of biodiversity-ecosystem functioning (BEF) relationships through metacommunity theory, focusing on how biodiversity loss impacts ecosystem functioning. Previous studies have shown that species loss can lead to variable outcomes, with experimental biodiversity loss often negatively affecting plant productivity, especially under additional disturbances like fertilization, drought, or overgrazing. Despite theories predicting species compensation, these effects are rare in nature. BEF studies typically focus on site-level dynamics, potentially overlooking the scale-dependent nature of biodiversity. Here, we propose to combine empirical data from species removal experiments with a metacommunity framework to understand how dynamics at multiple scales influence ecosystem functioning. Metacommunities can be sorted into four theoretical paradigms: neutral dynamics, species sorting, mass effects, and patch dynamics, which describe a continuum of processes in a three-dimensional space. Using this approach, we aim to clarify how biodiversity loss affects BEF across different ecosystems by simulating these processes and linking them to empirical data. Simulation scenarios will involve generating metacommunities based on key parameters and creating extinction scenarios by removing species inspired by literature and environmental disturbances. A case study will analyze where the synthesis data from previous studies fits within the metacommunity parameter space, identifying gaps in understanding and assessing the generalizability of experimental results across different ecosystems. This approach aims to elucidate the underlying processes driving ecosystem responses to species loss, enhancing predictions of BEF in the Anthropocene.

Keyword: biodiversity change, plant ecology, simulations, ecosystem functioning, biodiversity-ecosystem relationships

Session 5A – Future Ecosystems Climate and Land Change

OC107

INTEGRATING SPECIES POOLS AND FUNCTIONAL REDUNDANCY TO ASSESS STABILITY IN PLANT COMMUNITIES ★

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In the face of global environmental changes, it is timely understanding the resilience and stability of ecosystems. The species pool concept, encompassing the species and traits which can potentially inhabit a local community, combined with functional redundancy - the presence of species with similar functions but different environmental preferences within the species pool - are often used independently as indicators of community resilience and stability. This is because these suitable and functionally redundant species are in the surroundings and theoretically ready to buffer local losses. However, both concepts are rarely used in combination, yielding a lack of both theoretical and empirical evidence of their synergistic importance in ecological studies. Our theoretical framework suggests that functionally redundant species pools can buffer against local species losses, maintaining ecosystem functions due to the availability of suitable replacements within the region, supporting the so-called insurance and complementarity effects in temporal turnover. To illustrate these ideas, we used temporal datasets of plant communities from around the globe and functional traits. Preliminary findings indicate that the species pool concept is important in evaluating the stability and resilience of local communities over time, providing a scalable approach to assess ecological robustness across various regions and ecosystems. Our study underlines the species pool framework combined with functional diversity as innovative and critical in examining the dynamics of plant communities globally amidst ongoing climate change. This approach not only enhances our theoretical understanding but also promises to offer practical insights for conservation strategies in a rapidly changing world.

Keyword: Community assembly, Functional diversity, Insurance effects, Resilience, Climate change, Functional species pools

OC108

INFLUENCE OF BIODIVERSITY LOSS AND ENVIRONMENTAL FACTORS ON SHAPING PLANT COMMUNITY COMPETITION

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Biodiversity loss has been repeatedly demonstrated to decrease community resistance to colonization, increasing their sensibility to invasive species. Biodiversity loss can empty ecological niches through the loss of species complementarity. Consequently, low diversity communities should be associated with lower interspecific competition allowing the colonization of non-resident species. It has been rarely tested whether diversity correlates with the community competitive ability. We used phytometers in a long-term diversity experiment and investigated whether diversity loss affected the competitive ability of communities.

We transplanted one grass and one forb species in plots varying in species diversity and measured their relative growth rate (RGR) and traits associated with size and leaf economics. Results were compared with individuals grown in competition-free gaps.

While we observed a strong effect of the vegetation compared with gaps on RGR and traits, we found weak differences between diversity levels. Trait responses were consistent with the idea that the vegetation exerts a strong competition on both species. However, these responses were irrespective of the species diversity, challenging the idea of a decrease in competitive ability with biodiversity loss. We demonstrate more complex relationships involving indirect effects of diversity on phytometers through other community factors (community biomass, soil fertility, light availability).

Our study provides insights into the complex mechanisms underlying the relationship between diversity and community competitive abilities which might be critical for the colonization of new species in the community. Our results have implications for ecological theory and management practices, offering valuable guidance for sustainable ecosystem conservation and restoration efforts.

Keyword: Biodiversity loss, Competitive ability, Complementarity, Environmental factors, Phytometers, Resistance to colonization

Session 5A – Future Ecosystems Climate and Land Change

OC109

CAN TRAITS HELP US PREDICTING ECOSYSTEM FUNCTIONS FROM SPECIES COMPOSITION? ★

Tereza Švancárová (Czech Republic)¹; Tomáš Hájek (Czech Republic)²; Marie Konečná (Czech Republic); Aleš Lisner (Czech Republic); Eva Janíková (Czech Republic); Jules Segrestin (Czech Republic)¹

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The “holy grail” of functional ecology has been defined as the ability to predict ecosystem functions based on the functional traits of species composing ecological communities. According to the mass-ratio hypothesis, ecosystem functioning is primarily determined by the characteristics of dominant species. In this study, a trait-based approach is employed to investigate the predictions of community processes from traits with a focus on the community-weighted mean (CWM) as a key metric. We still lack knowledge on the reliability of this metric for the scaling from species to community processes. In this study, we focused on a critical ecosystem function, photosynthetic capacity, which can be measured at both species and community levels using comparable units of expression. We selected 15 grasslands along a productivity gradient where variability in CWM is expected. Net ecosystem photosynthesis was measured using closed chambers connected to a portable gas analyser. The species composition of each community was characterized, and the leaf photosynthetic capacity of abundant species was measured using a Portable Photosynthesis System (LI-COR 6400). Other leaf traits were also measured to compare results obtained from “softer” traits. This study enhances our understanding of how traits may predict community processes and offers a more mechanistic perspective through experimental testing.

Keyword: functional traits, community processes, net ecosystem photosynthesis, photosynthetic leaf capacity, grassland, community-weighted mean

OC110

PLANTS ARE COLORFUL: ALLOWING COLORBLIND PEOPLE TO INTERPRET REMOTELY-SENSED VEGETATION VARIABLES

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Vegetation maps represent powerful tools to show the spatial variation of plant assemblages in a straightforward manner. A crucial aspect in map rendering for its interpretation by users is the gamut of colors used for displaying data. One part of this problem is linked to the proportion of the human population that is color blind and, therefore, highly sensitive to color palette selection. The aim of this talk is to present the `cblindplot` R package and its founding function - `cblind.plot()` - which enables color blind people to just enter an image in a coding workflow, simply set their color blind deficiency type, and immediately get as output a color blind friendly plot. We will first describe in detail color blind problems, and then show a step by step example of the function being proposed. While examples exist to provide color blind people with proper color palettes, in such cases (i) the workflow include a separate import of the image and the application of a set of color ramp palettes and (ii) albeit being well documented, there are many steps to be done before plotting an image with a color blind friendly ramp palette. The function described in this paper, on the contrary, allows to (i) automatically call the image inside the function without any initial import step and (ii) explicitly refer to the color blind deficiency type being experienced, to further automatically apply the proper color ramp palette.

Keyword: remote sensing

Session 5B – Restoration, Conservation and Vegetation Management

OC111

TRENDS OF GLOBALLY-TRADED CITES-LISTED PLANTS ACROSS SPACE AND TIME, IMPLICATION FOR BIODIVERSITY CONSERVATION

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Plants are a vast, lucrative portion of global wildlife trade and the most speciose clade listed under the Convention on International Trade in Threatened Species-CITES. A key question is understanding the diversity and volume of plant trade under CITES across space and time. Between 2000-2020, over 8.4 million m³ of timber, 197 million individual live plants, and 4.6 million kg of plant products were traded under CITES, comprising 53, 765, and 74 species, respectively. Most species are traded between key exporter and importer nations, especially China, USA, and Europe. Total numbers of timber species and volumes increased over time, whereas live richness declined, and product richness and mass fluctuated uncertainly. Most species were not evaluated by the IUCN Red List when first traded, with high volumes of timber and products concentrated among threatened taxa post-evaluation. Despite a lack of clear decrease or increase in the average of species presence and volume in all IUCN statuses of timber and most statuses of products, the average NE, LC, VU, EN, and CR live-traded species there have been declines in species presence in trade, but not their volume when traded, indicating such species have disappeared from trade rather than their volumes have declined. The high prevalence of poorly understood species necessitates enhanced rigour in ensuring sustainable CITES trade.

Keyword: Conservation, biodiversity, CITES, Wildlife trade, plant trade, sustainable use, Vegetation management

OC112

LAND-USE LEGACIES AND POST-FIRE FOREST MANAGEMENT DRIVE RECOLONIZATION PATTERNS OF GROUND VEGETATION ★

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Recent wildfires have burned large forest areas in Germany, where the risk of wildfires is predicted to increase. However, studies on fire effects in temperate forests are rare. We studied recolonization patterns of ground vegetation two years after a severe fire on 200 plots in a burned Scots pine forest in Brandenburg (NE Germany). On many plots post-fire management activities were carried out including different levels of salvage logging and soil disturbance (raking, ploughing), while other plots remained unmanaged. We studied the effect of post-fire forest management, pre-fire land use legacies (stand age and forest continuity), fire severity and distance to the unburned edge on ground vegetation. We classified plant species according to regeneration from wind-dispersed seeds (invader), the soil seed bank (seed banker), and resprouting (sprouter). Pre-fire stand age had a positive effect on invaders and mean Ellenberg indicator values for nitrogen (mN) and reaction (mR), whereas it was negative for seed bankers. One the one hand, old forest stands are characterized by thick humus layers, which can release high amount of nutrients during the fire. On the other hand, seeds are mainly stored in the seedbank during open stages and their viability decrease over time, leading to reduced seedbanks in older stands. Seed bankers were favoured by forest management including high levels of soil disturbance (e.g. ploughing), which probably activated the seed bank. Bryophyte cover was highest on plots with no forest management, while it was reduced by forest management involving soil disturbance such as ploughing.

Keyword: wildfire, succession, seedbank, recolonization, post-fire vegetation, salvage logging, pioneer vegetation

Session 5B – Restoration, Conservation and Vegetation Management

OC113

NO GENERAL SUPPORT OF FUNCTIONAL DIVERSITY ENHANCING RESILIENCE ACROSS TERRESTRIAL PLANT COMMUNITIES

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Understanding the mechanisms promoting resilience in plant communities is crucial in times of increasing global environmental change. Here, we present the first meta-analysis evaluating the relationship between functional diversity and resilience of plant communities. Specifically, we tested whether the resilience of plant communities is positively correlated with interspecific trait variation (following the niche-complementarity hypothesis) and the dominance of acquisitive and small-size species (following the mass-ratio hypothesis), and for the context-dependent effects of ecological and methodological differences across studies. We compiled a dataset of 69 independent sites from 26 studies that quantified resilience. We conducted a meta-analysis based on correlation coefficients between functional diversity and resilience of biomass and floristic composition. In general, we found no positive functional diversity-resilience relationships of grand mean effect sizes. In contrast to our expectations, we encountered a negative relationship between resilience and trait variety, especially in woody ecosystems, whereas there was a positive relationship between resilience and the dominance of acquisitive species in herbaceous ecosystems. Finally, the functional diversity-resilience relationships were strongly affected by both ecological (biome and disturbance properties) and methodological (temporal scale, study design and resilience metric) characteristics. We rejected our hypothesis of a general positive functional diversity-resilience relationship. In addition to strong context-dependency, we propose that idiosyncratic effects of single resident species present in the communities before the disturbances and biological legacies could play major roles in the resilience of terrestrial plant communities.

Keyword: Resilience, Disturbance, Functional diversity, meta-analysis

Session 5B – Restoration, Conservation and Vegetation Management

OC114

ASSESSING DUNES AND SALT MARSHES CONSERVATION STATUS THROUGH COUPLED FIELD AND REMOTE SENSING APPROACHES

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Mediterranean dunes and salt marshes are home to a wide range of organisms and unique and fragile plant species assemblages. A comprehensive assessment of coastal ecosystems status could help counteracting increasing anthropogenic pressures, that are hampering local plant communities' resilience. The main aim of this study is to assess and map dunes and salt marshes conservation status along the Tuscany coast, to provide information for successful management strategies. The three specific objectives of this study are: i) assess dunes and salt marshes plant communities' conservation status based on their taxonomical and functional composition; ii) test if different taxonomical and functional compositions correlate with different remotely sensed spectral signatures; iii) map dunes and salt marshes conservation status to identify critical areas in need of protection efforts.

We analyzed species data from more than 600 vegetation plots located along the coast of Tuscany and extracted multi-organ functional traits from various sources: specific leaf area (SLA), leaf area (LA), leaf dry matter content (LDMC), seed mass, height, clonality, succulence, dispersal mode and pollination syndrome. We further categorized plots conservation status by linking species composition to anthropogenic pressures and we assessed plant communities spectral signature using Sentinel-2 images. Lastly, we mapped dunes and salt marshes conservation status along the coast of Tuscany according to their spectral signature. The results of this study could provide valuable information for salt marshes and dunes management and conservation. Protecting these ecosystems is pivotal in ensuring the provision of ecosystem services, such as coastal protection or CO₂ sequestration.

Keyword: functional traits, spectral signature, diversity

OC115

TWENTY-YEAR EFFECT OF SEWAGE-SLUDGE FERTILIZATION ON VEGETATION DYNAMICS IN A MEDITERRANEAN GRASSLAND ★

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Mediterranean semi-natural grasslands are biodiversity hotspots of high conservation interest. However, they are threatened by climate and land-use changes, such as land-use intensification and addition of fertilizers. Commercial fertilizers are currently being substituted by sewage sludge, though detailed studies on its long-term effects on vegetation dynamics are still missing. Understanding how fertilization with sewage sludge affects Mediterranean semi-natural grasslands is of multifaceted interest, from perspectives of waste management, ecosystem conservation, and vegetation ecology. We analysed the vegetation dynamics of a Mediterranean semi-natural grassland for 20 years (2004-2023) in response to a single sludge fertilization event in 2003. In particular, we tested the legacy effects of fertilization, the response of species with different functional traits and from different functional groups, and the influence of fertilization on the year-to-year vegetation response to climatic factors (temperature and precipitation). Our findings reveal significant alterations in community species composition lasting over two decades following the fertilization event, ultimately impacting long-term successional trends. However, 17 years post-fertilization, species compositions in control and fertilized plots began to converge. Among the species present, fertilization favours annuals with higher SLA over perennials, and influences the year-to-year response of community species composition to climatic factors such as summer drought, leading to different responses depending on the functional group and traits of the species studied. These results highlight the complex interactions between fertilization practices and climatic variability, and underscore the importance of considering long-term ecological dynamics to understand the impacts of anthropogenic activities and climatic changes on Mediterranean grasslands.

Keyword: fertilization, functional groups, land-use, lifespan, long-term time series, Mediterranean grassland, Principal Response Curves, sewage sludge, soil water deficit, vegetation dynamics, wastewater treatment

Session 5B – Restoration, Conservation and Vegetation Management

OC116

DEMOGRAPHIC STABILITY OF DOMINANT PLANT SPECIES IN FREQUENTLY BURNED OLD-GROWTH SAVANNAS

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Old-growth grasslands are disturbance-dependent, biodiverse ecosystems. Long-lived perennial grasses are considered a defining feature of these ecosystems because they confer substantial resilience to disturbance. We conducted two studies to provide data-driven support for the persistence of ancient grasslands. Our studies focused on the dominant, endemic bunchgrass *Aristida beyrichiana* (wiregrass), a keystone species across much of the southeastern U.S. First, we developed demographic models of *A. beyrichiana* in wet and dry pine savannas that were burned at different frequencies and in different seasons for at least several decades. We monitored nine populations over 2-4 demographic transitions and developed integral projection models. Second, we used long-term community composition data from fire-frequented pine savannas along a moisture gradient in the same region to examine patterns of stability and abundance of *A. beyrichiana* and co-occurring plant species over time. Our studies indicate numerically stable populations of *A. beyrichiana* despite very different fire regimes. The survival of populations was 100% in most years, with minimal contribution of recruitment to population growth. The long-term community data showed that the abundance of *A. beyrichiana* and co-occurring dominant plant species remained consistent over more than 20 years. In fact, changes in average relative percent cover between any two sampling years were less than 0.5% for the most abundant species. The consistency of results between studies and over time bolsters support for old-growth savannas in the southeastern U.S., which has, until recently, been very understudied and suffered from a lack of recognition by the global community.

Keyword: Fire, Grasses, Demography, Southeastern USA, Community composition, Keystone species

OC117

ROADLESS AREAS FOR NATURE PROTECTION IN THE EUROPEAN UNION

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The identification of remote and unfragmented areas has emerged as a crucial tool for spatial planning in the context of international commitments to nature protection. Here, we identified roadless areas for the whole European Union (EU) and assessed their environmental representativeness, ecological value, and current protection level. First, we developed a reproducible R workflow for roadless areas' extraction based on data from OpenStreetMap. Two alternative sets of roadless areas were created based on the presence of different types of linear infrastructure. Then, we evaluated the environmental representativeness of roadless areas by analysing their distribution across ecosystems and determining their abiotic envelope. The ecological value of roadless areas was determined in terms of their size and the potential presence of habitats and plant species of conservation interest. Finally, we assessed the current protection status of roadless areas by overlaying consolidated spatial data from the World Database of Protected Areas, with a focus on strict protection (IUCN categories I and II). Roadless areas cover between 5 and 15% of the EU land territory, depending on their definition, with large variations among countries. Despite encompassing a great proportion of the EU abiotic envelope, some ecosystems are strongly underrepresented among roadless areas. On the other hand, roadless areas potentially host several species of conservation interest, representing a viable addition to national and EU protected area networks. This research sheds light on the potential contribution of roadless areas within the European Union toward fulfilling international conservation and restoration objectives.

Keyword: Roadless areas, Rewilding, Big data

Session 5B – Restoration, Conservation and Vegetation Management

OC118

EFFECT OF FOREST MANAGEMENT IN THE TAXONOMIC AND FUNCTIONAL DIVERSITY OF MEDITERRANEAN SCOT PINE UNDERSTORY PLANT COMMUNITIES

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Scot pine forests (*Pinus sylvestris*) in the Spanish Central System constitute together with the relictic betic populations, the South-western limit of the species distribution. These forests have been subject to various types of management since ancient times.

In recent times, there has been a great interest in developing Scots pine management approaches that simultaneously support biodiversity, production, and optimize the benefits of climate mitigation. However, the direct and indirect effects that forest management has on biodiversity are not yet fully understood.

Thus, our objective is to assess the effects that different forest management practices have on the plant biodiversity taking into account the functional and phylogenetic composition of the Scot pine understory plant communities. For that we selected two locations with actively managed pine forests with different silvicultural treatments for field work during 2022 where a total of 64 floristics inventories were performed.

Taxonomic and functional diversity between management treatment was compared among different forest management types using multivariate statistical techniques. Our results show significant differences in taxonomic and functional diversity between pine forests subjected to more intensive management versus those managed with techniques that generate homogeneous stands. The latter forests are more diverse in both taxonomic and functional traits and maintain a higher conservation value.

In a global change context where southern populations of Scots pine are threatened, our results highlight the importance of management focused on the conservation of species and communities in a global change context.

Session 5C – Biogeography and Evolution in Island Ecosystems

OC119

PROTECTED AREA EXPANSION TO COVER THE PLANT COMMUNITY GRADIENTS ACROSS MEDITERRANEAN ISLANDS

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Islands are a natural test bed for studying and testing evolutionary and ecological theories. With only a small fraction of land area, islands harbor one fifth of the Earth's biodiversity, and a proportionately high amount of extinct (75%) and threatened species (50%). Protection of island ecosystems is fundamental to preserve evolutionary lineages and ecological assemblages. With this study we aimed to test how much of the plant diversity in terms of number of species and community gradients is presently protected by the existing system of protected areas in the Mediterranean countries and figure out which are the most important facets of biodiversity to be included in a future enlargement of the protected area network.

We used the geographical data from the recent MEDIS database, that contain information for the 2217 islands larger than 1ha in the Mediterranean basin and we calculated the amount of protected areas using data from WDPA and national reports. Then obtained the all the available plot data for these islands from EVA and integrated it by original plot data, to obtain a data set including 4653 species from 47,700 plots on 455 islands. We analyze the species composition by multivariate methods and overlap the compositional multidimensional space with the area covered by the existing network of protected areas of different IUCN categories, highlighting the degree of protection already onset. Then, we highlight the need for expanding the conservation areas with respect to the compositional space and island surface area.

Keyword: Biodiversity, Island biogeography, Conservation planning, Biodiversity strategy, Isolated communities

OC120

CAN WE PREDICT SYNCHRONY BY FUNCTIONAL TRAITS AND PHYLOGENY IN PLANT COMMUNITIES?

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A key aspect of ecosystem stability relates to the temporal replacements in species abundances in the plant community. The mechanism resulting from these replacements can produce species' compensatory dynamics, hypothetically led by functionally different species being either synchronized or asynchronized in their temporal fluctuations. To assess this, here we investigate how the synchrony between pairs of species is connected to their functional and phylogenetic (F&P) relatedness, with two alternative hypotheses: (i) closely F&P-related species being synchronous, suggesting a similar response to weather fluctuations; (ii) closely F&P-related species being anti-synchronous, suggesting competition among similar species leading to temporal niche partitioning. To test this, we compiled data from long-term yearly repeated vegetation surveys (LOTVS database, ~11.000 permanent plots Worldwide, from ~90 sites), functional traits (TRY database), and phylogeny (mega-tree implemented in Phylomaker). We related temporal synchrony (a detrended temporal correlation in yearly abundances between pairs of species) and species pairwise (dis)similarity in terms of traits (Gower's distance on functional traits linked to plant and function traits trade-offs) and phylogeny (squared cophenetic distance). Analyses show a general prevalence of sites with greater synchrony among similar species (up to 20% depending on the spatial scale and F&P relatedness considered) over the alternative hypothesis of anti-synchrony among similar species (max. 3%). This indicates that species with similar adaptations might respond similarly to inter-annual climate fluctuations, with less related species increasing compensatory dynamics.

Keyword: Synchrony, Permanent plots, Compensatory dynamics, Temporal niche partitioning

Session 5C – Biogeography and Evolution in Island Ecosystems

OC121

SEXUAL COMPOSITION OF *CHAMAEROPS HUMILIS* L. POPULATIONS IN THE MEDITERRANEAN COASTAL VEGETATION OF SICILY

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The dwarf palm (*Chamaerops humilis* L.) is one of the most representative and distinctive species of the Mediterranean coastal landscapes. Within its range (Western Steno-Mediterranean), it is a key element of the shrub formations in the Mediterranean maquis. In Sicily, the dwarf palm is a component of various formations such as forests (*Quercetalia ilicis*), maquis and garrigue (*Quercetalia calliprini*), and, to a lesser extent, scrublands (*Cisto-Micromerietalia julianae*) on substrates of various nature (limestones, marls, dolomites, clays, basalts, and calcarenites).

The initial investigations conducted as part of the PRIN 2022 PNRR “CHAMPION” project (funded by the European Union–Next Generation EU) indicate that the species is dioecious in formations with a high frequency of individuals, whereas in relic stations with sparse populations, the presence of monoecious plants with unisexual inflorescences is more common.

The aim of this work is to understand how the structure, floristic composition, and traditional anthropogenic activities of the plant communities characterized by *Chamaerops humilis* are influenced by the frequency of the sexes of individuals. One objective will be to formulate hypotheses to verify the possible relationships between the induction of environmental and phytocoenotic components regarding the phenotypic expression and reproductive potential of the dwarf palm.

Keyword: Mediterranean Palm, Biotic Interactions, Habitat fragmentation

OC122

DRIVERS OF EPIPHYTE DIVERSITY IN THE NEOTROPICS

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Session 5C – Biogeography and Evolution in Island Ecosystems

Vascular epiphytes are plants that grow on other plants, as they germinate and establish non-parasitically on them. They are one of the most conspicuous and diverse life forms in tropical forest canopies, for instance, they comprise roughly 10% of the world's vascular plant diversity. Epiphytes are the most species rich in the Neotropics, across the tropics, where they make up to 39% of the vascular flora. Epiphytes play critical roles in the forests through the provision of ecosystemic and ecological services, and, overall, they add great structural complexity to the forest canopies.

Factors determining the elevational and latitudinal distribution of epiphytes may act in concert; whereby adaptations to the epiphytic habit, which mainly deal with low water availability, could constrain their physiological tolerance to factors such as low temperatures. Although it is known that global patterns of epiphyte richness may reflect latitudinal patterns observed in other taxa, e.g., the latitudinal diversity gradient; richness in epiphytes decreases with increasing latitude at a rate three times faster than terrestrial plants. Similarly, a mid-elevation bulge is clearly observed for epiphytes as for other taxa. Nonetheless, little progress has been made in understanding the role of regional heterogeneity in the diversity of epiphyte assemblages. Available research is mostly local, and most recently, a single study on the global drivers of epiphytic richness was published. Both local and coarse-grained analyses inevitably lead to an underestimation of the importance of regional variation such as over elevational gradients or ecoregions. No studies evaluating both species richness and abundance at a regional or continental scale exist. Given current and future global change scenarios, understanding the mechanisms underlying spatial patterns of biodiversity is crucial. Here, we assess the drivers of epiphyte plant species richness and abundance and their association with environmental, geographical, and historical factors at regional and community scales to characterize and understand the drivers of Neotropical epiphyte diversity. We will use a new database of epiphyte Neotropical community data with information from ca. 9 000 host trees, with ca. 150,000 epiphyte individuals distributed in ca. 1,500 epiphyte species; from 25 ecoregions, to evaluate elevational and latitudinal patterns of regional and community richness and abundance using generalized additive models. We will model regional and community richness in a mixed-effect modelling framework using environmental, geographical, and historical predictors from global raster layers. We expect that Neotropical epiphyte patterns of richness and abundance will be predicted by climatic variables related to precipitation and temperature with opposing effects; whereby abundance will be aided by temperature and richness will be limited by precipitation.

Keyword: epiphytes, diversity, Neotropics, richness, abundance, climate

OC123

CHARACTERISTICS, EVOLUTION, AND ADAPTATION OF THE “SKY ISLAND” FLORA ON QINGHAI-TIBET PLATEAU

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The “Sky Island” flora of the Qinghai-Tibet Plateau (QTP) is mainly distributed in the highest in the vertical spectrum of high mountains and mostly adjacent to the ice and snow zone with the altitude is generally between 4300-5200m or higher. There are no obvious dominant species of vegetation, making it difficult to classify them. The flora in QTP is consisting of 56 families, 188 genera, and 1578 species of vascular plants. Among them, the most typical genera include *Saxifraga* (75 species), *Corydalis* (55 species), *Saussurea* (49 species), *Arenaria* (31 species), *Cremanthodium* (28 species). Also there are a high proportion of endemism, with a total of 13 endemic genera and a high proportion of 40% of endemic species. In the distribution pattern of species, some species exhibit a pattern of one peak and one endemic species, and it is common for populations of different peaks to have their own unique genetic characters, the “Sky Island “ may have played an important role in the differentiation of species. These plants have the most complex and diverse morphological specialization structures that adapt to extreme environments, such as “wooly”, “greenhouse”, “drooping heads”, defense structures such as “camouflage”, etc. The genomic analysis of some groups showed the periglacial plants exhibit significant convergent evolutionary characteristics, such as the convergent contraction of disease resistance genes, molecular convergence characteristics on genes involved in self incompatibility, cell wall modification, DNA repair, and stress resistance, etc. Therefore, convergent evolution also plays an important role in its ecological adaptation.

Keyword: Sky Island, Plant Diversity, Differentiation

OC124

ANALYSIS OF THE FACILITATIVE EFFECT OF NURSE SHRUBS ON THE REGENERATION OF ENDANGERED ENDEMIC TREE SPECIES IN SOCOTRA ISLAND (YEMEN)

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Socotra island is considered a biodiversity hotspot with 46% of species being endemic and with a significant ecological and cultural values. However, the combined effect of grazing, mainly by goats, and climate change is threatening the survival and regeneration of iconic tree species, such the dragon blood tree (*Dracanea cinnabari*), frankincense (*Boswellia spp.*) and myrrh (*Commiphora spp.*) endemic trees. In our study we analysed the facilitating role of thorny or poisonous shrubs as nurse plants in promoting tree regeneration. Six shrub species were selected, and phytosociological surveys were carried out in randomly chosen shrubs to evaluate species abundance and shrub characteristics. Corresponding control plots were also established. Multivariate analysis and weighted means at the community level were utilised to analyse functional traits, and the Relative Interaction Index (RII) was utilised to comprehend the dynamics between the shrub and its surroundings. Plot positions and nurse species significantly affected the results of multivariate analyses. Different patterns of plant communities were revealed by the Indicator Species Analysis, with graminoids predominating outside shrubs and forbs being more common inside. The diversity indices showed that species' levels of biodiversity varied, and the RII results helped in the selection of beneficial nurse shrubs. The next step will be focused on planting seeds within this nurse species, checking the survival of seedlings. This will be useful for future ecological restoration project on the island, implementing this nature-based intervention fostering climate resilience and sustainable ecosystem management on Socotra Island.

Keyword: Facilitation, Nurse Species, Endemic Trees, RII

Session 6A – European Vegetation Survey

OC126

PHYTOSOCIOLOGICAL REVISION OF THE DRY AND SEMI-DRY GRASSLANDS OF THE EASTERN ALPS

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We present a revision of the dry and semi-dry grasslands of the Eastern Alps, based on a TWINSPLAN classification of 2924 relevés. At the highest level, xeric grasslands (rocky steppes and grass steppes) were separated from meso-xeric (semi-dry) grasslands. Within the first group, a strong biogeographical gradient was revealed, separating the dry grasslands of Tyrol and adjacent regions from those further east. Most of the xeric grasslands are rocky steppes corresponding to the order *Stipo-Festucetalia pallentis* while grass steppes (corresponding to the *Festucetalia valesiacae* s.str.) are very rare in the Eastern Alps and were only separated at a low hierarchical level within the two geographical subgroups. The diagnostic species of the two orders as determined in previous studies for east-Central and Eastern Europe are not directly applicable to the inner Alps. Thus, for the time being, we unite the rocky steppes and grass steppes of the Eastern Alps in a single order *Festucetalia valesiacae* (s.lat.) with three alliances: Stipo-Poion xerophilae (incl. *Diplachnion serotinae*) in the west, and *Seslerio-Festucion pallentis* and *Festucion valesiacae* in the east. The semi-dry grasslands are included in the order *Brachypodietalia pinnati* with two alliances: Mesobromion (NW margin of the Eastern Alps) and *Cirsio-Brachypodion* (inner valleys and eastern margin of the Alps).

Keyword: Alps, syntaxonomy, *Festucetalia valesiacae*, steppe grasslands, Stipo-Poion xerophilae

OC127

MONITORING OF VULNERABLE HABITATS TO CLIMATE CHANGE IN THE WESTERN ALPS ★

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Climate and land use changes are occurring at an unprecedented rate causing shifts in plant communities. Depending on water and nutrient variability, decomposition, climate and plant production, mires are among the most vulnerable and threatened ecosystems. Several studies documented the current responses of mire vegetation to global changes, even if these habitats have been long considered rather stable with slower plant changes. Repeating historical surveys provides a unique opportunity to detect vegetation changes and their potential drivers over the last decades. The species of the alpine mires are strongly exposed to extinction risk also because the Alps represent one of the southernmost important areas for the European mires. To our knowledge, no resurvey on the Western Alps Sphagnum-dominated mires has already been published. Our study aims to understand the changes in species composition of the Western Alps mires vegetation and their threats. We resurveyed the vegetation in 14 sites. In particular, we monitored 70 quasi-permanent and 69 permanent plots previously described in historical phytosociological surveys in 1998 and 2011 respectively. Both vascular flora and Sphagnum species were sampled. Gamma diversity has significantly increased in permanent and quasi-permanent plots by 33.33% and 11.94% respectively. Alpha diversity increased too in both groups. Landolt ecological indicators changes suggest higher drought and nutrient availability. The tree dominance and associated shade-tolerant dwarf shrubs have increased. The indicator species of present surveys confirm these results, e.g. *Larix decidua*, *Vaccinium myrtillus*, highlighting an acceleration in the vegetation dynamics.

Keyword: resurvey mires peatlands climate change

OC128

MEASURING WATER STRESS IN ALPINE ECOSYSTEMS

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Water stress is an important but often overlooked driver of plant communities, influencing both adult and regeneration plant stages. Understanding spatiotemporal variation in water stress is urgently needed to predict the response of vegetation to current and future climatic conditions. To investigate whether alpine vegetation is associated with water stress, we measured soil water potential in 10 European alpine systems, including temperate and Mediterranean vegetation monitored by GLORIA and similar initiatives in Austria, Italy, Greece, Spain and Switzerland. The data consisted of year-round records collected every two hours in the soil with a tensiometer, in a minimum of two sites per system. We calculated the number of days with soil drought, i.e., when the soil reached the permanent wilting point at -1.5 MPa, as a water stress variable to model macro- and meso-ecological conditions. Our results showed a wide variation of water stress among regions, with lower variability within sites of each system. We found a lack of water stress in most of the plots from the Alps, and a range between 0 and 66 days of water stress in the Cantabrian and Apenine mid-latitude mountains. The largest periods of water stress were detected in Crete (62 to 146 days), followed by the Madonie mountains in Sicily (58 to 66 days). Our results were consistent with the vegetation types and the life forms observed in the study sites, suggesting that direct measurements of soil water potential are necessary to understand microclimatic trends in water-sensitive vegetation.

Keyword: Alpine, Climate, Drought, Microclimate, Mountains, Soil

Session 6A – European Vegetation Survey

OC129

SEEDLING FUNCTIONAL TRAITS ALONG ALPINE ENVIRONMENTAL GRADIENTS ★

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Seedling establishment is the most vulnerable stage of plant regeneration, but little is known about seedling functional traits and related developmental strategies. In alpine communities, seedlings must overcome low temperatures, high solar radiation and short growing seasons in a complex topography that creates sharp temperature variation and snowmelt gradients at fine scales. Here we explore seedling trait functionality by focusing on 12 alpine specialists of grassland communities above 1900 m a.s.l. in the Cantabrian Mountains (Spain). To capture regional variability, we studied six species from the two macroclimates represented in the study area: Mediterranean and Temperate. We also selected species with ecological preferences in contrasting microclimatic conditions based on field temperature series. We measured a set of traits including seed mass, emergence and establishment periods, and above and belowground biomass. A Principal Component Analysis revealed consistent strategies across macroclimates, suggesting a separation between acquisitive and conservative seedling strategies. When both macroclimates were analysed separately, we found specificities. Trait variation in temperate species was mainly driven by relative growth rate, with species from colder and snow-persistent microclimatic conditions emerging and developing faster. Trait variation in Mediterranean species was mainly driven by radicle length, with species from warmer and less snowy sites having longer radicles. Our study indicates that seedling traits in alpine communities show functional variability along both macroecological and microclimatic gradients.

Keyword: alpine regeneration, microclimatic conditions, seedling strategies, seedling traits

OC130

NOMENCLATURE REVISION AND DISTRIBUTION MAPS OF THE SYNTAXA INCLUDED IN THE ORDERS PHRAGMITETALIA AND BOLBOSCHOENETALIA MARITIMI IN EUROPE

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As part of the WetVegEurope project, in 2020, we published the “Classification of European marsh vegetation (*Phragmito-Magnocaricetea*) to the association level.” However, with the publication of the fourth edition of the International Code of Phytosociological Nomenclature in 2021, our one-year-old work already needed a nomenclature revision. We now present how a thorough revision of phytosociological nomenclature has changed the list of names of marsh vegetation units for the orders *Phragmitetalia* Koch 1926 and *Bolboschoenetalia maritime* Hejný in Holub et al. 1967. With the help of our co-authors and consulting numerous literature sources, we also prepared distribution maps for each association.

We revised a total of 316 names, including accepted names and synonyms, a total of 32 associations, 3 alliances, and 2 orders. Eight names were corrected according to Articles 43 and 44, six were mutated according to Article 45, and three names were inverted according to Article 42. We designated 14 lectotypes and 4 neotypes. The analysis of the distribution maps showed that the highest diversity of marsh vegetation associations is found in the Mediterranean and Central European countries. Most of the rare wetland associations are restricted to Eastern Europe. The Balkan countries have the greatest lack of data.

Our work has shown that nomenclature revision is a time-consuming but feasible task that contributes to the stability of the names used in vegetation classification. Furthermore, the distribution maps allowed us to highlight which are the most important countries for wetland diversity and the data gaps in Europe.

Keyword: Vegetation classification, nomenclature, marsh vegetation, wetlands, distribution maps

Session 6A – European Vegetation Survey

OC131

EUROPEAN FLORA REVISITED

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Since the idea of a pan-European Flora was discussed at the International Congress of Botany in Paris 70 years ago, theoretical and applied research on the systematic of vascular plants and vegetation has virtually exploded. Many national and regional floras, checklists and databases are now available in analog and digital form.

Based on this data, we compare the characteristics of (i) non-apomictic and (ii) apomictic endemics, that are restricted to one or two predefined regions in Europe, and (iii) non-endemics that are widely distributed within and outside Europe.

Therefore, data from Euro+Med Plantbase, TRY, IUCN Red List, and different national online tools, and a few own observations are combined to new databases, and used to collect information about all European vascular plant species.

As interim result, the flora of Europe including Turkey and Caucasia comprises more than 30,000 vascular plant species with c. 55 % endemics. Plants in horticulture and agriculture without any tendency to run wild are not included.

In our analyses, we focus on range distributions, habitats, traits and globally threatened species in Europe under constant or changing abiotic conditions.

Nevertheless, it is still difficult to clarify synonyms over long distances. Moreover, many former subspecies have been listed as species in recent decades. We also ask how the great diversity or increasing number of descriptions of apomictic taxa should be taken into account. In retrospect, it can be shown that the perception of change is not only related to the environment, but also to a change in perception.

Keyword: Phytogeography, endemism, habitats, traits, conservation

OC132

RECENT DEVELOPMENTS IN THE STANDARD EUROPEAN VEGETATION CLASSIFICATION

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A comprehensive classification system of European vegetation, colloquially known as the EuroVegChecklist, was published in 2016 by a team of 32 vegetation scientists led by Ladislav Mucina. It was accepted by the IAVS Working Group European Vegetation Survey (EVS) as the standard classification of European vegetation. While the EuroVegChecklist accepted 1106 alliances dominated by vascular plants, more than 300 new alliances have been described since its publication, and numerous revisions of the syntaxonomical system have been proposed. The EVS has established the European Vegetation Classification Committee to evaluate such proposals if submitted for evaluation, and some changes have been accepted. Updated versions of the classification system with tracked changes compared to the EuroVegChecklist are published in the Vegetation module of the new online database FloraVeg.EU. The most important changes were made to the coastal dune vegetation, Mediterranean pine forests and bogs. The current number of alliances dominated by vascular plants is 1116. The Vegetation module of FloraVeg.EU has been extended with new information not included in the original EuroVegChecklist, in particular, distribution maps for each syntaxon and standardized attributes of 12 variables characterizing the structure, ecology and biogeography of each alliance. Queries combining distribution data with attribute values can reveal different patterns of European vegetation diversity. In addition, the database is complemented by photographs documenting different physiognomies of each European alliance in different parts of its distribution range. Currently, the database contains 4259 photographs of 425 alliances, and the collection of the photographic database is still ongoing.

Keyword: database, Europe, phytosociology, syntaxonomy, vegetation classification

Session 6A – European Vegetation Survey

OC133

BIOGEOGRAPHY OF ANGIOSPERM PARASITES IN EUROPE

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Parasitic plants are a functional group that has developed specific strategies to facilitate resource acquisition. Parasitic plants can influence the plant community they inhabit by shaping nutrient cycling and dominance dynamics. Despite their ecological relevance, no large-scale analysis of their ecological niches has been done so far.

We analysed the ecological niches and habitat types of 246 parasitic plants in Europe using a dataset of 890,799 vegetation plots from the European Vegetation Archive (EVA). In the dataset, 144,181 plots (16.2%) included at least one parasitic species. We explored the geographical distributions and occurrence in habitat types of parasitic plants in Europe. Using a gradient tree boosting analysis, we further defined their ecological niches along climatic and soil gradients.

We found the highest occurrences of parasitic plants in grasslands, forests, and heath- and scrublands with some contrasting patterns between functional types of parasitic plants. Green ephytoid hemiparasites occurred mostly in open habitats of colder climates and low nutrient availability and notably well represented in Europe's mountainous and subarctic regions. Mostly non-green obligate root parasites strongly to fully dependent on their host occurred more frequently in the warm and summer-dry regions. Mistletoes were confined to woody habitats of either low or high precipitation. Parasitic vines occurred in warm open habitats on basic bedrock. In addition to these differences between the functional types, we also identified substantial interspecific variation within them suggesting species niche partitioning along the environmental gradients.

Keyword: Parasitic plants, Ecological niches, Biogeography, Hemiparasites

OC134

RELICT FOREST COMMUNITIES OF THE BALKAN ENDEMIC *AESCULUS HIPPOCASTANUM*

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Aesculus hippocastanum L. (European Horse-chestnut) constitutes a biogeographical relict species of the Balkan Peninsula, occurring in isolated and topographically distinct localities in Albania, Bulgaria, Greece and North Macedonia. Despite the great botanical, ornamental and pharmaceutical value of this species, a thorough investigation of habitat diversity of the communities in its native distribution range has not been conducted yet. The present study aims at the syntaxonomic classification and ecological features of plant communities dominated by this species across its overall native distribution range. On the basis of 55 phytosociological relevés, five ecologically, floristically, and spatially well differentiated clusters were identified, with the main revealed gradients of differentiation being geographic location (longitude, latitude), altitude, annual precipitation and precipitation seasonality. These communities belong mostly to the alliance *Ostrya carpinifoliae-Tilion platyphylli* and only an isolated forest in Greece, which is in the species altitudinal extremum, is included in *Abietion cephalonicae*. The distinct microhabitats with a special refugial character where these plant communities occur meet the species' requirement for relatively high air and soil humidity. They have allowed the preservation of *Ae. hippocastanum* through time highlighting their great conservational value. The last one could be useful for the implementation of some appropriate measures for effective conservation of these communities.

Keyword: Tertiary relict, Ravine forest, Seed dispersal strategy

Session 6B – Restoration, Conservation and Vegetation Management

OC135

IMPACT OF WATER TABLE DEPTH ON CERRADO WETLAND PLANT COMMUNITIES

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Cerrado wetlands are unique ecosystems due to their distinctive hydrological functioning. Despite their global and local significance, these ecosystems are often neglected and misunderstood, lacking effective protection in Brazil. How their plant communities are influenced by their hydrological functioning, however, remains unclear. To address this gap, we sampled 16 wet-grassland sites in southeastern Brazil. We sampled the plant community in each site using 30 1-m² plots and measured the water table depth representing three wetland zones: edge, middle, and core. We used linear regressions to test the hypotheses that: (i) a narrow range in the water table depth within a wetland patch would mean low species turnover, and (ii) species richness would be lower the higher the elevation of the water table. Additionally, we prepared a dendrogram using Jaccard dissimilarity index (presence/absence matrix of species per zone in each site), in search for particular guilds associated to the core, middle or edge of the wetlands. Both hypotheses were confirmed, with beta diversity positively associated with the amplitude in the water table depth and lower richness the closer to the surface is the water table. We did not find clustering across sites related to the zones (core, middle or edge). However, clustering was found merging plot sets with similar water table depths. All results provided evidence that the water table depth is a strong filter driving the community assembly (diversity and species composition) in wet grasslands of the Cerrado. Conservation and restoration of these ecosystems depend on understanding this relationship.

Keyword: Cerrado, wetlands, grasslands, groundwater

OC136

PLANT COVER OF THE FORMER KAKHOVKA RESERVOIR, UKRAINE

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On June 6, 2023, the dam of the Kakhovka hydroelectric power plant was detonated, causing an environmental catastrophe in the Northern Black Sea region. Despite the severe environmental and socio-economic repercussions, the disaster offered a unique opportunity to study vegetation development in the long-flooded area. We visited the area twice, three weeks and 3.5 months after the incident. Our studies found that the number of vascular plants in the area increased nearly seven times from June to October, contradicting initial pessimistic predictions of desertification. Both short-lived and perennial plants were almost equally represented, with many spread by the wind. Moreover, the low prevalence of alien species challenges hypotheses of neophyte overgrowth. We delineated four types of newly formed terrestrial habitats, including willow thickets and marshy habitats, as well as mud and shell-covered areas with sparse vegetation. Remote sensing methods, augmented by machine learning techniques, complemented these findings, providing a detailed habitat map for the entire reservoir bed. Our observations suggest the potential restoration of pre-reservoir vegetation, and may serve as a foundation for ongoing monitoring efforts. This study contributes to the understanding of ecological succession and habitat dynamics in post-catastrophic landscapes, informing future management strategies for such territories.

Keyword: Kakhovka reservoir, habitats, remote sensing, vegetation, restoration

Session 6B – Restoration, Conservation and Vegetation Management

OC137

UNRAVELING SHORT-TERM CHANGES IN TAXONOMIC AND FUNCTIONAL DIVERSITY WITHIN AN OLD-GROWTH FOREST

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Old-growth forests serve as invaluable reservoirs of biodiversity. Understanding the temporal dynamics and trajectory of undisturbed old-growth forests is needed to ensure their conservation and to improve close-to-nature management strategies. By shedding light on recent temporal dynamics of an iconic old-growth forest within an Italian strictly protected area, our study contributes to understanding the intricate balance within these habitats. Focusing on understory herb-layer species, we employed a multifaceted approach to explore alpha and beta taxonomic and functional diversity, alongside forest-specialist species richness, over a 10-year period. Our findings reveal changes in taxonomic turnover, while functional turnover remained unaffected, indicating diverse effects of time on different diversity facets. This suggests that temporal changes in undisturbed conditions lean more towards stochasticity than determinism. The rise in species richness, coupled with a decline in functional diversity, may imply increased redundancy at the plot level, potentially supporting resilience to future disturbances and climate change. Gained species predominantly comprised forest-specialist species with traits typical of mature forests, while lost species were primarily generalists, hinting at enhanced habitat quality within the strictly protected area. Our study underscores the importance of concurrently considering various diversity facets when investigating the effects of temporal changes on vegetation. Moreover, our findings offer valuable insights into the ecological transformations of old-growth forests after under strict protection especially considering the need to increase the share of strictly protected areas, as directed by the European Biodiversity Strategy of 2030.

Keyword: Short-term changes, Taxonomic diversity, Functional diversity, Strictly protected forest, Old-growth forest

OC138

CHALLENGES IN THE MONITORING OF FLOODPLAIN VEGETATION DIVERSITY WITH REMOTE SENSING ★

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Monitoring vegetation composition is essential to evaluate restoration projects and relies on relevant biodiversity indices. Remote sensing (RS) tools have been increasingly applied to upscale this assessment, however, it depends on identifying metrics that retain key information on changes in vegetation composition under different contexts. We aim to i) evaluate changes in vegetation diversity indices after restoration actions, and ii) assess the ability of RS to estimate vegetation diversity. The study site is a floodplain forest in NW Portugal. Restoration actions between 2020 and 2022 included exotic plant removal and the plantation of native cuttings, as part of the LIFE FLUVIAL Project (LIFE16/NAT/ES/000771). We performed floristic inventories in 24 plots of 100m² (07/2021, 07/2022) to calculate biodiversity indices (Shannon's diversity and Pielou's evenness). Airborne data were collected (10/2020, 10/2022) with a fixed-wing UAV mounted with a Multispectral camera. Based on spectral bands (Red, Green, NIR, and Red edge) and the Canopy Height Model, we calculated different spectral diversity indices (Rao's Quadratic entropy, Mean Euclidean Distance, Convex Hull Volume, and Coefficient of Variation). Field biodiversity indices differed between years, suggesting their relevance in detecting short-term changes after restoration. However, we found no correlation between field-based and spectral indices. Indeed, the species composition, the succession stage, and the habitat heterogeneity of a site can affect the efficiency of high-resolution images to detect biodiversity changes. Thus RS indices showed to be context-dependent. We discuss how to overcome such limitations, notably by using structural and functional diversity to upscale the monitoring of different vegetation components.

Keyword: riparian vegetation, remote sensing, restoration, biodiversity, monitoring

Session 6B – Restoration, Conservation and Vegetation Management

OC139

THE IMPORTANCE OF PRISTINE GRASSLAND FRAGMENTS SUPPORTING AND/OR RESTORING GRASSLAND BIODIVERSITY

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His research activity covers the whole range of ecology, including ecological modelling, multivariate statistical methods, and also such applied subdisciplines of ecology like restoration ecology and urbanization. Pristine grasslands harbour high biodiversity and even small fragments of these grasslands can act as important refuges for plant and animal species in urbanised or agriculture-driven landscapes. We compared the species diversity and functional attributes of pristine and recovered grasslands, by studying the taxonomic and functional diversity in steppic grasslands (8 pristine and 5 recovered) using plots ranging from 0.01 to 100m². Our findings indicated that there are remarkable differences in taxonomic and functional diversity between pristine grasslands and recovered ones. We also pointed out that there is a functional saturation of the species assembly in the first few decades of recovery, while patterns and structure of recovered grasslands became similar to those of pristine grasslands, but the species richness and diversity remains much lower. This underlines the importance of the conservation of existing pristine grassland remnants, which may serve as sources of species for future restoration actions.

OC140

CRINUM BULBISPERMUM, A MEDICINAL GEOPHYTE WITH PHYTOSTABILIZATION PROPERTIES IN METAL-ENRICHED MINE TAILINGS

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Ancient grasslands are lost due to agriculture, urban expansion and mines, this leads to ecosystem degradation and biodiversity loss. Globally, degraded grasslands are a priority for restoration efforts to recover ecosystem services. Although ecological and social benefits of woody species and grasses are documented, limited research has considered the use of forbs in restoration despite their benefits (e.g., C sequestration). This study aimed to determine if *Crinum bulbispermum* (Burm.f.) Milne-Redh. & Schweick., a medicinal geophyte, could be used to restore mined soils in South African Highveld grasslands. A pot experiment was conducted to assess the performance of *C. bulbispermum* in a random design, with three soil treatments (varying degradation and metal contamination). The plants were monitored for 12 months, and the morphological characters were measured to assess performance. Inductively coupled plasma mass spectrometry (ICP-MS) was used to determine soil and plant tissue concentration of potentially toxic metals. Results indicated that mine tailings negatively affected the growth of *C. bulbispermum*. Although survival rates indicated that it survives on tailings, below-par productivity indicates the species is not ideal for restoration unless the tailings are ameliorated with topsoil. Although there was root accumulation of metals (Co, Cd, Cu, Mo, and Zn), no translocation occurred, making *C. bulbispermum* suitable for medicinal uses even grown on metal-enriched soil.

While not suitable for phytoremediation, this species shows promise for phytostabilization due to ecological advantages. These findings emphasize the importance of integrating geophytes into grassland restoration strategies to expand their ecological and societal benefits beyond conventional approaches.

Keyword: bioaccumulation; geophyte; grasslands; potentially toxic metals; restoration

Session 6B – Restoration, Conservation and Vegetation Management

OC141

DEVELOPMENT AND DIVERSITY OF MACROPHYTES IN SMALL URBAN FRESHWATER ECOSYSTEMS

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Urban freshwater ecosystems are valuable components of the environment, supporting the adaptation of cities to climate change and providing a set of different ecosystem services (increase in biodiversity, recreational space for residents, limiting the impact of the urban heat island, water retention, etc.). One method that enriches and maximises these functions is nature-based solutions (NBS), broadly introduced as the proper design of blue-green infrastructure. NBS can be an alternative solution for engineer-based grey infrastructure that approaches various city environmental and social problems. Our study focuses on 12 small ponds and streams in Poznan (Poland), for which aquatic vegetation and several environmental variables were examined, including water quality, morphological state and hydrological conditions. The preliminary results showed significant macrophyte diversity between the ecosystems studied. Our investigation suggested that various environmental factors influenced macrophytes, and it's hard to distinguish the most significant one. Urban ecosystems, even when designed to enhance ecosystem services, are still subject to numerous and significant pressures, making identifying specific factors influencing macrophyte development challenging. Transformations of the hydrological regime, morphological conditions, and physical and chemical quality strongly impact macrophyte abundance and diversity in urban ecosystems. The hydrological characteristics of study sites defined by stable water isotopes (deuterium, oxygen-18) concentration indicated the impact of climatic factors on the conditions of the ecosystems, which may affect macrophyte communities.

This research was developed within the project *BiNatUr*, which was funded through the 2020–2021 Biodiversa and Water JPI joint call for research projects under the BiodivRestore ERA-NET Cofund (GA N°101003777).

Keyword: macrophytes, NBS, ponds, streams, cities

OC142

PLANT FUNCTIONAL COMPOSITION AND ECOLOGICAL NICHE DISTRIBUTION ACROSS URBAN GRASSLANDS

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Open habitats, including grasslands, cover a significant part of urban greenery. They provide numerous ecosystem services for local societies, and serve as refuge habitats for grasslands biodiversity in built-up areas. Despite their value, key questions about their ecology are still unsolved. The aim of our research was to capture main patterns in urban grasslands (UGs) vegetation structure: plant functional composition, ecological niche differentiation, and biodiversity metrics. Vegetation data were collected from 938 plots and analysed with principal component analysis (PCA), and Generalized Linear Models (GLMs). Ordinations enabled to limit number of independent variables (composite variables) while GLM models allowed to capture differences in vegetation structure between lawns of different sizes, locations, and types. The results indicated that the diversity of UGs vegetation was considerably high, vegetation structure varied mainly along mowing and soil disturbance gradients (UGs in centre, in built-up areas, and at roadsides – more disturbed, UGs in peripheries, in parks, and at river embankments – less disturbed). Moreover, the vegetation structure changed along with soil calcification (UGs in centre- higher pH, in peripheries- lower), and temperature (UGs at river embankment - the most xerothermic vegetation, in parks- the least). The analysed patterns correlated with the biodiversity measures. From a practical point of view, increase in habitat stability as well as extensive but regular mowing would be beneficial for biodiversity and functional diversity of numerous UGs exposed on too intensive disturbance.

Keyword: city, biodiversity, disturbance indicator values, Ellenberg indicator values, green infrastructure, lawns

Session 6C – Biogeography and Evolution in Island Ecosystems

OC143

VEGETATION CHANGES ON THE DUTCH CARIBBEAN ISLANDS OVER 25 YEARS

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We resurveyed vegetation plots on the Dutch Caribbean windward islands Sint Eustatius and Saba and on the, much drier, leeward island Bonaire. The old plots were made in the late 1990s, while the resurvey was carried out in 2020 (Saba), 2022 (Sint Eustatius) and 2024 (Bonaire), the last project still ongoing. The vegetation on the islands ranges from lowland and montane rainforest, through dry tropical forest and scrubland, to mangroves and other coastal communities. On all three islands overgrazing by goats and other domesticated animals is one of the main pressures for the vegetation development, and it results in vegetation degradation, soil erosion and run-off of sediments into the coastal seas with coral reefs. In places where goats have been removed a rather quick regeneration of grasses, herbs, shrubs and trees is seen, while in other areas degradation continues, indication by for example a decline of juvenile shrubs and trees. This forms a threat for the long term survival of the tree and shrub populations.

Keyword: neotropics, trend analysis, grazing

OC144

FLORA AND VEGETATION OF THE KURIL ISLANDS FROM THE NORTHWEST PACIFIC

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The Kuril archipelago spans 1200 km from Japan to Kamchatka, consisting of over 56 volcanic islands. The region is characterized by active volcanism and frequent tsunamis originating from the Pacific Ocean. The southern part of the archipelago has a mean annual temperature of +5.1°C and 1251 mm of precipitation, whereas the northern part experiences +2.8°C and 1844 mm. The climate varies along a latitudinal gradient, with the southernmost island Kunashir Island hosting cold-temperate broadleaved forests, while the northernmost Paramushir Island features scrublands of dwarf alder and pine. The climatic gradient affects the distribution of trees, shrubs, and woody liana species of East Asian origin. The archipelago's flora includes 1244 native vascular plant taxa, with species richness declining from south to north: Kunashir has 930 taxa, and Paramushir has 501, despite comparable island areas. Islands in the central part of the archipelago host the fewest taxa due to their small size, high volcanic activity, and remoteness. The flora and vegetation of the Kuril Islands reflect historical patterns, influenced by Beringian (NW America-NE Asia) and East Asian migrations during the glacial/interglacial periods of the Pleistocene.

The Kuril Islands illustrate the complex interplay of different factors that shape the diversity of floras. This complexity highlights the need to consider multiple factors to explain the phenomes of island floras in the broad biogeographical aspects and generalizations.

OC145

LOSSES IN PLANT DIVERSITY DESPITE STRONG PROTECTION: WET GRASSLANDS DRY OUT IN THE NP DONAU-AUEN, AUSTRIA

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National parks (NP) belong to the globally most strongly protected areas. However, global change effects do not necessarily stop at their borders and might fundamentally affect the functioning, development and composition of protected ecosystems as well as their species. The NP Donau-Auen comprises wetland and floodplain ecosystems along a free-flowing stretch of a main river in central Europe. It comprises a variety of grasslands of high conservation value ranging from wet sedge-bed marsh vegetation to dry meadows on gravel and sand banks. Monitoring the vascular plants these grasslands within the last years to decades revealed a significant shift towards species adapted to more dry conditions. This shift in species composition was particularly strong for wet and moist grassland. Such asymmetric shifts suggest local factors like the lowered groundwater table rather than climatic changes as the most likely cause of the observed deterioration. This is particularly worrying as the wet grassland types and their associated species are at high risk of being lost from the NP within the near future.

Keyword: protected areas, wetland meadows, Austria, monitoring, plant diversity

Session 6C – Biogeography and Evolution in Island Ecosystems

OC147

BIODIVERSITY MONITORING OF ISLAND ECOSYSTEMS (BIOMONI)

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Oceanic islands contribute disproportionately to global biodiversity, hosting many endemic species with unique evolutionary and functional adaptations reflecting life in isolation. Simultaneously, islands are epicentres of biodiversity change, particularly vulnerable to anthropogenic disturbances such as habitat loss, climate change, and the introduction of non-native species. Thus, BioMonI aims at building a global long-term, easily accessible monitoring network specifically tailored to the pressing needs of biodiversity conservation and monitoring on islands. In BioMonI, a main goal is to elucidate spatiotemporal biodiversity trends, including elusive dimensions of biodiversity, broadening the spectrum of monitoring and conservation by integrating cross-scale evolutionary and functional perspectives linking local, regional, and global scales. To do that, we are assembling BioMonI-Plot, a long-term vegetation plot network to understand biodiversity and ecosystem change, with baseline data from three focal archipelagos (Azores, Canary Islands, and Mascarenes) but aiming to mobilize data from archipelagos worldwide. The structure of BioMonI-Plot allows it to be easily integrated with species-level data and island-level information from the Global Inventory of Floras and Traits database (GIFT) and vegetation-plot initiatives.

Keyword: Functional biogeography, Monitoring, Vegetation plot network (BioMonI-Plot), Plant biodiversity

OC148

THE IMPORTANCE OF INTRASPECIFIC TRAIT VARIATION IN DWARF SHRUBS ACROSS COASTAL, ALPINE AND ARCTIC HEATHLANDS

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Dwarf shrubs dominate many heathland ecosystems at high latitudes. However, dwarf shrubs are underrepresented when modelling how vegetation influences fluxes of carbon, water and energy in land surface models. In the DURIN project, our aim is to provide a worked example of an integrated climate response-feedback research workflow, where we co-ordinate observational and experimental approaches ranging from physiology through to biotic interactions and ecosystem carbon fluxes, in order to create more realistic plant functional types for these key species within land surface models. One component of this is using plant functional traits to explore responses and effects to environmental and biotic interactions, and exploring to what extent, if any, intraspecific variation may play an important role. Here, we examine intraspecific variability in plant functional traits focusing on the dwarf shrubs *Calluna vulgaris*, *Empetrum nigrum*, *Vaccinium myrtillus* and *Vaccinium vitis-idaea* which were sampled in paired forested and open heathlands located at coastal and inland sites distributed in southern and northern Norway. We found high levels of intraspecific variation across our species, with more conservative trait expression typically exhibited in open habitats, inland and northern sites. Understanding the extent of intraspecific trait variation at local and regional scales, will provide insights as to the adaptive potential of these key species. Furthermore, when integrated with associated processes such as litter decomposition, plant growth, and carbon fluxes, will provide more robust parameters for land surface modelling.

Keyword: climate change; plant functional traits; land surface models; plant functional types

Session 6C – Biogeography and Evolution in Island Ecosystems

OC149

VEGETATION CHANGE ON SUB-ANTARCTIC MARION ISLAND: ECOLOGICAL DRIVERS AND IMPACTS OF CHANGE ★

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Understanding the impact of environmental change on vegetation dynamics on the depauperate sub-Antarctic islands requires considering the individualistic responses of plant species, which are influenced by their specific habitat requirements. We explored the potential for the combination of topographic, climatic, edaphic and biotic factors to influence vascular plant species distributional and cover changes in response to the key drivers of change on Marion Island (MI) in the sub-Antarctic. First, we revisited the vegetation classification by using various classification techniques to evaluate the appropriate scale for vegetation assessment and determined that a species-level approach aligned with continuum theory rather than community theory was more accurate for vegetation monitoring in species-poor environments. Next, we used repeat photography and a climate analysis to assess vegetation change and drivers thereof, between 1949 and 2020. Climate change and invasive species were identified as the primary interactive drivers of vegetation change. The impact of temperature change on past and present native and alien species distributions was then examined through species distribution models using Maxent, incorporating recently modelled edaphic properties, and climatic, topographic and biotic factors. With continued warming, the habitat suitability of generalist plant species was predicted to increase on MI, whereas the habitat suitability of most specialist species was not. The predicted greening trends were validated by the repeat photography analysis. This research highlights the importance of studying individualistic responses and understanding the specific habitat requirements of vascular plant species in species-poor and/or young environments, which may be overlooked when focusing solely on species assemblages.

Keyword: vegetation change, repeat photography, climate change, invasive species, island biogeography, sub-Antarctic tundra, vegetation greening

OC150

ETEROGENEOUS ORIGIN OF EVERGREEN BROAD-LEAVED FORESTS IN EAST ASIA

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Evergreen broad-leaved forests (EBLFs) are widely distributed in East Asia, it is a vital biome in maintaining the stability of the ecosystem. The origins of these forests in East Asia have been a topic of debate across different disciplines. In this study, we explored the emergence of East Asian EBLFs from palaeobotanical viewpoint. By collecting plant fossils from four regions in East Asia, we established the evolutionary history of the dominant genera of EBLFs. Through floral similarity analysis and paleoclimatic reconstruction, we revealed a diverse spatio-temporal pattern for the origin of EBLFs in East Asia. The earliest appearance of EBLFs in southern China can be traced back to the middle Eocene, followed by southwestern China during the late Eocene–early Oligocene. Subsequently, EBLFs appeared in Japan during the early Oligocene and finally originated in central-eastern China around the Miocene. Combined with paleoclimate simulation results, we further proposed that the precipitation of wettest quarter (PWetQ, mm) exceeds 600 mm is crucial for the origin of EBLFs. Moreover, the heterogeneous development of EBLFs in East Asia is closely associated with the evolution of Asian Monsoon. This study provides new insights into the origin of EBLFs in East Asia.

Keyword: Evergreen broad-leaved forests (EBLFs), Plant fossils, East Asia, Paleoclimate, Paleovegetation, Asian Monsoon

Session 7A – Alien Plant Species: Invasion Trends and Impacts

OC151

NURSERIES AND GARDEN CENTRES AS HUBS OF ALIEN PLANT INVASIONS

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It is widely recognised that most invasive species reach the invaded areas as a result of trade and that the rate of international trade is the strongest driver of the number of invasive species in a country. Horticulture has always been an important method of both intentional and unintentional human-mediated dispersal, but the growing international horticultural trade is having a steadily increasing impact on the rate of non-native species' introductions into new areas. As propagule pressure is considered among the most important factors determining the success of plant invasions, assessing the rate at which propagules and individuals are being introduced into new areas by horticultural trade is crucial for foreseeing future invasions. Nurseries and garden centres are known to accumulate introduced species, but there are hardly any quantitative assessments of this phenomenon. In 2019, we conducted three surveys in 12 nurseries and garden centres in and near Debrecen, Hungary, recording the individuals of all introduced plants excluding the plants for sale. We recorded altogether 93,788 individuals of 67 introduced species, several of which have not yet been reported from Hungary. Fifty-two of the species occurred in containers, thus, the customers can easily transport most of the species to distant areas. A large proportion of the species had considerable populations outside the containers. We conclude that the populations established in the garden centres can exert sufficient propagule pressure to induce invasions, while individuals established in containers and their seeds inside the containers are regularly transported to distant areas by the customers.

OC152

THE EFFECTS OF WHITE-POPINAC ON REGENERATING SEASONAL FORESTS PROPAGATE ACROSS SPATIAL SCALES ★

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Metacommunity ecology frameworks are useful to understand the effects of biological invasions because they explicitly consider local (community) and regional (metacommunity) scales. White-popinac (*Leucaena leucocephala* (Lam) de Wit) is a broadly dispersed invasive non-native species (INNS) in regenerating forests from Atlantic Forest (Brazil). White-popinac invasions provide an interesting spatial structure because the species forms dense and homogeneous patches, instead of spreading individuals throughout invaded areas. In this study, we aimed to observe the effects of time-advance of invasion upon communities (local scale – alpha diversity), metacommunities (regional scale – gamma diversity) and species composition among communities (β -diversity). We conducted floristic surveys in 131 communities distributed among 29 metacommunities of regenerating forests that had different ages of white-popinac invasion. We found (i) mirrored responses among local and regional scales: both scales went through a decrease in native species richness and increase in INNS richness; and (ii) an important decrease in β -diversity, showing that time-advance of invasion led to a homogenizing effect. We also found evidence that the advance of white-popinac patches towards regenerating forests is enhanced with time and proximity to the forest fragment. Our results may be consequences of biotic indirect effects, and they suggest that the effects of white-popinac invasions on regenerating forests can be so vigorous that they propagate from local to regional scale, via decrease in β -diversity. We reinforce the importance of considering multiscale approaches when assessing effects of white-popinac invasions.

Keyword: Alien species, Metacommunities, Natural regeneration, Upscaling, Biotic indirect effects, White-popinac

Session 7A – Alien Plant Species: Invasion Trends and Impacts

OC154

THE EFFECT OF *SPOROBOLUS CRYPTANDRUS* LITTER VERSUS NATIVE LITTER ON GRASSLAND SPECIES

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Sporobolus cryptandrus is an invasive C4 grass in Europe, with an especially strong negative impact in sand grasslands of Hungary. As other *Sporobolus* species are known to have allelopathic effects, assessing whether *S. cryptandrus* might also affect the native vegetation through allelopathy is important to help conserve the affected grasslands. Thus, we investigated the germination and seedling establishment of nine native grassland species and *S. cryptandrus* without litter, with native species' litter, and with *Sporobolus* litter. We hypothesized that (i) native litter has a negative effect on seedling germination and establishment compared to no litter; (ii) *Sporobolus* litter has a significant negative effect compared to native grass litter; and that (iii) the effect of litter type is species-specific. When analyzed across species, the presence of litter did not have an effect on germination rate and seedling weight. The presence of litter had a positive effect on seedling length compared to no litter, but there was no significant difference between the effect of native and *Sporobolus* litter. However, litter type had a highly significantly species-specific effect. When analyzed on the species level, *Sporobolus* litter had a significant negative effect compared to native litter only in the case of *Bromus tectorum*. Thus, our hypothesis that *Sporobolus* litter has a significant negative effect compared to native grass litter was only confirmed for *B. tectorum* but not for other species. These findings could guide strategies to conserve or restore the impacted grasslands.

Keyword: Native litter, Invasive C4, Germination, Allelopathic effects

OC155

VARIATION IN ROOT FUNCTIONAL TRAITS AND HIGH ROOT BIOMASS ALLOW AFRICAN GRASS SPECIES TO INVADE TROPICAL OPEN SAVANNAS IN BRAZIL

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Root traits are essential for resource acquisition, especially in nutrient-limited environments as savannas, but whether the competitive advantage of an invasive alien species (IAS) to suppress neighbours occurs through variation in root traits (i.e. functional dissimilarity) or only through belowground biomass production (i.e. illustrating favorable edaphic conditions) remains poorly studied. We selected five open savanna sites, composed by two paired subsites: one non-invaded and one invaded by African grasses of the genus *Urochloa*. We measured root functional traits in the uppermost layers (0–30 cm), and root biomass in the upper 1 m of soil, and correlated these measures with soil characteristics. We found evidence that functional dissimilarities leading to space occupancy prevailed as the main mechanism behind the invasion by *Urochloa* spp. Invaded sites presented roots with larger diameters, but lower root tissue density (RTD) and root dry mass content (RDMC) compared to non-invaded sites. Invaded sites showed higher root biomass and root length density (RLD) in the upper 10 cm of soil than non-invaded ones. Lower soil Al³⁺ concentrations in invaded areas correlated with reduced RTD and RDMC, whereas higher Mg²⁺ and Ca²⁺ were associated with more roots. Invaded savannas are characterized by traits evidencing fast root spreading and greater acquisition capacity and present high root biomass at soil surface, thus allowing effective neighbour suppression. Given that soil chemical composition can be altered by root traits, our results suggest that IAS may modify nutrient cycling, thus hampering restoration of invaded savannas.

Keyword: Cerrado, *Urochloa* spp., functional dissimilarity, invasive alien species, resource use

Session 7A – Alien Plant Species: Invasion Trends and Impacts

OC156

PROPAGULE PRESSURE AND SOIL DISTURBANCE DIMINISH PLANT COMMUNITY RESISTANCE TO INVASION ACROSS HABITAT TYPES

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Community resistance to non-native plant invasions results from intrinsic habitat characteristics, propagule pressure, and disturbance. Species identity further complicates this relationship due to pre-existing adaptations. Despite these mechanisms being understood in isolation, their interplay is rarely explored in field conditions. Furthermore, while studies have reported levels of invasion, few have tested invasibility experimentally across habitat types. We set up an experiment at the Kinsella Research Ranch, Alberta, Canada, and manipulated soil disturbance and propagule pressure in three habitat types (aspen woodland, shrubland, prairie grassland) and examined their impact on the germination success of three pairs of phylogenetically similar native and non-native species in the genera *Bromus*, *Elymus* and *Poa*. Germination success differed strongly across habitats, with aspen woodlands exhibiting the highest rates and reduced resistance. Germination was highest in disturbed soils across habitat types, and strongest effects were observed when combined with high propagule pressure. Propagule pressure had a strong overall effect across all habitat types, but the effect depended on habitat type and genus. Grasslands consistently had the lowest germination rates, regardless of genera or species origin. Our results underline that soil disturbance, and to some degree propagule pressure, can diminish community resistance to non-native plant invasions. Habitat type is crucial in conveying resistance, particularly when considering species identity. While aspen woodlands appear to have an invasibility lag, grasslands are more invaded than their resistance suggests. Thus, invasibility contrasts with levels of invasion reported in field surveys, supporting previous suggestions that these attributes do not always align.

Keyword: propagule pressure, alien plants, plant invasions, disturbance

OC157

DRIVERS OF BIOTIC INVASION WITHIN AND AMONG CITIES IN EUROPE

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Cities, as complex and dynamic environments, exert a profound influence on biodiversity and ecosystems worldwide. Cities act as hubs for introducing, establishing, and spreading alien plants.

I combined data from a detailed floristic survey of one central European city with information about urban flora within 60 cities of the mainland part of Europe to answer these fundamental questions: (i) How land-use change and microclimate are linked to invasion of alien plants within one city and (ii) How the connectivity together with biogeography and macroclimate drive the level of invasion among cities on the continental scale of Europe.

On the local scale of one city, the richness of alien species was supported by the prevalence of residential and industrial land use and the length of roads. The effect of the microclimate was less critical than that of land use. On the continental scale, the same urban habitats were hotspots of alien species richness among 60 European cities studied. Moreover, the compositional similarity of urban alien species increased with shorter geographic distances and lower climatic differences among cities. The composition similarity of alien plants increased more than that of native species, as human-mediated transport between cities allows alien species to overcome geographical barriers. Such a trend will likely be even more profound in the future.

All the studied drivers are essential for high levels of biotic invasion within and among cities. However, their effect varies between the studied scales.

Keyword: alien, city, land use, climate, connectivity, biogeographic distance

Session 7B – Molecular Approaches for Plant Communities

OC158

CONTRIBUTIONS FROM NATURAL HISTORY AND BIOGEOGRAPHY TO THE EVOLUTION OF THE IBERIAN WHITE OAK FORESTS (*QUERCUS* L. SECT. *QUERCUS*)

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The study of natural history, combined with the study of the environmental drivers that explains actual and past species distributions significantly enhanced our understanding of the evolution of *Quercus* forests in the Iberian Peninsula. A full Herbaria review provided insight into the distribution and diversity of Iberian Oaks and their hybrids, revealing their biogeographic features. These data were then incorporated into ecological modelling and molecular characterization, which in the end fed a newly updated taxonomic proposal for the Iberian white Oak syngameon. Biogeography sheds light on the historical migration routes and the environmental factors that shaped the current niche of species and species' groups. We identified single nucleotide polymorphisms throughout the genomes of 275 samples representing eight widespread Iberian oak species, including nothotaxa and infraspecific taxa, using restriction-site associated DNA sequencing (RADSeq). After revealing two subsections within Section *Quercus* and identifying a significant segregation of the Iberian pedunculate oaks, this work allowed us to solve the phylogenetic backbone of western Palearctic white oaks. Together, these disciplines offer a comprehensive view of the dynamic processes that have driven the development and adaptation of *Quercus* forests in the western Mediterranean Region, highlighting the interplay between ecological and evolutionary insights. In summary, our findings indicate that the integration of taxonomic and biogeographic knowledge, supported by robust historical collections and a thorough review of the literature, is crucial in addressing challenging plant groups that exhibit reticulate evolution.

Keyword: Biogeography, Evolution, Mediterranean Forests, RADSeq, Hybridization

OC159

ROLE OF FACILITATION/COMPETITION AMONG MEDITERRANEAN PLANT LIFE FORMS IN SOIL-VEGETATION SPATIAL PATTERN DEVELOPMENT UNDER AN INCREASING ARIDITY

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The distributional position of plant life forms on environmental gradients appears to be crucial for predicting the proportions of species involved in positive or negative interactions. Different life forms represent different survival strategies during periods of drought, high temperatures or torrential rains, more frequent under the present climate change scenario in semi-arid areas of Southern Spain. Under such harsh conditions, plant interactions may shift their sign. Our objective was to assess the relative contribution of species and life forms to pattern formation and to positive associations, indicating facilitation, or negative associations, indicating competition processes.

We selected two disturbance sequences of dry-semiarid-, termo-meso-Mediterranean shrublands from Eastern Andalusia (Spain). In the first sequence, differences among plots were associated to an increasing frequency of fires: >45 yr unburned garrigue-, 1-burned gorse-garrigue-, 2-burned and 3-burned gorse-shrublands. In the second sequence, topography and land-uses determined the degree of disturbance in a 25-yr period after crop- and grazing-abandonment: *Pinus* reforestation, *Retama-/Artemisia-/* pasture-colonized plots, and semi-preserved *Stipa* vegetation. At each stand, cover of each plant species plus surface soil properties, nutrient concentrations and transformation rates, were analyzed along a ≈70 m-perpendicular-to-slope transect of contiguous quadrats. Analyses based on species richness showed a higher sensitivity for detecting positive associations. Cover data did so for detecting negative interactions. These patterns were analyzed using variance partitioning with principal components of neighbor matrices-PCNM and multi-scale ordination-MSO.

Our results suggest that facilitation becomes more important when abiotic aridic stress is high for late- and mid-succession, even when competition and consumer pressure is still intense.

Keyword: fertility islands, Mediterranean desertification, patchiness, woody encroachment, climatic change, reforestation, Raunkiaer plant life-forms

Session 7B – Molecular Approaches for Plant Communities

OC160

POPULATION RESPONSE OF MOUNTAIN SPECIES TO PAST CLIMATE CHANGE IS INDEPENDENT FROM THEIR ELEVATIONAL ZONE

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Understanding population genetic structures and demographic responses of species to past climate changes is important for predicting their response to the current and future climate change. This study assesses the demographic history of nine endemic mountain plant species from the Iranian Plateau in response to Pleistocene climatic oscillations. We hypothesized that mid-elevation (montane) zone species experienced post-glacial expansion, while cold-adapted (alpine) zone species experienced post-glacial contraction, corresponding to the area size increase and decrease in the mentioned elevational zones, respectively, during the post-glacial periods.

We selected four montane and five alpine plant species endemic to, but widely distributed in the Iranian Plateau. Population genetic data from RAD Sequencing were analysed using coalescent demographic modelling using *FastSimCoal2 2.7*.

Results showed that models with post-glacial expansion or with post-glacial contraction were best supported in six and three species, respectively. Contrary to our hypothesis, four out of five alpine species showed post-glacial expansion, and only one species showed population contraction. As the four alpine species with post-glacial expansion are associated with habitats characterized by short snow cover, this suggests a major role of the microhabitats of the species for the response to climate change.

Consequently, we conclude that elevation does not play a determining role in the demographic response (contraction vs. expansion) of species, but that microhabitats, differing in snow cover duration, play a significant role.

Keyword: Demographic history, Alpine species, Microhabitats

OC162

SPACE-DEPENDENT PHYLOGENETIC SIGNALS IN PALAEARCTIC GRASSLANDS, ROLE OF SPACE ON PHYLOGENETIC DIVERSITY

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Palaeartic grasslands host a noticeable part of the realm's diversity. It has been well documented that taxonomic diversity usually peaks at intermediate levels of water and nutrient availability as well as disturbance, and in largest spatial scales, depending on the vegetation types. However, our knowledge on phylogenetic diversity in Palaeartic grasslands, with an overview on evolutionary relatedness between plant taxa is more limited. Therefore, we used data from the GrassPlot database to assess phylogenetic diversity patterns across seven standard grain sizes (ranging from 0.0001 to 100 m²). We obtained a phylogeny of plant taxa based on the most-up-date megaphylogeny using U.PhyloMaker R package. Then, phylogenetic diversity for the grain sizes was calculated using phylogenetic Hill numbers and phylogenetic distance metrics. Furthermore, the change in phylogenetic diversity across different grain sizes was assessed using one-way ANOVA, Tukey's multiple comparison test, and regression models. Phylogenetic diversity exhibited a significant linear increase in phylogenetic Hill numbers across the grain sizes. In contrast, a noticeable linear decrease in phylogenetic distance metrics was observed across the grain sizes. Our findings revealed scale-dependent phylogenetic signals in Palaeartic grasslands, consistent with the establishment of phylogenetic overdispersion patterns. This demonstrates the occurrence of a wide range of plant species with phylogenetically divergent relatedness under smaller grain sizes. Conversely, the largest grain sizes supported the presence of closely-related plant taxa at shallower levels of phylogeny, forming phylogenetic clustering patterns.

Keyword: GrassPlot, Palearctic grasslands, Phylogenetic diversity, spatial scale, phylogenetic signal

Session 7B – Molecular Approaches for Plant Communities

OC163

GENETIC STRUCTURE OF COMMON GRASSLAND SPECIES POPULATION AT LANDSCAPE SCALE AND ITS CONSEQUENCE FOR GRASSLAND CONSERVATION

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Species-rich, seminatural grasslands diminish their area and become more isolated. It restricts gene flow and migration possibilities, influencing populations' genetic structure, and in turn, decreasing adaptation potential to environmental changes, as well as biodiversity at the within-species level. Genetic research and conservation actions are focused typically on rare plant species or species with high monetary value for agriculture, while little attention is paid to common grassland species. Nonetheless, the recent dynamic changes in landscape structure and land use systems could be pernicious also for more common grassland specialists. Here, we analyzed the spatial pattern of the genetic structure of *Achillea millefolium*, *Agrostis capillaris*, *Hypericum maculatum*, and *Cirsium helenioides* populations in Karkonosze Mts, S-W Poland, to establish genetic diversity conservation areas and strategy of genetic resources conservation. The population's genetic structure was assessed using SNP genotyping, sampling from 20 to 25 grassland patches ('populations') per species. The results show that for the conservation of 99% of alleles needed is from 5 to 17 populations depending on species, while PCA ordination allows us to prioritize populations regarding their contribution to overall species genetic diversity. The least cost path method did not reveal that recent landscape structure explains better genetic similarity of population than simple geographic distance. The results allow us to find grassland patches supporting the highest genetic diversity for particular species, and to designate grassland patches suitable for establishing genetic conservation areas as well as suggest a demand for assisted gene flow migration for some species.

Keyword: connectivity, gene flow, genetic conservation areas, habitat continuity, semi-natural grasslands

Session 7B – Ecoinformatics and Models in Vegetation Science

OC47

TREE-DIVERSITY PATTERNS IN A GLOBAL BIODIVERSITY HOTSPOT: REMOTE SENSING AND MODELING APPROACH ★

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Despite the importance of species diversity and ecological uniqueness in biodiversity, research on characterizing species diversity and assessing its drivers remains disproportionately limited particularly in tropical forests. This research evaluated the alpha(α)-beta(β) diversity of trees; and their determinants and spatially mapped the distribution patterns in a tropical forest landscape of the Western Ghats, India using the 170, 0.1 ha plots and remote sensing imagery. We used multivariate statistical analysis, machine learning and advanced computation techniques to map and quantify causal direct and indirect effects of covariates on α - β -diversity. A total of 8120 trees which belonged to 175 species from 67 families were enumerated. At the landscape level, Shannon (proxy to α -diversity) and LCBD (Local contribution to beta-diversity, proxy to β -diversity) were 1.61 and 0.005 respectively. The final parsimonious structural equation model explained about 67% and 46% of the variation in Shannon and LCBD spatially. More importantly, our results showed that structure, disturbance and edaphic variables contributed to α -diversity directly and indirectly; whereas, climate, topography, structural and spatial covariates affected the β -diversity. The spatial distribution map based on Sentinel-2 data exhibited the high occurrence of α -diversity (2.3 – 3.2; in 57.45% area) followed by moderate (1.3 – 2.2; in 31.38% area), and low α -diversity (< 1.3; in 12.1% area). The β -diversity map clearly distinguished the four forest types with a few exceptions in semi-evergreen forests. Overall, our findings on tree diversity patterns in tropical forests offer insights into biodiversity conservation and forest management efforts, particularly in the context of Anthropocene era.

Keyword: Vegetation patterns, Western Ghats, Sentinel-2, Machine learning, Structural equation modeling, BiodivMapR

Session 7C – Ecoinformatics and Models in Vegetation Science

OC164

PLANT COMMUNITY ASSEMBLY EMERGING FROM ENVIRONMENTAL FILTERING AND COMMUNITY FEEDBACK EFFECTS

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Plant ecologists often distinguish between abiotic and biotic factors in community assembly. The prevailing view is that the former act as 'environmental filters', leading to trait convergence, and the latter to trait divergence to avoid plant-plant competition. However, these factors can change during the community assembly process, not only by external drivers but also due to feedback from the existing community. We argue and provide evidence, using a simulation model, that environmental filtering selects individuals from a species pool based on their traits and that community feedback on environmental factors produces environmental heterogeneity, which mimics plant-plant interactions. Both negative and positive plant-plant interactions are actually mediated by a range of environmental factors that interacting individuals modify at fine spatial and/or temporal scales. Moreover, factors may be structured in space and time on different scales, so their effects are often nested. In addition, some environmental factors, particularly those modified by community feedback, remain hidden and are not directly observable. This is often the case when they are linked to unknown past conditions or when they affect community assembly at a finer resolution than the grain size of the studied community units. Furthermore, we show that trait divergence both between and within communities, depending on the size of the community units, emerges from feedback-modified, nested environmental factors filtering plants based on their traits.

Keyword: Biotic filtering, Community assembly, Community simulation, Environmental filtering, Plant-plant interactions, Traits

OC165

CONFIRMATORY FACTOR ANALYSIS: A NEW WAY TO EXPLORE CORRELATION STRUCTURE OF TRAITS

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Although dozens of plant traits are listed in handbooks, plant ecologists believe that a few adaptation strategies, like the leaf economy spectrum, govern trait variation. Several attempts have been made to find these major axes of trait variation by analyzing the correlation structure of traits in large datasets. Principal Component Analysis (PCA) was the main statistical tool in these analyses. However, PCA has two major disadvantages. First, the created principal components are linear combinations of the observed traits. When ecologists think about strategies or economics spectra, these are unobservable variables influencing the traits rather than combinations of traits. Second, PCA is an exploratory method that cannot confirm or reject hypotheses. A recent debate on coordination between leaf and fine-root traits illustrates the need for confirmatory analysis: two research groups led to contradictory conclusions from the same dataset using PCA.

Confirmatory factor analysis, a specialized form of structural equation modeling, is a statistical tool widely used in psychology to calculate latent variables from observed indicators. It offers a solution to the limitations of PCA, modeling observed traits as a linear function of latent (unobservable) strategies and allowing for hypothesis testing. In this presentation, I will briefly introduce confirmatory factor analysis and demonstrate its practical application by re-analyzing data from the debate on coordination between leaf and root traits.

Keyword: Traits, principal component analysis, statistics, plant strategies

OC166

PLANT SIZE: UNIFYING ABOVE AND BELOWGROUND DIMENSIONS ★

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1 - University of Tartu

Understanding the global variation of plant strategies is essential for unravelling eco-evolutionary processes and ecosystem functions in the light of global change. Despite the diversity of plant phenotypes, trait combinations can be summarized along four dimensions of variation, mainly associated with aboveground size and plant economics. However, how root size fits within the trait space defined by these dimensions is still uncertain. Here, we included maximum rooting depth and lateral root spread to a set of twelve key traits defining the fundamental investments of plants in growth, reproduction, and survival. Using this set of traits, we constructed a multivariate space to examine whether the inclusion of root size traits alters the dimensionality and structure of trait correlations known to define plant functional strategies. Our results showed that belowground and aboveground sizes coordinate along the same dimension of trait variation. We demonstrated that including root size traits does not alter space's observed structure and dimensionality, independently from the species' trait completeness and phylogenetic relatedness. Plant size defines a single continuum of allometric investments at the global scale, independent from leaf and roots economics strategies.

Keyword: Macroecology, functional diversity, plant strategies, plant economics, multivariate space

Session 7C – Ecoinformatics and Models in Vegetation Science

OC167

SHADOWS OF THE PAST: HOW HISTORICAL CLIMATES SCULPT CONTEMPORARY PLANT PATTERNS ★

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Understanding how biodiversity responds to environmental changes is crucial for conservation planning and decision-making. Species distribution models (SDMs) are widely used to characterize species environmental niches and forecast future biodiversity patterns and trends. However, current SDMs have some limitations, such as assuming that species distributions are in equilibrium with the contemporary climate and using long-term mean climate variables to characterize species' niches. These assumptions may not reflect the actual environmental conditions experienced by different groups of species with varying degrees of mobility and longevity and may ignore the effects of historical climate on species niches. In this study, we develop a novel multi-temporal SDM approach that incorporates time into SDMs to account for historical climate effects and species' longevity. We test our approach on various plant species using biodiversity data from GBIF, climate data from CHELSA. We compare our approach with conventional SDMs using different performance metrics and evaluate how different time lags (years prior to observations) and time windows (length of time span) affect the predictions of SDMs for different groups of species. Our results show how multi-temporal SDMs perform compared to conventional SDMs in terms of accuracy and discrimination. We also demonstrate whether historical climate conditions are more important than contemporary climate conditions in explaining current biodiversity patterns, and whether the optimal time lag and window vary depending on longevity of species. Our study demonstrates the potential of multi-temporal SDMs to better characterize plant species' niches under variable environmental conditions and to improve biodiversity forecasting under future scenarios.

Keyword: Biodiversity, Historical Climate, Plant Species Niches, Species Distribution Models, Multi-temporal SDM

OC168

DEADTREES.EARTH - AN OPEN, DYNAMIC DATABASE FOR ACCESSING, CONTRIBUTING, ANALYZING, AND VISUALIZING REMOTE SENSING-BASED TREE MORTALITY DATA

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In the recent decades, extreme tree mortality rates are prevalent in many regions of the world, driven by complex interactions of abiotic and biotic factors such as global warming, climate extremes, pests, pathogens, and other environmental stressors. Earth observation satellites combined with machine learning offer promising solutions for mapping standing dead trees and understanding the underlying dynamics. However, the absence of comprehensive, georeferenced training data across various biomes and forest types has hindered the development of a unified global model for tree mortality patterns. Existing ground-based observations are often sparse, non-standardized, and lack spatial specificity.

Aerial imagery from drones or airplanes, coupled with computer vision techniques, provides a precise and efficient method for local-scale mapping of standing deadwood. These detailed local maps can be used to train satellite-based models to predict standing deadwood on larger scales.

To harness this potential and enhance global understanding of tree mortality, we developed a dynamic database (<https://dead-trees.earth>). This platform allows users to upload and download aerial imagery with optional labels on standing deadwood, automatically detect standing dead trees in uploaded imagery through a generic detection computer vision model, and visualize and download extensive spatiotemporal tree mortality products derived from satellite data.

This presentation provides an overview of the deadtrees.earth database, detailing its motivation, current status, and future directions. By integrating aerial imagery from drones, airplanes and Earth observation data from satellites, this initiative aims to bridge knowledge gaps in global tree mortality dynamics, offering a valuable resource for researchers, stakeholders and the public.

Keyword: tree mortality, climate extremes, remote sensing

Session 7C – Ecoinformatics and Models in Vegetation Science

OC169

EASSEMBLING TREE COMMUNITIES UNDER ANTHROPOGENIC CLIMATE CHANGE VIA ASSISTED TREE MIGRATION ★

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Since the onset of global warming, European forests have been facing increased tree mortality. As a mitigation strategy and given limited dispersal ability of trees, foresters turn to assisted tree migration of drought- and heat-tolerant species, sometimes selecting exotic species. Yet, it remains unclear whether the realized climatic niche of candidate species does or will, by 2100, occur in the recipient region. Focusing on hexagonal France as the recipient region, we selected 129 exotic tree species whose geographical native range is known. For each species, we ran a Principal Component Analysis (PCA) of historical (1951-1980) bioclimatic conditions across the species' native range, together with conditions in France during past (1951-2010), present (2011-2040) and future periods (2041-2100). Then, within the PCA space, we measured the Euclidian distance of a given spatial unit to the closest margin of the realized climatic niche, using the Niche Margin Index (NMI), and projected it into the geographical space in France. Positive and negative NMI values indicate conditions falling respectively inside and outside the species realized climatic niche. Depending upon the scenario, we found that the realized climatic niche of 20,15% species was not even available and 39,53% shrinking in France by 2100, suggesting a low establishment likelihood under future climate change. Although this approach cannot anticipate the species' ability to explore and fill in new climatic niche spaces, it allows to prioritize the risk of assisted migration failure and help foresters to take oriented decisions. It also sheds light on potential novel tree species assemblages.

Keyword: Realized climatic niche, Ordination-based approach, Exotic tree species, Climate change, Predicting future climatic distribution

OC171

A SYSTEMATIC COMPARISON OF GLOBAL CHECKLISTS OF VASCULAR PLANTS

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Primary sources of taxonomic information play an important role in providing the taxonomic backbones of taxonomic aggregators such as the Catalogue of Life or biodiversity databases like the Global Biodiversity Information Facility (GBIF). The most important taxonomic group for many kinds of analyses on global change, ecosystem functioning, and biodiversity conservation is vascular plants. They contribute the majority of the biomass and primary productivity and a large part of the biodiversity in most terrestrial ecosystems. Currently, there are about 350,000 known species of vascular plants, and four actively developed global taxonomic backbone databases or checklists: the Leipzig Catalogue of Vascular Plants, the World Catalogue of Vascular Plants, World Flora Online, and WorldPlants. These four initiatives, originally deriving the bulk of their seed data from the same sources, differ in many respects, which can be attributed to factors such as the number of people involved, the decision-making behind the integration of new taxonomic information, and the regularity of updates. In 2023, we published a systematic comparison of these four checklists. Since then, there have been several updates. We show a comparison through time and highlight major differences that may influence analyses using one or the other backbone. We also discuss potential difficulties arising from the aggregation processes of databases integrating several of the checklists, and present the algorithm used to compare them, allowing for maximized usability of the data from all four checklists, including distributional and higher-order taxonomic information, as well as links to external sources and references.

Keyword: vascular plants, biodiversity, checklists, taxonomic harmonization, taxonomic name resolution

Biogeography and Evolution in Island Ecosystems

P1

ENVIRONMENTAL HETEROGENEITY DRIVES PLANT TRAIT DISTRIBUTIONS IN TERRESTRIAL HABITAT ISLANDS

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Environmental heterogeneity representing various patterns of resources and limiting factors is an important driver of community-level patterns by affecting the selection of the most adaptive functional traits. We explored plant trait–environment relationships in environmentally heterogeneous microsite complexes at a few meters' scale for which we used ancient Bulgarian and Hungarian burial mounds covered by dry grasslands. We assessed within-site trait variability typical of certain microsites (mound slopes with different aspects, mound tops, and surrounding plain grasslands) characterized by different combinations of environmental parameters using a dataset of 480 vegetation plots. We calculated community-weighted means (CWMs) and abundance models. Despite their small size, vegetation on mounds was characterized by different sets of functional traits (higher canopy, level of clonality, and heavier seeds) compared to the plain grasslands. Mild north-facing slopes held perennial species with light seeds, short flowering period, and high proportion of dwarf shrubs sharply contrasted from plain grasslands, and also from south-facing slopes and mound tops with harsh environmental conditions. Patterns predicted by CWMs and abundance models differed in the case of certain traits (perenniality, canopy height, and leaf dry matter content), suggesting that environmental factors do not necessarily affect trait optima directly, but influence them indirectly through correlating traits. Due to the large relative differences in local environmental parameters, contrasts in trait composition among microsites were mostly consistent and independent from the macroclimate. Mounds with high environmental heterogeneity can considerably increase variability in plant functional traits and ecological strategies both at the site and landscape levels.

Keyword: abundance trait models, community-weighted mean, environmental filtering, kurgan, landscape feature, microsite, refugium

P2

REVISITING THE SMALL MEDITERRANEAN ISLAND OF PIANOSA (ITALY) ★

Michele Mugnai (Italy)¹; **Alice Misuri** (Italy)¹; **Lorenzo Lazzaro** (Italy)¹; **Eugenia Siccardi** (Italy)¹; **Renato Benesperi** (Italy)¹; **Bruno Foggi** (Italy)¹; **Lorella Dell'olmo** (Italy)¹; **Daniele Viciani** (Italy)¹

1 - *University of Florence*

Resurveying historical vegetation plots has become a fundamental methodology in ecological research as it provides a unique opportunity to estimate vegetation and environmental changes over the past decades, allowing to evaluate how the vegetation dynamics are affected by anthropogenic factors, such as land-use change, invasion of alien species and climate change. Small islands are among the ecosystems in which the effect of these processes might be more detectable and less predictable. One of this case consists in Pianosa (Tuscan Archipelago, Italy), a small Mediterranean island in which such factors had influences since the end of the 1990s. This research aimed to evaluate how different types of vegetation occurring on the island (rocky cliff, Mediterranean xeric grasslands, and scrub) changed in the last 15 years, both in terms of species and functional composition. A total of 53 vegetation relevés carried in 2008 have been resurveyed following the original methodology in spring 2023. The preliminary results showed a significant compo-

sitional shift for all the vegetation types. The main processes which has been detected as responsible of such changes in species composition are: i) the spread of some alien species which colonised and drastically changed the physiognomy of some contexts; ii) a significant encroachment of the grasslands by typical shrub species, with their transition to maquis; iii) a decrease of the abundance of some typical rocky cliff species. Such changes in species composition have been recognized, even at higher degrees, at functional level, and is probably due to the changes in vegetation physiognomy.

Keyword: vegetation science, functional traits, resurvey

P3

THE REVIEW OF THE VEGETATION RESEARCH ON EASTERN ADRIATIC ISLANDS (CROATIA)

Nenad Jasprica (Croatia)¹

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Croatia has 1231 islands (ranging in size from 1 to 485 km²), islets (<1 km²), and reefs. The 30 largest Croatian islands cover as much as 92.2% of the total island area, with elevations ranging from several meters to 778 m a.s.l. While the flora of the eastern Adriatic islands and islets, belonging to Croatia's territory, is relatively well-documented, the same cannot be asserted regarding the extent of understanding of their vegetation. This area has been neglected in studies of Mediterranean vegetation diversity, or at least not represented to the extent of some other areas. It's important to note that the primary reason for this is the small size of the community of botanists, particularly phytosociologists, in Croatia. Previous studies on the vegetation covering the entire surface of the islands are over 60 years old (e.g., Krk, Rab, Pag), while more recent research, conducted in the last two decades, is still scarce (e.g., Molat, Olib). In the last decade, systematic research on the vegetation of islands, especially those smaller than 1 km², particularly in the central and southern Adriatic, has intensified. In summary, there is a lack of data on the vegetation of the majority of islands and islets in Croatia. Most of the available data for the islands mainly comes from studies focusing on specific types of vegetation, such as maquis, garrigue, dry grasslands, calcareous rocky slopes with chasmophytic vegetation and dry walls.

Keyword: Vegetation, Phytosociology, Syntaxonomy, Northeastern Mediterranean

P4

TRACING VEGETATION DYNAMICS ON RIVER ISLANDS BY REMOTE SENSING

Francesco Boscutti (Italy)¹; **Maurizia Sigura** (Italy)¹; **Valentino Casolo** (Italy)¹; **Elisa Pellegrini** (Italy)¹; **Giorgio Alberti** (Italy)¹; **Marco Vuerich** (Italy)¹; **Daniel Moro** (Italy)²; **Anna Lilian Gardossi** (Italy)¹; **Sara Gargiulo** (Italy)²; **Edoardo Asquini** (Italy)³; **Paolo Gingano** (Italy)²; **Giacomo Boscarol** (Italy)¹; **Danièle Lagnaz** (Switzerland)⁴; **Florent Jouy** (Germany)⁵; **Jana Chmielecki** (Germany)⁶; **Michał Habel** (Poland)⁷; **Dawid Szatten** (Poland)⁷; **Marta Brzezińska** (Poland)⁷; **Giacomo Trotta** (Italy)²

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Rivers play a pivotal role in biodiversity conservation and ecological connectivity. Understanding how plant communities vary in these highly dynamic systems and how their changes are visible by applying remote sensing approaches is crucial for implementing effective conservation strategies. The Tagliamento river (N-E Italy) is characterized by flashy-flood events and a wide pristine gravel-bed where river bars are characterized by complex habitats corresponding to different successional stages. It is therefore subjected to nature conservation initiatives.

In this area, 51 plots of 100 m² area have been surveyed during the last week of June 2022 and 2023, within an Erasmus+ program involving

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Posters – Abstracts – Monday 16 (session P1-A)

four European countries and more than 70 participants. In each plot, we recorded occurrence and cover value of all vascular plants and collected soil data. Moreover, we analysed satellite images in the period 1985-2023, calculated principal multispectral indices, and identified the age of the river bars (i.e. years since vegetation established on bare bars). We found satellite-derived indices to be effective in tracing changes of vegetation over time. NDVI was positively related to the river bar age, linked to the occurring vegetation successional stage. Moreover, the plant diversity and functional identity of the community was driven by the river bars age, and significantly related with the remote sensing index variation. Our results provide new insights into the dynamics of riverbed vegetation and the application of satellite imagery for remote sensing and conservation of these valuable habitats.

Keyword: Alpine rivers, Biodiversity, Natura 2000, Ecological succession, NDVI, Functional traits

P5

MUSSCHIA WOLLASTONII LOWE (CAMPANULACEAE): MIXED-MATING SYSTEM AND FLORAL VISITORS COMMUNITIES DO NOT CORROBORATE OUTCROSSING ORNITOPHILOUS TRAITS

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Flowering plants have many reproductive strategies that impact sexual fitness, being of particular relevance for conservation plans of rare, threatened, or endemic flora. *Musschia wollastonii* Lowe is a rare monotypic neoendemic species occurring on Madeira Island, typical of rocky stream beds of the stink-laurel forest in Madeira. The plant displays outcrossing-promoting characteristics like ornitophilous traits and, a long flowering period while its weak dichogamy and a mechanism of secondary pollen presentation allow for selfing to occur. Based on both fruit and seed set, obtained through hand-controlled pollination treatments, it was determined that *M. wollastonii* is self-compatible species with spontaneous delayed selfing. Furthermore, the pollen to ovule ratio indicates facultative xenogamy. These characteristics together with the plants' outcrossing-promoting traits, suggest a mixed mating system. Pollination syndrome and previous pollinator studies highlight *M. wollastonii* as a bird-pollinated species. However, only insects from the Syrphidae, Nymphalidae, Vespidae, and Drosophilidae families were observed in this study. All insects had larcenist behaviour, with pollen thieving likely having an impact on the plant's reproductive success. Nonetheless, the pollinator role of both syrphids and butterflies cannot be disregarded.

Keyword: Breeding system, Delayed selfing, Pollen thief, Self-compatible, Self-pollination

P6

COMMENTS ON THE MORPHOLOGY AND TAXONOMY OF MUSSCHIA AUREA (L.F.) DUMORT. (CAMPANULACEAE) AN ENDEMIC SPECIES OF THE MADEIRA ARCHIPELAGO (PORTUGAL) ★

Tiago Andrade (Portugal)¹; Catarina Gomes (Portugal)¹; Célia Bairos (Portugal)^{1,4}; Manuela Gouveia (Portugal)^{1,2}; António Pereira Coutinho (Portugal)³; Miguel Menezes de Sequeira (Portugal)¹

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Musschia aurea (L.f.) Dumort is a perennial chamaephyte of rocky cliffs, found at low altitude and some deep valleys of Madeira and Desertas Islands. The Madeira deep valley populations were first documented in 1815 by Ker Gawler, who noted they had narrower leaves (*β angustifolia*) when compared to other populations (*α latifolia*). In 1822, Dumortier formally described those populations as a separate species, *Musschia angustifolia* Dumort. However, this species has never been accepted by later authors. In this work we present a biometric analysis based on 47 specimens collected from 33 georeferenced populations, and a total of 67 quantitative characters. Exploratory analysis both including clustering (UPGMA) and ordination methods (PCA and PCoA) support the taxonomic recognition of a new subspecies, based on the original description by Dumortier, corresponding to the populations found above 600 m. Among other aspects, including the need to reevaluate the conservation status of what was so far considered as a single taxon, our results claim for a stricter control over seed use and potential reintroductions or reinforcements of wild populations, avoiding the mixing of different origins corresponding to distinct populations.

Keyword: Campanulaceae, Exploratory analysis, Morphology, *Musschia*, Taxonomy

P7

GENETIC DIVERSITY AND MOLECULAR TAXONOMY OF ANDRYALA (ASTERACEAE) BASED ON ISSR MARKERS

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The genus *Andryala* L. includes endemic species to the Macaronesian archipelagos of Madeira and the Canaries. In Madeira Island it comprises four taxa: *Andryala glandulosa* Lam. (also present in Porto Santo and Desertas islands), *Andryala subglabrata* (DC) M.Z.Ferreira, Alv.Fern. & M.Seq. and the two subspecies *Andryala crithmifolia* Ait. subsp. *crithmifolia* and *A. crithmifolia* subsp. *coronopifolia*, both extremely rare endemics found on very small populations on dry and rocky areas of the south and south-west coast of Madeira. We used the inter-simple sequence repeats (ISSR) to evaluate the levels and patterns of genetic diversity among the taxa of *Andryala* from Madeira and Porto Santo Islands. Results showed that the banding patterns were representative of each species studied. It is concluded that ISSR markers provides a quick and reliable marker system for DNA fingerprinting and species diagnosis.

Keyword: *Andryala*, Madeira archipelago, Genetic diversity, Taxonomy

P8

HOW OLD IS THE PRESENCE OF THE CANARY PINE FORESTS IN THE CANARY ISLANDS?

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The Neogene fossil record of *Pinus canariensis* C.Sm ex DC. proves a wider past distribution in Europe, but due to extirpation by past climatic events, today this taxon is restricted to the Canary Islands. Remarkably, the putative oldest *P. canariensis* fossil for the Canary Islands, found in Gran Canaria within the Tejeda intra-caldera tuffs is 13.3-13.0 Ma. This palaeobiogeographical information has been cited as proof of the deep-time presence of the genus *Pinus* L., P.

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Future Ecosystems Climate and Land Change

P9

BEYOND DROUGHT: INTRASPECIFIC VARIABILITY IN FINE-ROOT TRAITS OUTPACES ABOVEGROUND TRAITS IN HERBACEOUS ★

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¹ - University of Tartu

Intraspecific trait variation (ITV) plays a crucial role in shaping overall trait variability and environmental harshness can reduce among-species variation. While aboveground traits have garnered significant attention, understanding ITV in fine-root traits remains limited. This study investigates the partitioning of trait variation above and belowground in 52 European herbaceous species and how these proportions respond to drought. By examining seven morphological traits drought and well-watered conditions, we used linear mixed effect models and permutation-multivariate analysis of variance (PERMANOVA) to decompose trait variation. Notably, species identity dominates trait variation, accounting for 87-90% of the total variance in height and leaf area. Surprisingly, drought does not significantly alter the proportions of variation in these traits. However, all fine-root traits together exhibited higher ITV (44-44%) compared to aboveground traits (19-21%), suggesting their adaptability to soil heterogeneity. Analogous root traits also surpassed analogous leaf traits in ITV (51-50% vs. 27-31%). These findings underscore the importance of within-species variation and reveal the nuanced responses of fine-root traits, particularly root dry matter content (RDMC), while among-species trait differences, especially aboveground, may underscore distinct strategies and competitive abilities for resource acquisition and utilization. This study contributes to elucidate the mechanisms underlying the multifunctionality of the above- and belowground plants compartments.

Keyword: Analogous traits, belowground, interspecific trait variability, leaf traits, plasticity, root dry matter content, variance partitioning

P10

NATIVE VS. PLANTED PASTURES: HOW IS GRAZING AFFECTING TROPICAL SAVANNAS? ★

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Millions of hectares of Brazilian native grasslands within private rural properties are annually converted into pastures for cattle grazing, predominantly in the Cerrado domain. This conversion is identified as a primary driver of biodiversity loss and ecosystem service degradation, as it replaces native vegetation with exotic and invasive grass species. Balancing beef production with the preservation of natural vegetation presents an ongoing challenge for policymakers. Recent studies propose that prioritizing low-impact production systems (on native pastures) over heavy-impact ones (planted pastures with exotic grasses) could achieve this balance. However, limited information exists regarding how these low-impact systems might affect natural grasslands.

To address this gap, we examined low-impact and heavy-impact cattle-grazing systems utilized by farmers in settlements within the traditional Kalunga community in the central region of the Brazilian Cerrado. They have been using these two systems for decades, especially for beef production. Our reference system was a native Cerrado area that is ungrazed. Our findings reveal that both planted and native pasture communities undergo a process of substitution, exhibiting similar β diversity when compared to native areas without cattle. Additionally, vegetation structure and predominant

canariensis and the pine forest ecosystems in the Canary Islands, but also to justify the long-term evolution of *P. canariensis* within an active insular volcanic environment. Here we present a re-evaluation of the oldest *Pinus* fossil from the Canary Island based on the original description and the fossil specimen. The original paper states that the specimen resembles a pine bark. However, subsequent papers cite this information as the oldest presence of *Pinus* or *P. canariensis* in the Canary archipelago. The analysis of the specimen demonstrates that it lacks morphological or anatomical characters to identify as a pine bark or even as a plant fossil. The specimen is best interpreted as a lapilli-sized tube pumice, highly altered by mineral deposition promoted by the percolating hydrothermal water. So far, the oldest reliable *Pinus* fossils from the Canary Islands are 3.9-3.1 Ma and ca. 9 to 10 Ma younger than previously claimed. When did *Pinus* arrive at the Canary Islands is unknown, but this biogeographical question can be approached via focused palaeobotanical research in this archipelago.

Keyword: Biogeography, Macaronesia, Miocene, Palaeobotany, *Pinus*

P116

DRIVERS OF CHANGES IN PLANT SPECIES DIVERSITY ON EUROPE'S MOUNTAIN TOPS

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Global warming has strongly accelerated in the last decades which is predicted to be continued in the future all over Europe. In contrast, projected precipitation changes differ among regions and seasons, with considerable declines in southern Europe and increases in northern Europe. Resurvey data from European mountain tops showed an increase in vascular plant diversity in temperate and boreal regions but a parallel decrease in the Mediterranean. These differences were attributed to changes in climatic conditions, i.e., generally rising temperatures interfering with differences in precipitation patterns. Additionally, other global changes aspects such as airborne nitrogen deposition and land-use were identified as potential threats to high-mountain biodiversity. However, the characteristic micro-topographic variability of high mountain ecosystems may buffer the global change impacts on plant diversity. Thus, the relative contributions of these factors are still contentious.

Using linear mixed-effects models and structural equation modelling we disentangle the influence of temperature and precipitation changes, nitrogen deposition, measures of land-use intensity (mobility infrastructure and human appropriation of net primary production - HANPP), as well as topographic variability on changes in both the taxonomic and phylogenetic diversity of alpine plant species on 144 European GLORIA (Global Observation Research Initiative in Alpine Environments) summits monitored over the past two decades.

Keyword: alpine ecosystems, global change, climate change, biodiversity, monitoring

| **Posters** – Abstracts – Monday 16 (session P1-A)

growth forms varied across these systems, with native pastures showing higher levels of bare soil and lower biomass compared to planted pastures and native vegetation. Native pastures also showed to have more herbaceous ruderal species. Our results suggest that while native pastures may offer an alternative to heavy-impact systems, their ability to preserve native species may be more limited than previously believed.

Keyword: Community assembly, Alien species, Vegetation Management, Tropical savannas, Grasslands, Cattle grazing

Future Ecosystems Climate and Land Change

P11

THE EFFECT OF PLANT FUNCTIONAL DIVERSITY ON DRYLAND PLANT-SOIL INTERACTIONS AND FUNCTIONING

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Drylands sustain the livelihoods of billions of people worldwide, but their functioning and service provisioning is vulnerable to land degradation and desertification, with grazing intensification and climate aridification exacerbating impacts. Impacts on functioning happen directly through changed abiotic conditions, and indirectly through effects on the vegetation. Dryland vegetation is known to strongly depend on biotic interactions, but we know little about how plant-associated soil organisms and their impact on dryland functioning will respond to global change. One can expect a general positive effect of soil microbial abundance and diversity on dryland functioning, as different microbial taxa provide different ecosystem functions. Their contribution to functioning will also depend on the host plants dominating the vegetation, and their contribution to dryland functioning should increase with plant functional diversity in resource economy due to a high availability of plant-soil interaction niches in a functionally diverse vegetation. The latter could be one factor leading to the positive relationship between plant functional diversity and functioning in drylands. To discuss this hypothesis, I will present the results of an observational study of global drylands along a grazing gradient and the results of a full-factorial greenhouse experiment measuring ecosystem functioning of simplified annual dryland plant communities, that form a gradient of diversity in leaf and root resource economy, growing in soils with and without mycorrhizal fungi.

Keyword: ecosystem functioning, global change, plant-soil interactions, plant functional traits, plant-ressource economy, drylands, grazing pressure

P12

DROUGHT LEGACIES IN THE CENTRAL EUROPEAN MOUNTAINS. WILL SUBALPINE GRASSLANDS DISAPPEAR THERE?

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Ecosystems above the upper treeline, represented in Central European mid-mountain areas by subalpine grasslands, belong to vegetation extremely sensitive to global climate change, because of the small extent of forest-free areas and their isolation. Changes in species and functional composition, species richness and species upward shift are documented worldwide. However, these changes could be induced also by changes in management. Grazing cessation during the 20th century had a deep impact on the vegetation of subalpine grasslands, because it was sustained by traditional pasturing and hay cutting management for centuries. Although nature conservationists and farmers have initiated active management in many areas in recent period, extensive areas of subalpine grasslands suddenly died after extreme climatic events in 2003, 2012 and 2019 in the Eastern Sudeten (Europe, Czech Republic), leaving only thick compact cushions of dead biomass.

We established 44 permanent plots along the whole mountain

ridge within both healthy and dead grasslands to assess their regenerative potential. The spontaneous succession differed according to the locality: mid-elevations (above 1,350 m a.s.l.) showed slow regeneration with the generative spread of *Nardus stricta* and expansion of native *Galium saxatile*, while lower parts (below 1,350 m a.s.l.) implied blocked succession. Concurrently, the migration of overpopulated ungulates supported the spreading of some mesic species from lower elevations, e.g. *Juncus effusus*, *Carex leporina* and *Rubus idaeus*. Nevertheless, we have observed only three consecutive years of regeneration. Therefore, the question if affected subalpine grasslands will fully regenerate and show resilience according to the long-term dynamics remains.

Keyword: climate change, treeline, dying out, dead biomass, regeneration, sponateous succession

P13

A UNIFIED FRAMEWORK FOR PARTITIONING THE DRIVERS OF STABILITY OF ECOLOGICAL COMMUNITIES

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Identifying the drivers of ecological stability is crucial for maintaining ecosystem functioning and services, particularly in a changing world. However, existing theories on stabilizing effects offer disparate conclusions, creating a need for a unified framework. Here, we propose such a framework, allowing for the reliable assessment of three stabilizing effects on ecosystem function temporal constancy: the stabilizing effects of (a) dominant species, (b) species asynchrony, and (c) diversity. Our approach enables the disentanglement of these stabilizing effects at the level of individual communities, a significant advancement over previous methodologies that relied on indirect tests and comparative analyses across communities. We introduce a graphical representation on a ternary plot to illustrate the relative contributions of these three stabilizing effects, providing a standardized space for comparison across various ecological contexts. The unified framework answers the current need for linking theoretical concepts on the temporal stability of ecological communities to data analysis. Our approach promises flexible tests, offering a deeper understanding of biodiversity's ecological stabilization and the relative importance of its components. By providing a standardized method for assessing ecological stability, this framework contributes to more effective ecosystem management and conservation strategies in an increasingly changing world.

Keyword: climate change, treeline, dying out, dead biomass, regeneration, sponateous succession

Ecoinformatics and Models in Vegetation Science

P18

DEVELOPING AUTOMATIC CONVERSION SYSTEM FROM PRINTINGS INTO DIGITAL DATA BY OBJECT DETECTION

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OBJECTIVE: Many past vegetation survey data are published in paper printings such as books and reports, they are not stored in digital form. As past survey data cannot be obtained retrospectively, it is important to know the status of past vegetation. However, it is very time-consuming to manually input composition tables. Composition tables are often not recognised well by simple OCR because of their unique format. The aim of this study was to develop a system for automatically converting composition tables into digital data.

Posters – Abstracts – Monday 16 (session P1-B)

METHODS: Paper printings containing composition tables of local vegetation survey data in Japan were used as research materials. First, pre-processing was carried out such as scanning, deskewing and binarisation of the data. About one-third of the material was annotated with metadata (e.g. survey location), species names, layers and compositions as teacher data. Models were created using the teacher data and Detectron2, a Python object detection library, for training. The GPU used was an NVIDIA RTX 3050. Each part of new data was detected by inference using the created model. **RESULTS and DISCUSSION:** Although there were some discrepancies, the inference results were generally appropriate. OCR can be used to obtain appropriate survey data. As the format differs, it will be clarified whether the same model can be used to recognise other survey data. We will also clarify whether it is possible to digitize survey data using the similar model for non-Japanese vegetation data.

Keyword: composition table, OCR, Detectron2

P20

SPLITOPENR: AN R PACKAGE FOR ACCESSING SPLIT AND WORKING WITH THE OPEN VERSIONS OF SPLIT

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Big databases are essential for unraveling vegetation patterns across scales, especially in a changing world. sPlotOpen is an open-access database for plant community data containing nearly 100,000 records of vegetation surveys encompassing most of Earth's climatic diversity. Following the FAIR principles for open science, the data is publicly available from a curated data repository (<https://idata.idiv.de/ddm/Data/ShowData/3474>). Nevertheless, finding and working with big data can be overwhelming, given the increasing number of datasets available. In this sense, offering solutions for vegetation scientists to access and manipulate data directly with the software they are used to working with (i.e., the R environment) can make a dataset more accessible and usable. Here we introduce the sPlotOpenR, an R package developed for accessing, manipulating, and visualizing data from sPlotOpen. The package is composed of three main groups of functions. Functions `get_sPlot` and `load_sPlot` download and retrieve specific versions of the dataset including its metadata and auxiliary files. Data processing is done by the functions `site_by_species`, which creates an abundance or presence/absence site-by-species matrix; and the filtering functions `filter_species`, `filter_polygon`, and `filter_index`, which allows to filter data by a list of species, a geographic area, or by positional indexes. Visualization can be done using `map_plots` and `map_species`, functions that produce maps with the location of vegetation plots and the occurrences of selected species, respectively. The package is being publicly built in GitHub (<https://github.com/andrewseifert/sPlotOpenR>), from where a stable version is available. We warmly welcome contributions from users that want to help increasing the usability of sPlotOpenR.

Keyword: R package, sPlot, vegetation database, plant-community data, open science

P21

CHRONICLES OF SPECTRAL DIVERSITY: UNRAVELING PLANT ALPHA AND BETA DIVERSITY IN GRASSLANDS THROUGH A MULTITEMPORAL LENS

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Grasslands stand out as biodiversity hotspots, encompassing habitats that foster a remarkable range of biodiversity. Improving our ability to monitor grassland biodiversity is essential to mitigate plant species loss caused by global changes. Using drone-borne multispectral sensors has a far-reaching potential to provide cost-effective monitoring of grassland biodiversity. Such high-resolution data can theoretically capture the direct link between the diversity in species-specific optical characteristics (spectral diversity, SD) and ground diversity. However, the reliability of SD for plant diversity monitoring is controversial due to potential confounding factors. Besides, the potential of SD to infer multiple facets of diversity at the community scale and monitor them across years has scarcely been studied. This study investigates whether SD can reflect alpha- and beta-diversity in alpine grasslands, considering taxonomic, functional, and phylogenetic plant diversity and three types of spectral diversity metrics. Spectral and plant diversity were calculated based on data collected at the growing season's peak over four years in thirty 5 × 5 m plots. For both alpha- and beta-diversity, our results reveal that spectral species-based SD metrics better reflect all the facets of plant diversity considered, with consistency over the years, confirming that SD holds promise for biodiversity monitoring in grasslands.

Keyword: remote sensing, UAV, alpine grasslands, Spectral Variation Hypothesis

P22

KELVEG - THE DATABASE OF ROADSIDE VEGETATION IN LITHUANIA

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1 - Nature Research Centre

KELVEG is a database (GIVD EU-LT-002) that documents the diversity of roadside vegetation, tracks, and monitors changes of alien species' impact on the roadsides and connected habitats in Lithuania. The initiative is brand new, it started in the spring of 2023. Now, the database includes 434 vegetation plots from 101 randomly selected sites across the country.

Vegetation-plots are sampled along transects, starting at the edge of the roadside (road shoulder), and ending in a connected habitat. In each roadside part (road shoulder, first slope, second slope or flat part and attached habitat) 1 m² square-shaped vegetation plots have been taken. Additionally, 100 m² square-shaped vegetation-plots have been sampled in connected habitats. In each vegetation-plot, the cover of vascular plants and bryophytes was measured using a percentage scale, and the cover and height of vegetation layers were measured. The aspect and inclination of slopes were measured using an electronic compass and a Clinometer mobile application, respectively. In each vegetation-plot, soil samples were collected and agrochemical analysis was performed to evaluate soil/substrate pH, the concentration of total nitrogen, humus, phosphate (P₂O₅) and potassium oxide (K₂O). Additionally, in each part of the roadside and connected habitats tick samples were collected in 100 m long transects. The subsequent intensive collection of vegetation-plots will continue until 2026. The database is being developed under the project 'Coexistence of native and alien plant and tick species along roadsides' supported by the Research Council of Lithuania (Nr. S-MIP-23-1).

Keyword: Database, Tick, Native species, Exotic plants

P23

3D TERRESTRIAL LASER SCANNING FOR MODELLING AND MAPPING OF THE DISTRIBUTION OF *PAEONIA OFFICINALIS*: CASE STUDY OF DOLINES ON KRAS PLATEAU

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We attempted to model the present and future distribution of *Paeonia officinalis* on Kras plateau, using DTMs with very high resolution to account for modulations of the local ecological conditions, caused by karstic terrain.

Resolution of the modelling of plant species niches and distributions is limited with the resolution of input data, and often the effect geomorphology has on the ecological conditions in the meso- and microlocality of a particular individual has to be ignored. Recently, developments in Light Detection and Ranging (LiDAR) technology, enable the construction of digital terrain models (DTM) of high resolution, enabling us to account the effect of terrain on the conditions on the exact locality of an individual.

The other limitation for model accuracy and resolution is the mapping of the individual plants on the DMR, connected to the time and effort necessary for mapping of larger areas. We present a method of utilising TLS for greatly lowering the time and effort necessary to map the plants.

The hypotheses tested were:

1. *Paeonia officinalis* is not distributed randomly in and around dolines.
2. Climate change will force *P. officinalis* to change its distribution patterns in the dolines significantly.

Preliminary results show non-random distribution of *P. officinalis* individuals in the landscape of a doline and limited capabilities of the dolines to provide a suitable habitat for this species in the warming future.

Keyword: karst, terrestrial laser scanning, *Paeonia officinalis*, climate change, microhabitat

P24

ECOLOGICAL INDICATOR VALUES FOR EUROPE (EIVE): VERSION 1.5 AND COMPARATIVE TEST

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The Ecological Indicator Values for Europe (EIVE) 1.0 were released in January 2023 and are the hitherto most comprehensive ecological indicator value (EIV) system for Europe. They comprise the assessment of the five main niche dimensions (moisture, nitrogen, reaction, light, temperature) for almost 15,000 vascular plant taxa. EIVE was constructed as a consensus system across 31 regional EIV systems and provides for each niche dimension position and width on continuous scales from 0 to 10. Despite the short time since the release, EIVE 1.0 has already been used in various classification and macroecological studies at broad scales or when there is not regional system readily available. We now present EIVE 1.5 that comprehensively includes terricolous bryophytes and lichens of Europe and improved the values for vascular plants by integrating several new and updated EIV systems.

Second, we empirically tested EIVE 1.0 against measured environmental variables (soil pH, mean annual temperature at soil surface) with a Swiss dataset. We compared the performance of EIVE with to another European (Tichý et al.) and two regional (Ellenberg et al. and Landolt et al.) EIV systems and tested four different weighting approaches (unweighted, cover-weighted, sqrt(cover)-weighted and inverse niche width weighted). Generally, the performance of the four systems was similar, while inverse niche width was the best weighting approach, followed by unweighted means.

Finally, we present an outlook on the planned next development steps of EIVE: EIVE 1.7 (additional indicators), EIVE 2.0 (re-calibration with vegetation plots from EVA) and EIVE 3.0 (release of regional editions).

Keyword: averaging method, bioindication, bryophyte, calibration, ecological indicator value, EIVE, Ellenberg value, environmental variable, Europe, lichen, macroecology, niche position, niche width, soil pH, temperature, validation, vascular plant

P25

MACROECOLOGICAL MODELLING OF MULTI-SCALE ALPHA DIVERSITY PATTERNS OF PALAEARCTIC GRASSLANDS

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Palaeartic grasslands hold the world records for small-scale plant alpha-diversity, yet they are among the ecosystems most threatened by human impact. A better understanding of the patterns of this diversity and the factors that control it is key to their effective conservation. Local studies have not been able to derive general trends to explain patterns of grassland diversity across regions. One way to overcome this shortcoming is to make use of large data sets that cover a wide geographical area.

The GrassPlot database (<https://edgg.org/databases/GrassPlot>) collects vegetation plot data of grasslands (broadly defined) from the Palaeartic. GrassPlot contains nested plot series or data of eight standard grain sizes: 0.0001, 0.001, 0.01, 0.1, 1, 10, 100, 1,000 m². It also collects a wide range of in-situ measured environmental variables. It currently stores data for >200,000 georeferenced plots throughout the Palaeartic.

The aim of the present study is to determine the drivers of alpha-diversity of vascular plants, bryophytes and lichens in Palaeartic grasslands at different scales (0.1, 1, 10, and 100 m²) using data stored in GrassPlot and environmental data retrieved from open access global databases (i.e. CHELSA, SoilGrid, HYDE). We included a wide range of topographic, climatic, edaphic, anthropogenic and historical parameters as predictors of richness in generalised linear mixed models. We found that patterns and drivers of alpha diversity strongly vary across the four grain sizes, highlighting the importance of scale.

Keyword: alpha-diversity, grassland, Palaeartic, spatial scale, species richness, database

Future Ecosystems Climate and Land Change

P14

RESURVEY OF GRASSLANDS VEGETATION IN THE WESTERN ITALIAN ALPS ★

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The Alps are a biodiversity hotspot particularly affected by ongoing climate and land use change. In this context it is important to monitor the responses of ecosystems and species by exploiting the data collected during past studies to better direct conservation efforts. The research activities conducted focus, through vegetation re-surveys, on the study of changes occurred over the course of the last 45 years in the grasslands of the Western Italian Alps, into Gran Paradiso National Park.

Old vegetation plots may not have positioning data, affecting the correct positioning of new surveys. We then developed a method that integrates old field data such as elevation, aspect and slope, with the digital terrain model to highlight areas suitable for re-positioning. The result was complemented using apps for field navigation allowing for the best positioning of the survey.

Data from previous surveys were categorized into three plant community Association within European habitat 6150 (Siliceous alpine and boreal grasslands). Biodiversity changes over time were studied in each community, focusing on responses to climate change via bioindication and community life form composition. Analyses also delved into the processes behind detected changes, highlighting winning and losing species and exploring dynamics through range shift and range filling hypotheses.

Salicion herbaceae is the community most affected by climate change and invasion dynamics with species coming from surrounding *Caricion curvulae* prairies. *Nardion strictae* is the most affected by changes in life forms, indicating ongoing encroachment by woody shrubs and trees.

Keyword: resurvey, grasslands, vegetation, Alps, climate change, biodiversity

P15

CARBON SEQUESTRATION SHOWDOWN: COMPARING ECOSYSTEM SERVICES IN NATIVE AND ALIEN-DOMINATED FOREST HABITATS

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Forests ecosystems are home to vast part of the terrestrial biodiversity, making the study of forest communities a long-standing aspect of vegetation surveys. In our current changing environment, society is faced with the challenges of biodiversity loss and climate crisis. The assessment of different habitats is now being measured in terms of ecosystem services. One critical service provided by forest ecosystems is carbon sequestration, which is vital for both nature and humans. Therefore, it would be intriguing to explore the impact of planting non-native forests dominated by *Robinia pseudoacacia* trees in temperate zone on carbon sequestration, as compared to native forests. To investigate this, native forests and alien dominated forests were established across Western Slovakia as a twin plots. Data on soils, abiotic conditions, NDVI indices, vegetation, and aboveground biomass were collected and analyzed. Each plot was subjected to phytosociological relevé, soil sampling, and measurements of air temperature, humidity, and soil temperature (HAXO-8) during the 2023 vegetation season. NDVI indices were calculated using NATURASAT software. Additionally, a Stonex X120 GO handheld mobile scanner was used to quantify the amount of aboveground biomass.

The analysis revealed that native forests stored a slightly higher amount of organic carbon compared to the alien dominated forests.

The presence of *Robinia pseudoacacia* trees significantly altered the abiotic conditions (air temperature, humidity, soil temperature) and vegetation. The NDVI indices reflected the phenology of the trees. Ultimately, the results demonstrated that native habitats exhibited a greater volume of biomass compared to the *Robinia* stands.

Keyword: Above ground biomass, Ecosystem services, Organic carbon storage, Terrestrial laser scanning, Twin plots, Vegetation

P16

MORPHODYNAMICS AND VEGETATION CHANGES IN AZOV-TYPE SPITS USING EARTH REMOTE SENSING DATA

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The Azov-type spits (ATS) are unique landforms along the Sea of Azov's Northern coast, spanning from 46.2°N to 47.1°N and from 35.2°E to 38.1°E. ATS are dynamic structures, constantly changing due to abrasion-accumulation processes, sea level fluctuations, wind-wave regime alterations and variations in biogenic material volumes, influenced by global and local climate changes, rising sea levels, geological shifts and human activities. Our study aimed to assess morphodynamic processes and vegetation changes within ATS using Earth Remote Sensing (ERS) tools due to field research limitations amid military occupation, also verifying our previous forecast. Satellite imagery data (1975-2022) and specific normalized indices (NDVI, NDWI, NDMI, Thermal) were used, alongside with grassland relevés (1995-1999) and vegetation maps (1927-1929, 1934, 1996-1999). Kryva spit's area remained relatively stable, with notable changes in its isthmus and mainland areas. Bilosaraiska spit expanded slightly, while Berdianska and Obytichna spits decreased due to coastal erosion. NDVI dynamics analysis revealed consistent vegetation density increase across ATS territories, potentially indicating improved moisture conditions and possible alterations in the dominance of plant communities. Over 95 years, significant vegetation shifts occurred, with halophytic meadow and marsh communities expanding alongside some reductions in productivity, contrasting with increased productivity in sandy-steppe areas. These changes correspond to prevailing inundation trends, supported by NDVI and NDWI trends, despite climate-related challenges. Continuous monitoring efforts are crucial to understand ATS ecosystem dynamics, especially given projected sea level rise by 2050. ERS tools demonstrated efficacy in monitoring environmental changes and validating predictive models, aiding in comprehending ATS's evolving nature.

Keyword: Azov-type spits, satellite imagery, ERS tools, morphodynamics, vegetation changes

P26

FUNCTIONAL AND BIOLOGICAL DIVERSITY OF WILD EDIBLE PLANTS IN ITALY

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The project “FuD WE PIC” is specifically devoted to address the contribution of land-use, landscape patterns (fragmentation and heterogeneity) and climatic variables to the preservation of wild edible plants (WEP) and related ecosystem services, under a multidisciplinary framework involving Bioclimatology, Ethnobotany, Vegetation and Landscape Ecology. The project will perform a comprehensive investigation, based on vegetation plots data, to assess WEP species distribution in different habitats/ecoregions and to explore the correlations between environmental variables and species diversity.

The project consists of 5 work packages (WP): WP1 will set up a unified infrastructure to collect and share the data on wild edible plants of Italy; WP2 will focus on measuring and comparing landscape patterns, climatic variables and WEP diversity; WP3 will combine WEPs traits and species richness to explore the influence of WEP specific traits and species assemblages in the biodiversity–climate–land-use feedback system; WP4 will model losses and gains of WEP—and related ecosystem services—under different climate and land-use change scenarios; WP5 will analyse the effects of landscape attributes and WEP on the resilience of Traditional Environmental Knowledge (TEK) and folk perceptions of the oikos.

Our main targets to be achieved will be: i) the characterization of WEP biological, functional and coenological diversity in Italy; ii) the analysis and distribution patterns of ecosystem services related to WEP, in terms of provisioning and cultural assets; iii) provision of theoretical and practical tools for a better management of WEP diversity; iv) contribution to livelihoods, traditional ecological knowledge and cultural distinctiveness.

Keyword: floristics, species distribution, vegetation plots, Traditional Ecological Knowledge (TEK)

P27

SCALE-DEPENDENCY OF GRASSLANDS NICHE DIMENSIONS VARIES WITH THE HARSHNESS OF ENVIRONMENTAL CONDITIONS

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The climatic and edaphic niches of plant species determine their occurrence along environmental gradients and can be estimated using species-level ecological indicator values (EIVs). EIVs, such as Ellenberg-type indicators, are based on species occurrences in sampled vegetation, thus estimating the realized niche of a species along abiotic conditions, taking into account interspecific interactions. Ecological niche can be described by niche position - the optimal positioning of species along abiotic conditions - and by niche width - the range of conditions in which a species can occur. Community-level means of the EIVs, calculated for all species present in a community, are widely used to interpret patterns of species diversity along environmental gradients and to research management and conservation strategies for ecosystems. However, community-level estimates of niche position and

width may depend on the sampled scale. Larger areas generally contain more functionally redundant species, while in small areas, interspecific competition due to limited space restricts the coexistence of species with overlapping niches. We tested the scale-dependency of the major climatic and edaphic niches of plant communities across a wide range of grassland habitat types in Ukraine, ranging from saline and dry grasslands to wet, mesic, and alpine grassland types. We sampled plant communities in a nested plot series with seven grain sizes and assessed niche position and width for light, moisture, temperature, soil pH, and soil nitrogen content. Our results show that the scale-dependency of community niche varies with the grassland habitat type, depending on the severity of environmental conditions.

Keyword: niche width, niche position, EIVE, plant communities, nested plot, ecological indicator values

P30

DEPENDENCY OF SEEDLING ESTABLISHMENT ON SAFE SITES IN THE ALBORZ MOUNTAINS, N. IRAN

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Mountains with high elevations and adapted trees may provide opportunities to assess future tree advancement in response to climate change. Although climate warming may enhance advancement, this will only be possible with the successful establishment of seedlings and saplings beyond the current uppermost tree individuals. In this regard, few studies use seedling establishment to describe their dependence on safe sites, particularly in the Alborz where this has been poorly studied. We used seedling data from the uppermost tree growth of the Hyrcanian forest on the northern slope of the Alborz Mountains (Iran) to assess their dependence on safe site conditions and microhabitat substrates.

We collected seedling data including facilitative elements (rocks, stones, deadwood and canopy shading) and microhabitat substrates (vegetation, litter, bare soil and stones) at two establishment stages (0 < -10 cm) and (10 < -50 cm) from four different sites. We used generalised linear models to assess the importance of facilitating elements and microhabitat substrates on the density of the two classes of seedlings along the elevation. We found that seedlings were mostly associated with facilitative elements and less with microhabitat substrates. The seedlings showed different associations with safe site conditions, indicating their different requirements as they transition from small seedlings to young saplings. We concluded that the future possible upward movements of trees may be highly dependent on safe site conditions that provide favourable conditions for seedlings and young saplings.

Keyword: Alpine treeline, Climate change, Elevational gradient, Hyrcanian forests, Seedling recruitment

P31

TAXONOMIC AND FUNCTIONAL DIVERSITY OF TEMPERATE GRASSLANDS AFFECTED BY EXTREME CLIMATE EVENTS

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Global warming and extreme climate events may affect plant functioning, biodiversity and ecosystem processes in temperate grasslands. Here, we aim to identify changes in the taxonomic and functional structure of temperate grassland communities in response to extreme climate events during a three-year field experiment. Heavy precipitation was simulated by additional irrigation, while elevated temperatures were provided by open-top chambers. We used a taxonomic and trait-based approach to quantify variation in four functional traits (seed mass, plant height, LDMC and SLA) at the community level (CWM) and functional diversity (functional richness, FRic; evenness, FEve; and divergence, FDiv). In addition, we calculated Grime's CSR values for each species based on key leaf characteristics. We considered all species recorded, as well as graminoids and forbs separately. Our results showed that additional irrigation led to a decrease in species richness, CWM SLA and FRic and a decrease in species evenness in whole communities on irrigated plots. Passive warming significantly increased species evenness and decreased FRic of graminoids. We also found a significant effect of the interaction of additional irrigation and passive warming on FDiv for graminoids and forbs. Plots with higher water level and higher temperature had higher FDiv. We observed an increase in competitive strategy within forbs and at the whole community level and a decrease in ruderal strategy of forbs, with the opposite pattern for graminoids. Our research highlights the importance of considering interactions at species and functional group level separately when looking for responses to changes in water availability and temperature.

Keyword: grassland, meadow, taxonomic diversity, functional diversity, global warming

P33

HOW DOES PASSIVE WARMING AFFECT THE TAXONOMIC DIVERSITY OF SEMI-NATURAL GRASSLANDS?

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Due to the urgent problem of the direct or indirect effects of global warming on various ecosystems, many experiments are currently being conducted to simulate the effects of these changes on vegetation. The aim of this study was to investigate the effects of simulated climate change on the taxonomic diversity of semi-natural grasslands in Central Europe. The study was carried out in three field experiments located in southern Poland, including 1) lowland hay meadows, 2) mountain hay meadows, and 3) *Molinia* meadows, where global warming changes were simulated by passive temperature increase using open-top chambers (OTC). Species richness, Shannon index and species evenness were calculated as measures of taxonomic diversity. These indices were calculated for the whole community and separately for graminoids and forbs. The results showed that passive temperature increase at OTC had no effect on taxonomic diversity indices in lowland hay meadows. In contrast, it increased species richness in mountain hay meadows and evenness in *Molinia* meadows. Furthermore, higher Shannon index and species evenness within graminoids were observed in the two latter meadow types. In conclusion, there is no uniform effect of temperature increase on the taxonomic diversity of semi-natural grasslands in Central Europe. Our findings suggest the positive effect of warming on taxonomic diversity. However, this pattern may depend on different responses (i.e. shifts in interspecific interactions and dominance) of species within functional groups, particularly within graminoids - a major component of the analysed vegetation.

Keyword: taxonomic diversity, global warming, grassland, meadow, graminoids

P35

MICROCLIMATE AFFECTS FOREST RECOVERY PATTERN AFTER STAND-REPLACING BARK BEETLE DISTURBANCE

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Bark beetle outbreak caused large stand-replacing disturbances in the European coniferous forest. In our previous studies, we showed that the seedlings that emerged directly during the disturbance play a dominant role in the forest's natural recovery and that the spatial pattern of this natural regeneration mirrors the pattern of trees that formed the stand before the disturbance. Factors responsible for this self-replicating spatial pattern, however, remain to be discovered. Here, we explored the microclimate as one of the possible drivers behind this pattern.

We continuously measured air temperature near the ground, as well as soil temperature and moisture with TMS4 loggers in the natural coniferous forests in the Šumava Mts., Czech Republic. From these measurements, we calculated the duration of snow cover and melting date in different microhabitats and compared their microclimate during the growing season.

We found more microclimatic extremes in different types of disturbed forest stands than in various undisturbed stands and large differences in the microclimate of habitats related to tree trunks, which can affect seedling recruitment and survival success. Our findings highlight the key role of microclimate in ecosystem development. Microclimate thus should be part of future climate change assessment, as it can have significant impacts on forest recovery and resilience.

Keyword: microclimate, forest recovery, tree spatial pattern

P36

CONSEQUENCES OF TEN-YEAR ABANDONMENT IN A SUBALPINE GRASSLAND: SOIL AND LITTER DECOMPOSITION CHANGES

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Woody species encroachment on grassland ecosystems is occurring worldwide with contrasting consequences for soil chemical properties and litter decomposition rate, depending on the characteristics of the habitat and the woody species colonizing it. The present work aims to study the changes in soil temperature, moisture and chemistry, and litter decomposition following the early stages (10 years) of colonization by shrubs and trees in a subalpine grassland located in the Alps. Shrubland soil showed higher temperature and moisture compared to grassland, whereas no significant differences were found in terms of pH, ammonium and nitrate, available P, TOC, and TN, neither in the O nor in the A soil horizon. Nevertheless, a significantly higher DOC content was observed in the A horizon of the shrubland, as well as a higher content of microbial C and N, compared to grassland. Finally, a quantitatively higher decomposition rate was found in the litter bags incubated in the shrubland soil. Our results showed that the effects of the physical presence of woody species colonizing the grassland changed the microenvironmental factors even in the early stage of the encroachment process, creating a more favorable environment for decomposition. Changes in soil chemistry seem to require a longer time, although an increase in microbial biomass was already observed in shrubland soil.

Keyword: woody encroachment; vegetation dynamics; decomposition; soil properties; subalpine grassland

P37

TWO SHADES OF GREEN: TREE SPECIES GOVERNS THE DROUGHT EFFECTS ON BILBERRY

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1 - SLU

Climate change is increasingly affecting boreal forests. Among several climatic drivers, droughts can have significant effects on these ecosystems, but are largely understudied. For example, the last years' droughts have caused increased mortality to the dwarf shrub bilberry (*Vaccinium myrtillus*) in Sweden, but it is unknown if this mortality varies due to biotic and abiotic drivers. Bilberry is a key driver of ecosystem processes in European boreal forests, and for instance constitute a considerable share of many animals' diets. Here we asked how drought damage on this foundation species varies across landscapes, and specifically how soils and forest structure interact with drought. Ramets were checked for damages in 87 forest stands, randomly selected along continuous gradients of forest density and tree species composition (from Norway spruce (*Picea abies*) to Scots pine (*Pinus sylvestris*) in south-central Sweden, and we documented overstory density and tree species composition, soil conditions and micro-topography. A Hurdle GLMM combining binomial and beta distributions shows that bilberry damage was less likely to occur on wet sites while the proportion of damaged ramets was higher on elevated places like tree stumps and rocks. The effect of forest density was dependent on tree species composition. Whereas the effect of forest density was positive in forests dominated by pine, the proportion of damaged ramets increased with density in spruce dominated forest. This indicates that the effect of drought on bilberry is strongly dependent on forest management decisions and that selecting for pine could ameliorate future drought damages.

Keyword: coniferous forest, ericaceous shrub, heat spell, water limitation

European Vegetation Survey

P38

ENDEMIC *FESTUCA* SPECIES OF THE SANDY AREA IN THE CARPATHIAN BASIN

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In the open sandy areas of the Carpathian Basin, *Festuca vaginata* is the dominant species across all geographical units. As one moves towards the central part of the basin, the number of species increases. The northern periphery hosts the endemic *Festuca javorkae*, while the southern and central parts are home to the equally endemic *Festuca wagneri*. Additionally, the central region also harbors another endemic species, *Festuca pseudovaginata*. The deforestation and shrub clearance have resulted in exposed bare soil patches, providing opportunities for the establishment of new vegetation. The area has been subjected to significant anthropogenic impacts, which we have investigated and analyzed, including the vegetation and the occurring taxa. We examined the *Festuca* species based on 24 floral characteristics and leaf anatomy through leaf cross-sections. Moreover, we compared the micromorphological features of the leaves using stereomicroscopy, scanning electron microscopy, energy-dispersive X-ray spectroscopy, and phytolith analysis to determine the taxonomic applicability of epidermal micromorphological characteristics. We also discovered a new species, *Festuca tomanii*. Following deforestation and shrub clearance, the bare soil patches exposed to anthropogenic impacts facilitated the emergence of new plant species. Furthermore, the extreme climatic conditions in the central part of the basin, such as the intense dry heat, subject the vegetation to greater stress. This necessitates better adaptation to environmental factors and may also increase the proportion of endemic species.

Keyword: *Festuca wagneri*, leaf tissue, morphotaxonomic

P39

DATABASE OF ANNUAL WETLAND VEGETATION OF UKRAINE

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Modern vegetation-plot databases together with advances in vegetation classification methods open new avenues in vegetation science. They provide broad opportunities to develop comprehensive overviews of vegetation and habitats on different scales. Although the Ukraine Wetland Database was started in 2012 there are still information gaps in some separate vegetation types, in particular annual wetland vegetation. To fill this gap we built up the "Database of Annual Wetland Vegetation of Ukraine". We collected all possible information about this vegetation and digitalized it with the TURBOVEG program. Currently, the database

contains 1336 vegetation plots covering the period from 1985 to 2022. 58.3% of the plots are unpublished plots contributed by different authors; the rest came from papers or monographs. The size of plots ranged from 1 m² to 100 m². We georeferenced 90% of the plots and assigned precision values for coordinates. Syntaxonically our vegetation represents two phytosociological classes – *Isoeto-Nano-juncetea* and *Bidentetea*. Based on this database we plan to develop a comprehensive overview of the annual vegetation of Ukrainian wetlands, characterize it in terms of syntaxonomic diversity and habitat affiliation, and create an expert system for automatic classification of this vegetation in Ukraine. Beyond the above listed objectives, the database is available for other research projects in vegetation classification, community ecology and biodiversity topics at both the national and international levels. The database is currently involved in the AveWetlands project aims to develop a large-scale synthesis of annual wetland vegetation in Europe. This database is also important for nature conservation purposes.

Keyword: annual vegetation, classification, expert system, Ukraine

P40

PHYLOGENETIC PATTERNS AMONG EUROPEAN THREATENED PLANT SPECIES

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While the number of threatened species is drastically increasing worldwide, and the need for conservation is widely acknowledged, understanding the evolutionary context of extinction risk remains complex. Using the local red lists of vascular plants established by the European countries, we integrated phylogenetic information with species' conservation status (i.e. critically endangered, endangered and vulnerable spp.) to elucidate whether phylogenetic signals underlie plant vulnerability across Europe. We found that endangered species have mostly an overdispersed phylogenetic pattern, i.e. the group consists of rather distantly related species (in 20 countries out of the 33), followed by overdispersion in vulnerable species (in 15 countries) and in critically endangered species (in 8 countries). These findings suggest that conserving the endangered species may be particularly important in Europe since this helps to preserve the evolutionary history embedded in the phylogenetically distant lineages. The critically endangered species, on the other hand, are rather not widely distributed across the phylogeny in most countries, which may mean that they could be rather found in closely related clades, facing similar extinction threats. This research contributes to the efficacy of conservation initiatives and the resilience of European plant diversity in the face of escalating anthropogenic pressures and environmental change.

Keyword: Phylogeny, Threatened species, Conservation

P41

ABIOTIC FACTORS SHAPE PLANT CO-OCCURRENCE AFFINITIES

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Posters – Abstracts – Tuesday 17 (session P2-A)

Co-occurrence affinity (CoA) refers to the tendency of pairs of species to co-occur spatially or temporally more frequently than expected by chance. This phenomenon can manifest across various spatial scales, from local habitats to biomes. CoA is usually calculated as a fixed value without accounting for its variability in different environmental conditions. We propose a new method to investigate how species' CoA is shaped by abiotic factors. The workflow is divided in 4 steps:

- Divide the multidimensional environmental space into a regular grid, where cells reflect homogeneous abiotic condition.
- Associate each species assemblage (e.g. vegetation plot) to a specific cell.
- Calculate the CoA of each pair of species for each grid cell with an adequate index (e.g. Jaccard).
- Model CoA for each species pair as a function of abiotic conditions.

To test this method, we used the European Vegetation Archive database to calculate the CoA affinities of each of the 4,500,000 existing pairwise combinations of species across thousands of grid cells identified on mean annual temperature and annual precipitation. We then modelled the co-occurrence affinities of each combination of species as a function of the climatic conditions using GLM. We found that CoA are strongly determined by climate conditions with some exception, and temperature, in general, is more important than precipitation.

This approach opens new opportunities to study the effect of abiotic factors in shaping association, facilitation and competition among species and to provide an innovative and reproducible workflow to investigate mechanisms of underlying community assembly.

Keyword: co-occurrence, plant interactions

P42

CLASSIFICATION OF THE FLOODPLAIN FORESTS AND SHRUBS OF THE DNIEPER RIVER (UKRAINE)

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The Dnieper is one of the major transboundary rivers of Europe and the longest river of Ukraine. Within Ukraine, it is 1,095 km long and its basin covers 289,000 km². In the past, the river was surrounded by extended floodplains. After the regulation and building of the cascade of six big water reservoirs, the river underwent drastic changes. The floodplain vegetation has changed a lot over the last decades. After the Nova Kahovka dam collapsed in 2023 during the Russian invasion of Ukraine, new challenges and threats have arisen. Our study aimed to investigate the diversity of the floodplain forests and shrubs of the river. They have been studied since the 30-s of the XX century, but never across the all river. The dataset contains 150 relevés made during 2016-2021. Using numerical classification, we aimed to classify relevés at the alliance level and to identify the main underlying ecological gradients driving the variation in species composition. As a result, 8 clusters were obtained from 5 alliances: *Alnion glutinosae*, *Fraxino-Quercion roboris*, *Artemisio dniproicae-Salicion acutifoliae*, *Rubus caesii-Amorpha fruticosa*, *Salicion albae* (*Populus alba*, *Populus nigra*, *Salix alba* (a dry group with *Fraxinus pennsylvanica*), *Salix alba* (a wet group with *Salix cinerea*)). Relevés were subsequently analyzed within each of the three classes (*Alnetea glutinosae*, *Alno glutinosae-Populetea albae*, *Salicetea purpureae*). Due to the regulation of the river, the high presence of adventive species was noted. *Acer negundo* is presented in 1/3 of all relevés, *Amorpha fruticosa* in 2/3, in all groups, except *Alnus glutinosa*.

Keyword: Phylogeny, Threatened species, Conservation

P43

HOW GRADIENTS OF CLIMATE AND SOIL DETERMINE MEDITERRANEAN ANNUAL-RICH DRYLAND VEGETATION ★

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Dryland annual plant communities constitute the most species-rich small-scale vegetation in the Mediterranean. Our study aimed to investigate their species composition and richness patterns in relation to environmental gradients, particularly climate and soil characteristics. We recorded vegetation and soil characteristics on 82 plots of 4 m², sampled between 11 and 1410 meters asl in Central Crete, Greece. We employed generalized additive models to calculate species richness and community characteristics. Distance-based redundancy analysis was performed to identify the main environmental factors influencing species composition. We further assessed diagnostic species for bedrock types using an indicator species analysis. We observed 347 taxa of 43 plant families with a mean of 47 species per plot. While total species richness varied only slightly along the analysed environmental gradients, significant changes were observed for relative proportions of species from different life forms and families. Towards higher elevations the proportion of therophytes declined accompanied by a rise in the proportion of hemicryptophytes. Soil pH and elevation had the highest influence on the variation in species composition (21.0 % explained). Species turnover increased along the elevation gradient and was highest above 1000 m. We identified 22 species as indicative of calcareous rock and 24 species as indicative of lime-deficient rock types. We found considerable species turnover both along climatic (elevation) and soil gradients, highlighting the special importance of soil pH. Our data supply relevant ecological information for a well-needed classification of East Mediterranean annual-rich vegetation.

Keyword: annual plants, elevational diversity patterns, indicator species, drylands, Mediterranean vegetation, species composition

P44

BENCHMARKS OF SPECIES RICHNESS IN PALAEARCTIC GRASSLAND CLASSES

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Palaeartic grasslands are known for the high species richness of vascular plants. So far, most of the records of different plot sizes up to 100 m² were recorded in meso-xeric grasslands of the class *Festuco-Brometea* in the Carpathian region of Central Europe. In our study, we aimed to assess alpha diversity patterns among phytosociological classes of grasslands and other open habitats across taxonomic groups, plot sizes and regions of the Palaeartic. We extracted 121,633 vegetation plots of eight "standard" sizes (0.0001, 0.001, ..., 1,000 m²) with class assignment from the GrassPlot v.2.14 database. We obtained benchmarks of species richness of phytosociological classes for different plot sizes, taxonomic groups (vascular plants, bryophytes, lichens) and regions. For vascular plant

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species richness at 10 m², the top ten classes were grasslands of different climate zones, with the Mediterranean therophyte-dominated grasslands on limestone (*Stipo-Trachynietea*) ranked first for the mean richness values, while temperate dry grassland and steppe vegetation (*Festuco-Brometea*) had the maximum richness values. The poorest group consisted of scree, coastal dune and saline classes. Mean species richness showed variation among regions, with patterns varying by class. We found new hotspots of maximum and mean species richness and demonstrated that mean species richness is generally higher in Palaearctic non-forest vegetation than previous studies have suggested. Our findings of new regional and syntaxonomic hotspots contribute to ecological theory and may spur the search for new records. Since high-quality data are still missing for many regions and syntaxa, GrassPlot calls for filling these knowledge gaps.

Keyword: alpha diversity, biodiversity hotspot, bryophyte, grassland, GrassPlot, lichen, Palaearctic, phytosociological class, species richness, vascular plant, vegetation plot

P45

CLASSIFICATION OF SMALL-SCALE FOREST COMMUNITIES IN GEOMORPHOLOGICAL DIVERSE LANDSCAPES OF THE KRAS PLATEAU

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The presentation deals with forest communities that develop on small surfaces with a steep gradient in dolines in a geomorphologically diverse landscape of the Karst plateau. It is important to determine which communities appear there, but it is not possible to make a vegetation plot in sense of Central European method. We tried to detect forest communities on this small scale and steep gradient by small plots of 4 m² arranged in a continuous transect. We sampled only the ground layer and estimated cover of each species. We built an expert system based on all vegetation plots from the region and applied this system on a microplot matrix. We classified one third of plots in this way, but the rest was classified by semi-supervised k-means. In this way, we established 8 communities that appear in valleys and compared their characteristics and ecological conditions by bioindicator values. According to our analysis we can find oak-hornbeam forests in the bottom. In this zone, but at upper positions, we can find sessile-oak forests on deep soils and mesophilous ravine forests on rock. On lower slopes appear thermophilous ravine forests. In upper slope Turkey oak, hophornbeam-pubescent oak forests and scrub. We can find Turkey oak forests on rather deeper soils than hophornbeam-pubescent oak forests. On the top, we can find hophornbeam-pubescent oak forests that build the zonal vegetation of the region. On rock walls we can find vegetation of rock crevices.

Keyword: classification, doline, expert system, forest, karst, k-means, transect, TWINSpan, vegetation

P46

EXSERTOTHECO CRISPAE-RAMONDION SERBICAE NEW ALLIANCE OF CHASMOPHYTIC COMMUNITIES OF LIMESTONE CREVICES IN DEEP CONTINENTAL GORGES IN SUBMONTANE TO MONTANE ALTITUDINAL ZONE

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A recent study on the plant communities of the tertiary relict and Balkan endemic species *Ramonda serbica* resulted in a list of nineteen associations and subassociations divided into 3 chorological/ecological groups: Adriatic-Ionian, Moesian and Illyrian-Scardo-Pindic. The dataset included 204 vegetation plots/relevés of the two Balkan Ramondas (*R. serbica* and *R. nathaliae*), while associations, subassociations and alliances were identified using a hierarchical cluster analysis (the Sørensen index as a distance measure and the Flexible Beta method, $\beta = 0.25$). The *Ramonda serbica* communities of the Adriatic-Ionian cluster were classified to the alliances *Edraianthion*, *Centaureo cuspidatae-Portenschagillion ramosissimae* and *Campanulion versicoloris*, those of the Moesian one to *Edraiantho graminifolii-Erysimion comati* and those of the Illyrian-Scardo-Pindic one to the new alliance *Exsertotheco crispae-Ramondion serbicae*. Diagnostic species of the new alliance are *Exsertotheca crispata*, *Sesleria interrupta*, *Neckera pumila*, *Abietinella abietina*, *Marchantia polymorpha*, *Arabis alpina* aggr., *Galium intermedium*, *Schistidium apocarpum*, *Brachythecium glareosum*, *Euonymus verrucosus*, *Ctenidium molluscum*, *Scorpidium scorpioides*. Based on the analysis of the floristic composition of 51 relevés the species pool of the alliance consists of 197 species of vascular plants and 35 mosses. It is characterised by a relatively high proportion of mosses, both in terms of species number and total cover. *Exsertotheca crispata*, *Ctenidium molluscum*, *Abietinella abietina*, *Neckera pumila* are the diagnostic and dominant moss species. The herb layer is dominated by *Ramonda serbica*. These relict communities are typical for deep continental gorges in the submontane to montane altitudinal zone (550–1000 m.a.s.l.) in Montenegro, Serbia, Kosovo and North Macedonia. The substrate is exclusively calcareous.

Keyword: Chasmophytic vegetation, *Ramonda serbica*, Balkan peninsula

P47

VEGETATION TYPES AND HABITATS WITH PARTICIPATION OF LOCAL ENDEMIC PLANT SPECIES – A COMPARISON BETWEEN THE SILICATE AND CARBONATE PARTS OF NORTHERN PIRIN MTS., BULGARIA

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This study was carried out in North Pirin Mts. - the third highest mountain in the Balkans. It is national park, NATURA 2000 site and UNESCO World Heritage Site. The exceptional concentration of rare, relict and endemic plant species and vegetation communities is due both to the insularity of the mountains in south-eastern Europe and to the alternation in the highest part of carbonate (marble) and silicate (mostly granite) formations, which create unique environmental conditions for a number of Arcto-Alpine relicts and endemics. Subject of the study are the plant communities and habitats, with participation of 10 local endemic plant taxa. The species *Pirinia koenigii*, *Isoetes pirinica* are known only from the silicate part, while *Cyanus achtarovii*, *Oxytropis urumovii*, *Odontarrhena orbelica*, *Alyssum pirinicum*, *Veronica kellereri*, *Brassica nivalis* subsp. *jordanoffii* and *Arabis ferdinandi-coburgii* are from the marble one. Special case is *Oxytropis kozhuharovii*, which inhabits geological formation on the border of the silicate and marble parts. The study found that most of the studied endemic species in the carbonate part occur in various vegetation types and exhibit ecological flexibility. On the other hand, the local endemics in the silicate part are affiliated only with very specific habitats – glacial lakes (*Isoetes pirinica*) and steep granite rocks (*Pirinia koenigii*). This study also highlights the high conservation value of the carbonate high mountain vegetation belts of Northern Pirin Mts., as a habitat for numerous endemic plant species.

Keyword: glacial relicts, neoendemics, rock formations

P49

SYNTAXONOMY OF *ROBINIA PSEUDOACACIA* STANDS ACROSS EUROPE: A REVISION, REVIEW, AND REINTERPRETATION

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The North American tree *Robinia pseudoacacia* is a common part of vegetation in most of Europe. However, the controversy between its negative ecological impact and economic benefits complicates a deeper understanding of its stands and their classification according to species composition, habitat requirements, perspectives, and risks. In 2017–2023, we collected ~6,500 phytosociological relevés with *Robinia* using EVA, local literature sources and own field research. The final dataset meeting our criteria for analysis consisted of 2,325 relevés from 20 countries and included 1,336 plant species. Based on a numerical classification reflecting major vegetation gradients, we divided European *Robinia* stands into one order, three alliances and ten associations. We kept a separate class *Robinietaea* Jurko ex Hadač & Sofron 1980 in the broad concept of Mucina et al. 2016 with the order *Chelidonio majoris-Robinietaea pseudoacaciae* Jurko ex Hadač & Sofron 1980 which we merged with orders Bromo-Robinietaea Jurko 1963 and Euphorbio cyparissiae-Robinietaea Vítková in Kolbek et al. 2003. The first alliance *Lauro nobilis-Robinion pseudoacaciae* Allegranza et al. 2019 includes non-ruderal stands, characterized by species of oceanic and/or Mediterranean climates, such as *Hedera helix* and *Lamium galeobdolon*. The central alliance *Chelidonio majoris-Robinion pseudoacaciae* Hadač & Sofron 1980 is dominated by mezophilous ruderal and nitrophilous herbs (e.g. *Chelidonium majus*, and *Urtica dioica*). The last alliance *Balloto nigrae-Robinion* Hadač & Sofron 1980 is characterized by a high proportion of heliophilous annual herbs and graminoids (e.g. *Bromus tectorum* and *Convolvulus arvensis*). Our classification reflects more local habitat conditions rather than regional distribution.

Keyword: alien tree, *Robinia pseudoacacia*, black locust, vegetation classification, validation, Europe

P50

HOST RANGE AND COMMUNITY PREFERENCES OF *CUSCUTA* SPECIES IN BULGARIA

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Awareness of the host choice and habitat preference of parasitic plants may prove to be of high importance in the assessment of future population developments and vegetation patterning under environmental change. Still there is a lack of thorough data about the host choice and the way parasites affect the relationships between other species. We present first data on the hosts and plant communities preferred by five *Cuscuta* species distributed in Bulgaria. *Cuscuta epithymum* proved to be the most frequent with a wide range of hosts. Both *C. epithymum* and *C. approximata*, the last being rarer with a narrower host range, are found to infest autochthonous mainly dicotyledonous species in dry grasslands. *Cuscuta europaea* is common but with smaller host range and preference for nitrophilous and often meadow or marginal vegetation. *Cuscuta monogyna* shows host-specific behaviour infesting tree or shrub species. It is the only species found to parasitize in forests. The most common but with a preference for ruderal vegetation and with a wider host range is the invasive alien *C. campestris*. Being a host-generalist, it is also found to parasitize in some very rare and characterized with extreme ecological conditions habitats like sand dunes. Based on the occurrence data of the studied holoparasite species we performed stacked species distribution models, demonstrating the habitat suitability for the different *Cuscuta* spp.

Acknowledgements: The research is financially supported by the project BG-RRP-2.004-0008-C01 Sofia University Marking Momentum for Innovation and Technological Transfer (SUMMIT)

Keyword: *Cuscuta* spp., distribution, habitat preference, hosts, parasitism

P51

ECOLOGICAL NICHE BREADTH CHANGES ALONG THE CONTINENTAL GRADIENT IN EUROPEAN WEED SPECIES

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Species narrow their niche towards the edge of their distribution and from generalists become specialists. Weed species migrated from the Near East to Europe along the Danubian route and their niche changed along that migration.

We tested these hypotheses on large database of weed vegetation along SE-NW gradient across Europe spanning about 3200 km and used a co-occurrence species algorithm (theta value, Whittaker's beta index) to calculate the degree of specialization of weed species. We calculated specialist/generalist status of target species (alliances *Caucalidion* and *Scleranthion*) for three subsets: GR (comprising the southern part of the Balkan peninsula – 1297 relevés), CE (comprising the northern part of the Balkan peninsula and southern Central Europe – 9033 relevés), and NW (comprising parts of the Netherlands, northern Germany, and Denmark – 8550 relevés).

The results of our analysis partly support the hypothesis of a decreasing species' niche breadth with the increasing distance from the species' central distribution area. The trend, previously detected for weed species characteristic of cereal fields on base-rich soils (phytosociological alliance *Caucalidion*), was here confirmed on a much longer geographical gradient, encompassing the whole continent along one transect. For weed species characteristic of cereal fields on neutral to acidic soils (*Scleranthion*), the hypothesized trend of increasing specialization from the northwest towards the southeast was not confirmed. Testing niche theory is important for nature conservation because specialists are more prone to decline in abundance or go extinct.

European Vegetation Survey

P52

VEGETATION DYNAMICS IN THE LOWLAND OLD-GROWTH FOREST KRAKOVO (SLOVENIA) FROM 1978 TO 2023: A STUDY OF SPECIES COMPOSITION AND ECOLOGICAL CHANGES

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The Krakovo old-growth forest (SE Slovenia), a rare example of a lowland old-growth forest dominated by oak (*Quercus robur*) and hornbeam (*Carpinus betulus*), provides a unique opportunity to study undisturbed forest ecosystems, as many similar lowland floodplain forests have been drained due to agricultural use or intensively managed for the production of high-value oak timber. The 40-hectare old-growth forest Krakovo is located in a large managed forest complex and has a well-preserved old-growth structure characterized by abundant dead woody biomass and many old trees. Therefore, the study of such forests is very important for understanding and monitoring their condition, both in terms of biotic diversity and forest stand dynamics. In this study, changes in the vegetation structure and dynamics of the old-growth forest Krakovo from 1978 to 2023 are investigated. We repeated the inventory of forest vegetation on 40 systematically arranged releve plots in a 100 x 100 m grid. The inventories were carried out in early spring and mid-summer using the Braun-Blanquet method. Our results show that the total number of species in the old-growth forest has remained stable: 123 species were recorded in the original inventory, 119 in our survey. However, the species richness within the individual plots (alpha diversity) has increased. We confirmed the presence of 101 originally recorded species, while some species were not re-recorded and several new species were documented. Phytoindication based on Ellenberg values showed a slight increase in soil reaction values and a significant increase in nitrogen/nutrient values over the study period.

Keyword: Old-growth forest, vegetation dynamics, long-term monitoring

P53

GEOGRAPHIC PATTERNS IN ALPHA DIVERSITY OF EUROPEAN ANNUAL WEED AND RUDERAL VEGETATION

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Latitudinal gradients in species richness (SR) are one of the most interesting broad-scale ecological questions. The increasing SR with the decreasing distance from the equator has been shown across different taxonomical groups and scales. In certain vegetation types, e.g. cereal weed vegetation, other European-scale geographic gradients are important (southeast-northwest) because of historical processes.

In three broad vegetation types - annual weed (two types according to crop and the related management – cereal and row crops) and annual ruderal vegetation we explored the effects of geographic latitude and longitude on relevé-level SR. Using a dataset of 9195 relevés across Europe, we calculated the Spearman's rank correlation coefficient for the overall correlation and determined the best fit out of four models (linear, quadratic, cubic, and quartic polynomials) to explain the patterns in SR.

For the whole dataset, we did not find a correlation between SR and latitude (Spearman's rho 0.02; p=0.054), however, it was positive in

weed and negative in ruderal vegetation. The correlation between SR and longitude was slightly positive (Spearman's rho 0.063; p<0.001), the strongest for the cereal category. No relationship (between any vegetation type and any geographic gradient) was linear with different polynomials best explaining individual correlations.

Since in our results the correlation differs for the three selected disturbance types, we can assume that type of site management affects the relationship between SR and geographical location.

Keyword: weed, ruderal, geographic longitude, geographic latitude, species richness, alpha diversity

P54

AN OVERVIEW OF CAUSSE DU LARZAC GRASSLANDS (FRANCE)

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The Causses (France) are limestone plateaus, on the southern edge of the Massif Central. They feature karstic landforms and ruiniform dolomitic chaos, dominated by pseudo-steppe vegetation related to a long history of pastoral activities. A Natura 2000 site 'Causse du Larzac' has benefited from a vegetation survey (2022-2023), based on phytosociological relevés (Braun-Blanquet method). The statistical analysis of the relevés available on the site, extracted from SIMETHIS-Flore-CBNMed database (EU-FR-006), displays a great diversity of EUR28 habitats and highlights challenges regarding grasslands. Three agro-pastoral alliances, widespread in Europe, appear well represented: meso-xerophytic basiphilous grasslands of *Bromion erecti* (6210) and mesophilic meadows on mineral-rich soils of *Brachypodio-Centaureion* and *Arrhenatherion* (6510). Besides, seasonally flooded meadows of *Molinio-Holoschoenion* (6420) seem to become rare. Last but not least, the originality of this site lies in two endemic associations of the Causses: meso-xerophytic open swards on restricted areas of dolomite sands of *Arenario aggregatae - Armerietum junceae* T. Liou 1929 (6220), and submediterranean montane dry calcicolous widespread grasslands of *Stipo - Ononidetum striatae* Braun-Blanq. in Braun-Blanq. et al. 1952 (not of community interest). All these grasslands appear to be completely dependent on traditional pastoral and agricultural practices, nowadays in decline. Therefore, we consider the Causse du Larzac as a major workshop territory of the future Massif Central grasslands observatory (an initiative aimed at bridging the gap between research, conservation and farmers in the French territories).

This research was supported by the French Ministry of Ecological Transition, the Occitanie region, realized in partnership with CPIE Causses méridionaux and CEFE-CNRS.

Keyword: Grasslands, Agro-pastoralism, France, Larzac, Natura 2000, *Arenario aggregatae - Armerietum junceae*, *Stipo - Ononidetum striatae*

P55

SAND DUNE AND SALT MARSH VEGETATION DIVERSITY ALONG THE SOIL MOISTURE AND SALINITY GRADIENTS: EXAMPLE FROM THE EASTERN ADRIATIC (CROATIA)

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The highly indented north-eastern Adriatic (Croatia) coast consists mainly of solid and steep limestone rocks, therefore sand dunes and salt marshes are extremely rare, small and fragmented habitats, in contrast to the western Adriatic and the Ionian or Aegean coasts of the Balkan Peninsula. Coastal dunes and salt marshes are complex habitats occupying zones of transition between marine, terrestrial and freshwater ecosystems. One of the last preserved and unique vegetation complexes of Ninski Zaljev Bay (Northern Dalmatia) was thoroughly studied during 2016 following the Braun-Blanquet method. The dynamic, but finely structured mosaic of different plant communities in coastal microtopography was found to be distributed

Posters – Abstracts – Tuesday 17 (session P2-B)

along the gradients of salinity and soil moisture from sea towards inland in following zonation: species poor pioneer halo-nitrophilous short-lived vegetation of the class *Cakiletea maritima* Tx. et Preising in Tx. ex Br.-Bl. et Tx. 1952; species-rich psammo-halophytic vegetation (*Ammophiletalia* Br.-Bl. et Tx. ex Westhoff et al. 1946); brackish *Schoenus nigricans* dominated vegetation; pioneer vegetation of annual succulent halophytes (*Thero-Salicornietea* Tx. in Tx. et Oberd. 1958); succulent chenopod scrub vegetation (*Salicornietalia fruticosae* Br.-Bl. 1933); submerged brackish vegetation (*Ruppiaetea maritima* J. Tx. ex Den Hartog et Segal 1964), salt-marshes (*Juncetalia maritima* Br.-Bl. in Br.-Bl. et al. 1952); wet meadows (*Trifolio-Hordeetalia* Horvatić 1963) and reed swamps (*Phragmitetalia* Koch 1926). The relationship between community species diversity and functional diversity along the gradients was analysed in order highlight the effects of environmental filters on community composition.

Keyword: Grasslands, Agro-pastoralism, France, Larzac, Natura 2000, *Arenario aggregatae* - *Armerietum juncea*, *Stipo* - *Ononidetum striatae*

Historical Vegetation Ecology

P56

CHANGES IN BIODIVERSITY IN COASTAL DUNES AFTER FORTY YEARS

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Coastal dunes are important, yet very threatened ecosystems in Europe. Analyses of biodiversity trends of time in such environments is pivotal for detecting potential degradation and planning effective conservation strategies.

We performed a resurvey of 78 historical plots within the Natural Reserve "Castelporziano Presidential Estate", which host well-preserved Mediterranean coastal dune systems. We compared plant species occurrence and cover over the last 40 years by using ordination methods (DCA), species rarefaction curves, and Indicator Species Analysis. Moreover, we assessed changes in the ecosystem function to control coastal erosion, through an index based on rhizomatous geophyte grasses.

Typical species of embryonic dunes decreased significantly and were replaced by the species of fixed dunes. The xerophytic garrigues dominated by *Cistus salvifolius* evolved into holm-oak forests. Species richness decreased only for woody fixed dunes, while focal species cover decreased in all communities. Specifically, the decrease of pioneer dune species could exacerbate the effectiveness of coastal erosion control.

Considering the low human impact in the target area, our results suggest that natural succession played a significant role in shaping the observed variations in species composition. Furthermore, our research highlighted the efficacy of resurveying methods in revealing insights into vegetation dynamics, thereby establishing a robust foundation for the implementation of effective conservation strategies.

Keyword: coastal dune vegetation, resurveying studies, diachronic analysis, vegetation re-sampling

P57

THE EFFECT OF LONG-TERM CONTINUOUS HABITAT REPRESENTATION ON CURRENT PLANT SPECIES RICHNESS IN EUROPE

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It is increasingly recognized that one of the most important factors supporting local plant species richness is long-term habitat continuity. Here we investigate how the continuous representation of nine major European vegetation types influences the current species richness of their local communities. Based on pollen spectra from 802 sites covering the last 16 000 years, we created maps of the minimum continuous representation of each vegetation type in Europe. We also mapped climate stability over the same period using downscaled simulations of the CCSM3 global circulation model. These data were then used as predictors for the number of all species and the number of habitat specialists in the vegetation plots of each vegetation type obtained from the European Vegetation Archive. For most vegetation types, we found an insignificant or even negative effect of their minimum continuous representation on total species richness, but a significant positive effect on the richness of habitat specialists. This effect was also most pronounced when the minimum continuous representation of the vegetation type was measured since the times of its major bottleneck. When we partitioned the variation in species richness explained by the historical continuity of vegetation type, its modern area around each vegetation plot and climate stability, we found that the historical effects were largely habitat specific. Our results suggest that long-term continuity of vegetation type is important for maintaining high species richness of habitat specialists, whereas overall species richness is more dependent on other factors such as current climate, soil conditions or landscape management.

Keyword: habitat continuity, species richness, habitat specialists, Europe, vegetation types, pollen spectra, climate stability

P58

DO POLEMOFOREST PLANT COMMUNITIES REMEMBER PRE-WWI LAND-USE?

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World War I profoundly impacted soils and vegetation in North-Eastern France, erasing all traces of past land use in the "red zone" (i.e. completely destroyed area). At the end of the war, the former battlefield was either restored for agriculture or left to forest recolonization. The latter occurred on lands that were agricultural lands or woodlands prior to WWI. Here we asked whether the former land-use influences the composition and diversity of extant forest plant communities, more than one century after the end of WWI. We hypothesized that (1) woodlands that have re-established on former forested area contain more forest plant specialists than their counterparts that have established on former croplands, thanks to the soil seed bank legacy; (2) compared to ancient/recent forests of the adjacent "blue zone" (i.e. unaffected by warfare), woodlands that recolonized the red zone are more similar among each other, as a result of synchronized succession under similar ecological filters. To test these hypotheses we recorded all vascular plant species in 400 m² quadrats disposed in recent forests (i.e. established on lands that were cultivated before 1914) in both zones, ancient forests (i.e. that have continuously existed since ca. 1830) in the blue zone, and "pseudo-ancient" forests (i.e. that have re-established on deeply disturbed forest soils after 1918) in the red zone. We analyzed differences in plant species composition and in taxonomic and functional diversity indices. Our results reveal important differences among the four types of woodland investigated and provide support to our two research hypotheses.

Keyword: habitat continuity, species richness, habitat specialists, Europe, vegetation types, pollen spectra, climate stability

P59

PLANT LISTS AND ALTITUDINAL BELTS AS 19TH CENTURY APPROACHES TO VEGETATION SCIENCE: EXAMPLES FROM MADEIRA ISLAND

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Vegetation, as a scientific subject, was early approached in the late-18th to early-19th century by Alexander von Humboldt, when dealing with plant distribution along altitudinal gradients. However, a century passed before the first plant community concepts began to take shape in the works of Grisebach (1872), Flahault (1900), Drude (1902), Cajander (1909), Braun-Blanquet (1913), Pavillard (1918), Du Rietz (1918), Tansley (1920), etc., thus structuring the study of vegetation units, their patterns, species composition, distribution, etc. Nevertheless, Humboldt's ideas on plant communities and their distribution were not forgotten, and throughout the 19th century similar approaches were used by several botanists, although lacking a solid conceptual frameworks.

Plant lists were customarily compiled during the 19th century from various sources, often re-copied and subsequently added, noted, even published as commented lists. These lists are viewed as catalogues of a territory's plant biodiversity, a working tool for taxonomists focused on discovering, describing, and classifying such diversity. We argue that plant lists were also an essential working tool for those who, following Humboldt's approach, tried to identify and describe plant communities and complexes before vegetation science came into being, in the early 20th century.

We present the preliminary results of ongoing research on the historical plant lists prepared for Madeira Island during the 19th century, focusing particularly on those put together by Richard Thomas Lowe, who published pioneering work on the local flora and one of the first attempts to describe its vegetation belts.

Keyword: habitat continuity, species richness, habitat specialists, Europe, vegetation types, pollen spectra, climate stability

Restoration, Conservation, and Vegetation Management

P60

ENHANCING PLANT SPECIES DIVERSITY IN URBAN LAWNS

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Increasing plant species diversity in urban lawns is vital for enhancing urban ecosystems and providing habitats and food sources for a variety of insects, birds, and other wildlife. Our aim was to evaluate the effectiveness of various grassland management techniques and to assess public perceptions and educational outcomes associated with these experimental interventions.

A seven-year experiment was launched in 2021 in Riga, at the Botanical Garden of the University of Latvia. The aim was to compare 6 different grassland management techniques in controlled plots in a block design. In five repetitions (30 plots in total), we evaluated how the diversity of species changes depending on the mowing regime (1 and 2 times per season), the introduction of semi-natural grassland soil and sowing of seeds from semi-natural meadows.

Treatment with removal of turf, adding semi-natural grassland soil and seeding wild plant seeds was the most effective in increasing plant species diversity. Number of species increased from 11 before treatment to 69 perennials and 3 bryophyte species after 2 years of treatment.

In 2023, a total of 110 species were identified across the monitoring plots, including 100 perennial and 10 bryophyte species. It was observed that the number of species gradually increased in three test variants where meadow seeds were sown. In these variants, intensive

mowing was avoided; instead, mowing was limited to only once or twice annually, and all mown grass was removed. Simply reducing the frequency of mowing, and relying on natural species dispersal, did not significantly enhance species diversity.

Keyword: grassland management, urban lawns, semi-natural grasslands

P61

SATELLITE REMOTE SENSING OF MACROPHYTES AND REGIONAL ASSESSMENT OF VULNERABLE AQUATIC HABITATS

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According to the European Red List of Habitats, 15 mainland aquatic habitat types in Ukraine need protection. Rare oligotrophic, oligo-mesotrophic reservoirs in Ukraine are under increasing anthropogenic pressure, highlighting the need to assess their regional threat status. The main criteria for assessing vulnerability are quantity and quality trends over 50 years, long-term and future trends. An effective method to build a set of retrospective comparisons is to use satellite imagery. Oligo-mesotrophic habitats are clearly visible on satellite images due to the high transparency of the water. Such lakes develop as productive systems due to the photosynthetic activity of macrophytes, mainly – Chara. Any changes in the quantitative or qualitative indicators of phytocoenoses are evidence of changes in the trophic status of a water body.

The main anthropogenic pressure on these habitats in Ukraine is recreation. The analysis of time series of satellite images over a period of 1984-2024 years allowed us to assess the patterns of transformation of macrophyte habitats (RLC1.1a, C1.1b, C1.2a, C1.2b). It was found that direct mechanical impact leads to destruction of vegetation cover, loss of alluvial dependent species and simplification of community structure. With the degradation of macrophyte habitats, the role of phytoplankton increases ("algal blooms") and water transparency decreases (degradation of Chara communities at depths >5 m). Our results showed that the habitat structure of the most important recreational lakes has been significantly re-structured over 40 years. This allows us to assess the threat level of oligotrophic and oligo-mesotrophic habitats in Ukraine as Critically Endangered.

Keyword: aquatic habitats, Satellite remote sensing, macrophytes, oligo-mesotrophic lakes, oligotrophic lakes

P62

THE ROLE OF RODENTS AND BIRDS AS ECOSYSTEM ENGINEERS IN EURASIAN GRASSLANDS

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Environmental heterogeneity is a crucial driver of the biodiversity patterns in grasslands, and vertebrate ecosystem engineer species can have a crucial role in the formation of heterogeneous micro-habitats in closed grasslands. In the three presented case studies, we evaluated the vegetation composition on patches created by three ecosystem engineer species: i) the Steppe marmot (*Marmota bobak*) in Kazakhstan that builds large burrows in closed feather-grass steppes, ii) the Lesser blind mole rat (*Nannospalax (super-species leucodon)*) that builds smaller burrows in sandy grasslands

Posters – Abstracts – Tuesday 17 (session P2-B)

in Hungary, and iii) Eurasian cranes (*Grus grus*) that opens the vegetation in their foraging sites in alkaline grasslands in Hungary. In all studies, we compared the vegetation of the engineered patches with the surrounding undisturbed dry grasslands to identify differences in species composition and plant functional groups. Engineered patches were characterised by lower vegetation cover, higher cover of annuals and lower cover of perennial grasses compared to the undisturbed grasslands. The patches were structurally and compositionally different from the intact grassland vegetation and we identified several specialist plant species that were characteristic of the engineered patches. The ecosystem engineering effect, i.e., the contrast between the patches and the matrix was the largest in the more closed grasslands. Our results suggest that patches created by vertebrate engineers are crucial features in dry grasslands, which increase environmental heterogeneity, and provide suitable establishment sites and act as stepping stones for the dispersal of several habitat-specialist plant species.

Keyword: burrow, dry grassland, ecosystem engineer, patch dynamics, grassland conservation, soil disturbance

P64

ASSESSING GRAZING INTENSITY EFFECTS ON PHYTODIVERSITY IN PODILLIA'S MEADOW-STEPPE GRASSLANDS ★

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Understanding the impact of grazing on grassland biodiversity is crucial for ecosystem management. This study investigates this relationship in Podillia's meadow-steppe grasslands within Podilski Tovtry National Nature Park (Ukraine). To assess the effect of grazing intensity on grassland biodiversity, we applied various diversity measurements including the Shannon Diversity Index, Simpson's Dominance Index, Pielou Evenness Index, and Bray-Curtis β -diversity index. We investigated changes in life forms and ecological strategies diversity. And in addition we analyzed environmental conditions in different stages of pasture digression using ecological indicator values.

The study showed that different grazing intensities form two stages of pasture digression: the stage of forbs and the impoverishment of floristic diversity with an increase in the dominant grasses role. The forb stage is formed under weak and moderate grazing conditions and leads to an increase in biodiversity. With an increase in the intensity of grazing, a significant decrease in the number of chamaephytes was observed. In contrast, hemicryptophytes are the most resistant to predation and regenerate relatively quickly compared to other species. Moreover, notable alterations in Lc (light in the community) and Fh (variability of damping) ecological indicator values were noted within the sampled plant communities. Species diversity is mainly formed by species with C and CS strategies. The stage of impoverishment of floristic diversity is formed in conditions of excessive grazing and leads to the homogenization of vegetation and the appearance of monodominant communities. Which, under these conditions, leads to a significant loss of vascular plant species richness and highlights the potential threat to fragmented meadow-steppe grasslands in the Podolia region of Ukraine.

Keyword: diversity index, grasslands, grazing intensity, phytodiversity, phytointication

P65

ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF HOSTILITIES ON CONTINENTAL ENDANGERED HABITATS

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The coastal and psammophyte-halophyte habitats in the Azov-Black Sea region of Ukraine have been significantly impacted by the ongoing war. These habitats exhibit remarkable biotopic diversity, underscoring their uniqueness and conservation value. The mosaic of habitats with different ecological conditions ensured the existence of a high species richness and diversity of flora and fauna (including large areas of reproductive territories). Notably, the region hosts over 20 natural continental habitat types listed on the European Red List of Habitats. Among these, six are classified as Critically Endangered (RLB1.8b, RLA2.5d, RLC3.5c, RLC5.4, RLE1.1a, RLG1.2b). They are characterised by a high percentage of endemic and rare species. As a result of the hostilities, there are both direct (fires, munitions explosions, destruction of equipment, construction of fortifications, poaching, etc.) and indirect changes in the hydrological regime, soil contamination, air pollution, noise pollution. Direct impacts result in the death of individuals of various species of fauna and flora, mechanical destruction of habitats and reproductive areas. The results of indirect impacts include transformations in the structure or changes in the quality of edaphotopes (primarily desalination or alterations in moisture regimes, eutrophication), habitat fragmentation, and disruptions to migratory pathways, as well as noise or disturbance during the reproductive period. Some impacts on rare habitats are temporary, and their consequences will be compensated by neighboring habitats. However, there are also those that are irreversible, such as the burning or inundation of the local endemic habitat variant RLB1.7b – fragments of dune forests with *Betula borysthena* Klokov ("Berezovi Kolky").

Keyword: endangered habitats, environmental impact, coastal habitats, hostilities

Human Disturbance In Islands

P66

FIRST RECORD OF *HELIOTHrips HAEMORRHODIALIS* (BOUCHÉ, 1833) (THYSANOPTERA: THRIPIDAE) ON *MUSSCHIA AUREA* (L.F.) DUMORT. (CAMPANULACEAE), AN ENDEMIC SPECIES OF THE MADEIRA ARCHIPELAGO (PORTUGAL)

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The greenhouse thrips, *Heliothrips haemorrhoidalis* (Bouché, 1833) (Thysanoptera: Thripidae) was observed attacking *Musschia aurea* (L.f.) Dumort., an endemic perennial chamaephyte of the Madeira archipelago. This pest, originating from the tropical and subtropical regions of South America and first observed in Madeira on several cultivated plants (e.g. *Musa* spp., *Castanea sativa* Mill., *Anthurium* spp.), is causing typical damage on *M. aurea* plants including white and brown patches and black spots covering leaves, inflorescences and fruit. *Heliothrips haemorrhoidalis* was first observed during field-work in June 2021. Between June 2021 and June 2024 severe mortality was observed on adult *Musschia aurea* s.l. plants. This mortality affects mostly northern populations corresponding to the putative independent taxon *Musschia angustifolia* Dumort. This is the first documented thrip attack on *Musschia aurea* s.l. and implications for conservation caused by this newly introduced pest are discussed.

Keyword: Conservation, *Musschia aurea*, *Heliothrips haemorrhoidalis*, Thrips

Molecular Approaches for Plant Communities

P67

PATTERNS OF GENETIC DIVERSITY OF VASCULAR PLANTS IN RIPARIAN FORESTS

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Understanding the spatial patterns of biodiversity at different levels of its organization is critical for a better understanding of its functioning and for the conservation of threatened ecosystems. To date, many studies have focused on longitudinal (upstream-downstream) patterns of plant diversity in riparian ecosystems at the taxonomic and functional levels; however, results on patterns of genetic diversity are ambiguous. Some studies on riparian biodiversity revealed downstream increases in intraspecific genetic diversity (DIGD), a pattern resulting mostly from asymmetric gene flow due to prevailing downstream dispersal events. On the other hand, some studies did not confirm this or even showed an opposite trend. These inconsistencies may be the result of different dispersal strategies of the studied plants or alterations in ecological connectivity in the studied systems.

We studied the longitudinal patterns of genetic diversity of ten vascular plant species representing different life history traits (woody vs. herbaceous, different dispersal and pollination syndromes, etc.). This study was conducted in a natural watershed in SE Poland (the San River, Bieszczady Mts.) with near-pristine riparian ecosystems, thereby maintaining ecological connectivity in the river network. Our multi-species study in natural systems showed that the spatial patterns of intraspecific genetic diversity depend on plant traits and life strategies.

Keyword: riparian forest, river network, genetic diversity, upstream-downstream gradient, downstream increase in genetic diversity, river

Alien Plant Species: Invasion Trends and Impacts

P68

EFFECTS OF HABITAT CONDITION ON NATIVE AND INVASIVE *IMPATIENS* SPECIES FITNESS COMPONENTS

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North American *Impatiens capensis* has established in several European countries, being recognized as an invasive in some, such as Poland, but it is considered less competitive compared to its Asian congeners. On the other hand, this species is closely related to the native *I. noli-tangere*, which has suffered loss in both population and habitat, sometimes resulting in significant extinctions. Studies comparing natural populations of both species have not been conducted yet. In our research, we posed the following questions: Do habitat conditions of both species in Poland differ from each other? Are there differences in the condition and fitness of their individuals? Which environmental factors are correlated with the traits of studied *Impatiens*? Comparison of habitat characteristics between both species did not reveal significant differences for the majority of parameters. Between sites, regardless of species, numerous significant differences were observed, including soil pH, organic matter content, C:N ratio, phosphorus, potassium, calcium, magnesium, and various trace elements content in the soil. The condition of the native *I. noli-tangere* individuals is decidedly poorer; *I. capensis* exhibits greater height, more nodes and branches, produces more flowers and fruits, and also has longer and wider leaves. Seven environmental variables significantly influenced the observed variability: soil pH, phosphorus, calcium, and organic matter content, degree of shading, aphid infestation, and level of anthropogenic pressure. In our opinion, alien *Impatiens* much better tolerates unfavourable conditions, such as strong shading or aphid feeding.

Co-financed by the Minister of Science under the "Regional Excellence Initiative" Program for 2024-2027.

Keyword: invasive alien plants, morphological traits, environmental factors, natural populations

P69

THE STAND-LEVEL INFLUENCE OF WILD BOARS ON AN INVASIVE BAMBOO FOREST

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The moso bamboo (*Phyllostachys edulis*) is an invasive species in Japan that was introduced from China in the 18th century for its edible young bamboo shoots. Since the 1980s, the expansion of bamboo forests into the surrounding vegetation has increased because of the abandonment of bamboo forest management. Conversely, the population of wild boar (*Sus scrofa*) has been increasing in recent years; this may have affected the expansion of bamboo forests since the wild boar feed on bamboo shoots. Therefore, I aimed to clarify the effects of wild boars on the regeneration of bamboo culms in bamboo forests at the stand level.

The study was undertaken in Awaji Island, Hyogo Prefecture, western Japan. Three wild boar protection fences were set up in the bamboo forests. The numbers and sizes of bamboo culms that showed regrowth were recorded both inside the areas protected by the fence (unaffected by wild boars) and outside these areas (affected by boars).

The wild boars fed on the bamboo shoots from October to May. The number of regrowth bamboo shoots in each plot unaffected by wild boars was approximately 13/year/100 m², whereas that in each plot subjected to the influence of wild boars was approximately 2/year/100 m². The increase in the number of bamboo culms was

Posters – Abstracts – Tuesday 17 (session P2-C)

continuously suppressed by wild boar feeding. The effects of wild boar feeding on the bamboo culm size and species composition were also examined.

This study was supported by Kakenhi (22K05711)

Keyword: moso bamboo (*Phyllostachys edulis*), wild boar (*Sus scrofa*), wild boar protective fence, culm regeneration, expansion of abandoned bamboo forests, changes in secondary forest vegetation

P70

INVASIVE GRASSES CAN LEAD TO LEGACY EFFECTS THROUGH CHANGES IN BELOWGROUND COMMUNITY ★

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Invasive African grasses threaten plant communities and hinder ecological restoration in the Cerrado. Their aboveground impacts are well-described, but their belowground effects are less known. Thus, we investigated if the presence of an invasive African grass (*Urochloa decumbens*) affects Cerrado belowground communities, both functionally as the proportion of fine roots, and structurally as the abundance of different types of underground storage organs. Given native species rely on belowground organs for their persistence, changes in underground community structure reveal effect legacies of the invader. In Cerrado open savannas (Southeastern Brazil), we selected five invaded patches (minimum patch size = 10m) and paired each with an adjacent non-invaded patch as a control. In every patch, we collected aboveground biomass, fine roots and belowground organs. All material was processed and sorted in the laboratory. Buds were counted in the fresh material and roots and belowground organs were oven-dried and weighed, as well as the aboveground biomass. Our findings reveal that *Urochloa decumbens* shifted the belowground community from woody rhizomes and xylopodia of native species towards a dominance of its own fine roots and rhizomes. Fine root biomass was higher in the upper layers of the soil in invaded areas, indicating faster nutrient cycling. The density of bud banks in the invaded area decreased, pointing to loss of regeneration capacity. Our results suggest that invasion led to functionally and structurally different belowground communities, resulting in drastic changes in plant community dynamics and resilience, impacts that can persist as legacy effects after invader's removal.

Keyword: Belowground bud bank, Invasion, *Urochloa decumbens*, Cerrado

P71

WHERE CURRENT AND FUTURE ALIEN SPECIES MIGHT COME FROM? ★

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The introduction of alien species continues in an escalating trajectory worldwide. We addressed this issue by identifying where the currently established alien plant species came from and the intensity that donor regions can continue to donate alien species. To proceed, we identified the native ranges of present (recorded) and likely future invaders (ecologically suitable alien species currently absent—alien dark diversity) in 367 worldwide destinations. Then, we used bilateral trade volume between each donor and destination to define their human connections. We assigned a value of one for each present alien species and the ecological suitability indication for absent aliens. Those values were divided among all regions hosting these species as native (donors) proportionally to their bilateral trade. We then calculated each donor's cumulative sum of these values, representing its realized and unrealized donor capacities.

Our results show that the current most frequent worldwide donors can continue to lead the global scenario of alien species exchange in the future ($\rho = 0.76$, $p < 0.0001$). We revealed a large continuous area from Western Europe to Far West Asia that is and tends to remain a donor hotspot of alien species. For each destination, we identify a top-realized and a top-unrealized donor region, indicating that a few top regions extend their influence across multiple regions and into the future. Our outcomes broaden our ecological knowledge and can be used for conservation agencies to trace plans of route control ahead of time and try to avoid those likely events from happening.

Keyword: Biological invasion, donor regions, source regions, future invasion, dark diversity

P72

MONITORING NATIVE AND ALIEN SPECIES SPREAD TO ALPINE TUNDRA: BOTANICAL RESEARCH AND AIRBORNE TECHNOLOGY COMBINED TO ASSESS CONSERVATION RISK

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The highly specialized and vulnerable plant communities of the Arctic-Alpine tundra are preserved in the transboundary national parks of the Krkonoše/Karkonosze Mts in the Czech Republic and Poland. In this area, rare and original communities have evolved under different human impacts since the 16th century, and in the last decades, they have faced increasing pressure from global changes. Our research documented an increase in species from 196 to 270 over the previous 40 years. Monitoring the area surrounding roads and hiking trails above the treeline showed that thermophilous, nutrient-demanding, and shade-tolerant species have increased recently. Many increasing species are alien, apophyte or native expansive, spreading from lower altitudes and leeward sites with deeper soil. For our research project, "Monitoring the spread and management of invasive and expansive species using advanced Earth observation methods", we selected three alien (*Rumex alpinus*, *Lupinus polyphyllus*, and *Telekia speciosa*) and two native (*Veratrum lobelianum*, *Senecio nemorensis* agg.) species; all are strong competitors and dominants of new communities and threaten protected species and natural habitats. We aim to design and automate a technology for monitoring their spread and evaluate the effectiveness of different management practices (grazing, mowing, chemical treatment, mulching); to achieve this, we will combine botanical mapping and the UAV imagery classification. The early detection of undesirable species in poorly accessible mountain terrain that hosts many endemics, glacial relics, and rare protected species with a limited capacity for recovery is a crucial factor for effective conservation management.

Keyword: alien plant species, mountains, airborne technology, monitoring and management, botanical mapping

P73

UNRAVELLING THE EFFECTS OF GLOBAL CHANGE AND NATIVE COMMUNITY FUNCTIONAL STRUCTURE ON THE SPREAD OF NON-NATIVE SPECIES ALONG MOUNTAIN ROADS ★

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Mountain ecosystems have been generally considered to be relatively resistant to non-native plant invasion. However, climate warming, increased human modification, and global connectivity are amplifying the vulnerability of mountain ecosystems to biological invasion. Mountain roads are the major corridors for non-natives' dispersal along elevational gradients as well as propagules' reservoirs of non-native species coming from the surrounding lowland and warm regions. Here, following the road survey protocol of the Mountain Invasion REsearch Network (MIREN), we collected vegetations data close and far from roads in 60 sites evenly stratified by elevation along three mountain roads to jointly investigate abiotic and biotic drivers of plant invasion in mountain ecosystems. Using structural equation models, we unravel the relative effects of land-use and climate changes occurred over the last half century as well as of the functional characteristics of the invaders and the invaded communities in driving the occurrence and cover of non-native species along elevation mountain roads. Preliminary results suggest that land-use change is the strongest direct driver of plant invasion, especially in those sites where changes in land-use have occurred earlier in time and have deeply transformed the surrounding landscape into urban and agricultural areas, creating higher opportunities for non-natives to spread. Climate change favoured the expansion of non-natives at higher elevations but also influenced native communities by facilitating the upward shift of more competitive species, i.e. tall species with acquisitive leaves. This increase of competitive native species may, in turn, hamper community invasibility through mechanisms of limiting similarity and competitive exclusion.

Keyword: non-native species, Mountain roads, MIREN, climate change, land-use change, community invasibility, Functional traits

P74

METHODOLOGY AND KEY FINDINGS OF THE ALIEN AND INVASIVE PLANT INVENTORY: THE CASE OF LITHUANIA

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The results of the inventory of invasive and alien species across Lithuania (65,300 km², European hemiboreal zone) are presented. The inventory was carried out in 2019–2023. The project aimed to assess the status of invasive and alien species, estimate their population sizes, areas occupied and environmental threats, and produce distribution maps.

Two main field survey methods were used. During the survey of invasive alien species of Union Concern, each population was recorded and assessed. If the species covered less than 100 m², it was mapped as a point, while unmanned aerial vehicles were used to map larger areas. All other species were inventoried using a geo-referenced grid (5 × 5 km). It was mandatory to assess the target species population in at least one site per grid cell.

The Invasive and Alien Plants (INVA) GIS database includes information on 230 plant species. The dataset contains 84,596 georeferenced locations, including both point and polygon layers.

During the project, internationally significant data was collected on the status of invasive alien species of Union Concern in Lithuania. The main numbers are as follows: *Heracleum sosnowskyi* – 6,790 sites, covering 4,916 ha; *Impatiens glandulifera* – 946 sites, covering 518 ha; *Asclepias syriaca* – 32 sites, covering 2.6 ha; *Heracleum mantegazzianum* – 4 sites, covering 0.6 ha; *Celastrus orbiculatus* – 28 sites; *Elodea nuttallii* – 3 sites.

The distribution patterns of alien plants were studied by analysing the natural and human-induced characteristics of the environment, including urbanisation, land use characteristics, road and river networks.

Keyword: Mapping, Unmanned aerial vehicle, Hemiboreal

P75

THE IMPORTANCE OF LUPINUS POLYPHYLLUS FOR THE BIODIVERSITY AND PRODUCTIVITY OF GRASSLANDS

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The main topic of the presented project is *Lupinus polyphyllus* - an invasive species belonging to the legume family, which naturally grows on dry slopes and river banks of North America. In the nonnative range, lupine was grown for its ornamental value or as a plant for increasing soil fertility. Currently, it spreads spontaneously, mostly in mountain grasslands. In the presented research, I put the following hypotheses: 1) with the increase of *Lupinus polyphyllus* cover, the cover of grassland species decreases, but the grassland species richness remains constant; 2) the quality of hay from grasslands invaded by *Lupinus polyphyllus* is lower than in grasslands without invasive plant. The phytosociological analysis was done by using 334 releve. The analysis of hay quality was conducted in 30 locations representing grasslands invaded by *Lupinus polyphyllus* in the Sudetes Mountain (Poland). In each plot, phytosociological releve and grasslands biomass was collected. Vegetation analysis involves comparing biodiversity indicators (species richness, Shannon-Wiener index) for areas with different invasive species cover. The analysis of grassland biomass consists of modeling changes in the chemical composition of grassland biomass with varying amounts of lupine. The results of the conducted research allow us to determine the impact of *Lupinus polyphyllus* on grassland biodiversity and hay quality, thus allowing us to assess whether *Lupinus polyphyllus* poses a real threat to biodiversity and the economy.

Keyword: *Lupinus polyphyllus*, invasive plants, grasslands

P76

FINE-SCALE DOMINANCE OF INVASIVE HERBS DOES NOT ALTER LANDSCAPE-SCALE DIVERSITY PATTERNS OF SANDY OLD-FIELDS

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Invasive alien species can outcompete native plants through various mechanisms, thus decreasing fine-scale species diversity. However, it is still obscure how fine-scale effects scale up to the landscape level.

On grasslands and old-fields of sandy areas of Hungary, the most significant invasive herbs are *Asclepias syriaca*, *Solidago gigantea* and *S. canadensis*. In this study we examined how the fine-scale dominance of *Asclepias syriaca* and *Solidago* spp. influence the landscape-scale variation of alpha and beta diversity, both in terms of taxa and functional traits.

Pairs of uninvaded and invaded plots by *Asclepias* or *Solidago* were sampled and the cover of vascular species were recorded. We assembled mean trait values of plant height, seed mass and specific leaf area. We tested the difference in species richness and functional diversity indices between invaded and uninvaded plots for both invasive species. We calculated dissimilarity matrices among uninvaded plot, plots invaded by *Asclepias* and plots invaded by *Solidago*; then, we tested their relationships.

We found no difference in species richness and functional diversity between invaded and uninvaded plots. Dissimilarity matrices of plots invaded by *Asclepias* were less strongly correlated with the uninvaded pairs, than in the case of *Solidago*; however, pairs of plots with *Solidago* showed higher beta-diversity, too.

We conclude that landscape-scale effects of fine-scale invasions are notoriously difficult to sort out. Variation in local species pool due to environmental and historical factors often govern the biotic effects of invasive species in the studied system.

P77

URBAN NATIVE AND NON NATIVE PLANTS IN SEMINATURAL HABITATS: A TRAIT AND A RARITY PERSPECTIVE

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Several species groups and functionalities conform present urban biotas. It has been noticed that nonnative species are particularly present in cities, and urban settlements could be centers of nonnative biodiversity and stepping stones towards colonization of more natural areas. Nevertheless, cities shelter different habitat types, some conform novel ecosystems not found outside the city limits. However, some others are remnant natural habitat, as they remain less altered and more natural, surrounded by a human matrix. Native and non native species may respond differently according to these habitat types. Here, we present preliminary analyses to fulfill the following objectives: To study functional diversity among non native and native component of a seminatural area immersed in a urban matrix.

To explore the role of different urban habitats and species abundances (rare versus common plants) in the conformation of present urban composition of plants.

Preliminary results showed differences among the non native and native traits spectra in seminatural areas. The distribution of traits among non native are more spread along the PCA values. Native species are more located, indicating that some traits are more common in the native group, more specifically native species trend to be herbs of small size whereas non native species also are conformed by species of larger size and woody.

Eventually, we will be able to offer some guidelines about the urgent need to protect and restore these remnants of natural habitats inside cities.

Keyword: urban ecology, seminatural habitats, biodiversity conservation

Restoration, Conservation, and Vegetation Management

P78

WOODY ENCROACHMENT VIEWED THROUGH TRAIT INTEGRATION IN FOREST-GRASSLAND MOSAICS FROM SOUTHERN BRAZIL ★

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Changes in community structure and composition also indicate a shift in the functional strategies of plants in response to the environment. These strategies come from the degree of relationships among functional traits (i.e., phenotypic integration). Due to biotic and abiotic pressures, plants may integrate traits from different organs in positive or negative relationships. During woody plant encroachment (WPE), there is a change in community trait mean values as forests develop over open ecosystems. Such contrast could reflect distinctive levels of phenotypic integration between forests and grassland species along a WPE. We evaluated six traits from various organs in adult woody plants in two forest-grassland mosaics in Southern Brazil. In one of the mosaics, the WPE is well advanced in a subtropical rainforest; in the other, there is a shrubland. We built networks with traits as nodes and their correlation as edges to explore net properties as measures for phenotypic integration (i.e., edge density, diameter, mean path distance). We found that grasslands only present more trait integration than forests if WPE is not advanced. Once woody plants get established in open ecosystems, there is a site-specific change in trade-offs (i.e., direction and strength of negative correlations) and co-optimizations (i.e., direction and strength of positive correlations) of traits. Therefore, the shifts in the vegetation as WPE develops lead to shifts in trait integration; that is, plant traits get adjusted with abiotic factors, such as abundant light, different soil conditions, and occasional fires.

P79

ENDEMIC COMMUNITIES OF LILAC ALDER IN CARPATHIANS: CURRENT STATUS, PROSPECTS FOR CONSERVATION

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Lilac alder forests dominated by *Sirynga josikaea* L. (in the shrub layer) are endemic and relict in the Eastern Carpathians in Ukraine and Romania. These 1-3 ha forests occupy levelled terraces of mountain streams at an altitude of 350-800 m above sea level. Today, these terraces have been significantly transformed by human activity. In Ukraine, at the beginning of the last century, there were about 30 localities of Hungarian lilac forests (Fekete and Blattny, 1914), and by 2009, 16 localities were identified (Felbaba-Klushyna, 2005; Felbaba-Klushyna and Stoyko, 2009). In 2023, we found 8 localities. Over the 19 years of our observations, the area and floristic composition of these communities have changed significantly. These phytocoenoses are included in the Green Book of Ukraine (2009), and *Sirynga josikaea* is included in the Red Book of Ukraine. In Ukraine, 4 localities of Hungarian lilac alder have the status of "Natural Monument". However, the small size of the protected areas, their close proximity to populated areas and the almost complete lack of control over compliance with the protected regime threaten the complete disappearance of the studied communities. Given the powerful hydrological role of alder forests and their importance in the context of climate change, it is necessary to protect all riparian forest ecosystems, including Hungarian lilac forests, declare them objects of the highest conservation value and introduce monitoring of their condition.

Keyword: Vegetation dynamics, management, protection

P80

SEED GERMINATION OF TWO SANDY GRASSLAND *FESTUCA* SPECIES IN VARIOUS SOIL MIXTURES

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Exotic grass species are used for the establishment of urban green areas. This practice's side effect is that these grass species may escape into nature and become invasive species, endangering our natural grasslands. Therefore, we were looking for aesthetically-pleasing native grass species which could be suitable for urban environments. With this in mind, dominant grass species of a pasture near Kunpeszér were analyzed, and the *Festuca wagneri* was selected for further investigation. First, we investigated the germination of grass seeds in different soils in order to establish an efficient cultivation technology. Seeds from ten samples of *Festuca wagneri* were sown into six different substrates, namely: sand-peat mixture, sand, coconut coir, peat, coconut coir-sand mixture, native sandy soil. The results showed that the germination percentage was the lowest in the habitat sandy soil and the height of the seedlings was also the lowest, while the germination in the peat soil appeared to be the most effective. In summary, sowing on soil mixed with peat is recommended, however open sandy grassland species tolerate extreme conditions well. The research was supported by the OTKA K-125423, OTKA K-147342 grants and the MATE Research Excellence Program.

Keyword: fescue, sandy grassland, urban environment, germination, seed

P81

FOR PLANTS UNDER FIRE, IT'S ALL ABOUT SURVIVAL

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Grassland and savanna plants have life history strategies that work in concert with fire regimes. Plant populations persist because a combination of growth, survival, and reproductive rates keeps population numbers stable or increasing within the range of environmental conditions the plants experience. We studied populations of perennial grass species in pine savannas of the USA and Belize, modeling their population dynamics as well as those of the dominant canopy tree in Belizean savannas, Caribbean pine. Our results indicate that, under frequent fire regimes (1-4 years), the stability of these populations are driven primarily by adult survival. Grassland and savanna conservation and restoration are often concerned with plant reproduction. Re-establishing individuals is important where species have been eliminated, and seedlings are necessary for adult replacement in existing populations when adult mortality does occur. Where possible, however, conserving existing natural populations of grassland and savanna species and their genetic diversity should greatly support their persistence. In addition, management for regimes of frequent, heterogeneous fires should allow for the survival of individuals of all stages, including plant establishment.

Keyword: fire regime, savanna, demography, grass, pine

P82

RARE PHYTOCOENOFUND OF UKRAINE

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On the territory of Ukraine, a rich natural forest vegetation has been formed on an area of 9.6 million ha (15.9%). It is characterized by the presence of 53 rare vegetation associations, which belong to phytosociological 19 alliances 17 orders of the classes *Vaccinio-Piceetea*, *Erico-Pinetea*, *Roso pendulinae-Pinetea mugo*, *Carpino-Fagetea*, *Quercetea robori-petraeae*, *Quercetea pubescentis*, *Alnetea glutinosae*. The rarest communities belong to the associations *Cembro-Piceetum*, *Achnathero-Pinetum pithusae*, *Phleo-Juniperetum excelsae*, *Cisto-Arbutetum andrachnis*, *Paliuro-Pistacietum muticae*. Long-term exploitation of Ukrainian forests has led to radical changes in their biotic structure, which has affected the vegetation diversity, especially its rare component. Therefore, the problem of protecting rare forest communities has always been relevant for Ukraine. Rare forest communities are under protection in 45 protected areas of the highest categorical ranks, and they are included in the Green Data Book of Ukraine (2009). Today, along with traditional threats to rare forest biodiversity, the most dangerous and threatening is ongoing war - 832 thousand hectares of forests are in the combat zone. The most affected are the rare communities of *Pinus sylvestris* on the chalk and *Betula borysthenica*.

Keyword: forest vegetation, rare plant community, classification

P83

PECULIARITIES OF BRYOPHYTE COMMUNITIES OF THE UKRAINIAN PART EASTERN CARPATHIANS

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Epigeic bryophytes of the forest ecosystems and their communities are sensitive to changes in abiotic and biotic factors. The goal of our study was to find out the changes in the relationships of species in bryophyte communities depending on the degree of anthropogenic influence.

For sampling, eight transects were laid in the forest ecosystems of the *Carpino-Fagetea silvaticae* class with varying degrees of disturbance (in the zone of protected area, regulated recreation and felling). Within each transect, in homogeneous conditions, from 10 to 20 plots with an area of 1 m² are described. The species composition, frequency of occurrence, projective cover, ecobiomorphological structure and biomass of bryophytes were determined on each of the sites.

The following bryophyte communities were found in the protected zone: *Hylocomietea splendentis* class, *Eurhynchietum striati* association; *Pleurozietum schreberi* association; class *Cladonio digitatae* - *Lepidozietea reptantis*, association *Plagiothecietum cavifolii*. In the conditions of natural disturbances, unranked communities of *Dicranella heteromalla* were observed. In the recreation area, in addition to the *Eurhynchietum striati* association, representatives of the *Pogonato urnigeri-Atrichetum undulati* association. In the felling, the associations of the *Ceratodonto purpurei-Polytrichetea piliferi* class are common: *Racomitrio-Polytrichetum piliferi*.

Based on the analysis of frequency of occurrence, projective cover and biomass, the activity of bryophyte communities in the research area was determined. The activity of 31 species of bryophytes was determined, groups were distinguished: highly active (30–15%), medium active (15–5%), low active (5–1%), inactive (less than 1%).

Disruption of forest ecosystems causes an increase in the activity indicators of ruderal bryophytes.

Keyword: Bryophytes, mosses, liverworts, rare species, bioindication, ecosystems, Carpathians

P84

CHANGES IN DIVERSITY OF EUROPEAN AND NATIONAL IMPORTANT GRASSLAND VEGETATION IN SLOVAKIA

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Landuse changes dynamically over time, reflecting grassland vegetation's diversity, composition, and structure. The aim is to assess changes in European and national important grassland vegetation and recent state of the habitats using resampling of phytosociological relevés.

Resampling research was carried out during vegetation seasons in 2021–2023. Old relevés of alliances *Bromion*, *Arrhenatherion*, *Calthion* and *Violion* of 1998–2003 were obtained from Slovak Vegetation Database and authors' private databases. To each old relevé, we resampled new one with the same parameters (longitude, latitude, altitude, slope, exposition). Gradient analyses were performed in Canoco. DCA was applied to visualise similarity of vegetation types and to compare environmental conditions of individual syntaxa between old and new relevés. Differences among old and new relevés of four alliances and ecological indicator values (EIV) were tested using ANOVA and Tukey HSD (post-hoc) test with $p < 0.05$.

DCCA revealed that time significantly influenced species composition of all studied alliances. A statistical comparison of EIV revealed significant differences in light of *Bromion*, *Arrhenatherion*, and *Violion* and also in nutrients of *Bromion* and *Violion*, which resulted in higher representation of nutrient-demanding species in re-sampled relevés. Moreover, in *Violion* there is a clear shift from typical low stands to tall, broad-leaved but relatively thermophilous stands. Significant differences in temperature and humidity were observed in *Calthion*, resulting in slight decline of hygrophilous species. The largest relative change in species composition is in *Violion* (1.5% of variability), then *Arrhenatherion* (0.8%), *Calthion* (0.7%) and finally *Bromion* (0.5%).

Acknowledgements: This research was supported by VEGA 2/0132/21.

Keyword: diversity, functional traits, grasslands, resampling, Slovakia, species richness

P85

LONG-TERM IMPACT OF RESTORATION MANAGEMENT ON DRY GRASSLAND HABITATS

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The unique geographical location of the Devínska Kobyla Mt. (Slovakia) on the border of the Pannonian and West Carpathian biogeographical regions is reflected in species-rich steppe vegetation. Grazing with sheep and goats was regularly carried out there until the 1960s. The subsequent abandonment of any grassland management practices led to dramatic successional changes in grasslands. During the winter of 2015/2016, extensive management measures were implemented, focusing on removing shrubs and trees and restoring of goat grazing. Five permanent plots were established in 2014 and six in 2016 to assess the impact of management treatments. Gradient analysis and ecological indicator values were used to analyse and interpret vegetation changes. We assessed species diversity, representation of species traits, and the occurrence of target dry grassland species.

After the first two years following the removal of shrubs and trees, we have observed a notable increase in the abundance of heliophilous and thermophilous species, such as *Astragalus onobrychis*,

Posters – Abstracts – Thursday 19 (session P3-A)

Carex michelii, *Chamaecytisus austriacus*, *Jurinea mollis*, *Linum tenuifolium*, *Pulsatilla pratensis*. After 7–9 years following tree removal and subsequent goat grazing, the overall species diversity increased in favour of the target dry grassland species. Goat grazing has suppressed the growth of shrubs, and disturbance of the turf created suitable conditions for the existence of therophytes (*Kernera saxatilis*, *Alysum alyssoides*, *Cerastium pumilum*). In plots where *Pinus nigra* has been removed, species richness significantly increased in favour of target species (*Allium flavum*, *Crinitina linostris*, *Petrorhagia saxifraga*, *Sanguisorba minor*, *Seseli osseum*, *Thesium linophyllum*).

Contribution was supported by grant VEGA 02/0132/21.

Keyword: dry grasslands, grazing, management, restoration, species diversity, target species

P86

BOTANICAL CONSERVATION AND RESTORATION EFFORTS IN THE GOURITZ CLUSTER BIOSPHERE RESERVE

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The Gouritz Cluster Biosphere Reserve (GCBR) is testament to the intricate interplay between local ecological dynamics and global environmental changes. Spanning across large portions of the Southern and Western Cape, and Klein Karoo regions of South Africa, the GCBR is the only place in the world where three global biodiversity hotspots converge: Cape Floristic Region, Succulent Karoo, and Maputoland-Pondoland-Albany. In 2015, UNESCO designated the GCBR as a place of major biodiversity significance to the plant, thus creating South Africa's largest biosphere reserve, covering an impressive 31,879 km². The GCBR is characterised by high endemism of plant species, with at least 670 of the approximately 5 000 plant species being endemic to the Biosphere Reserve. Drawing on extensive research and data, supported by field surveys we implement and monitor targeted activities aimed at restoring threatened and degraded ecosystems and preserving the regions unique biodiversity. When unveiling the botanical treasures harboured within this Biosphere Reserve the global significance of the GCBR's vegetation diversity transcends local boundaries and highlights its vital contribution to broader environmental sustainability efforts on a global scale. Through this presentation, we aim to not only showcase the ecological marvels of the GCBR but also advocate for the imperative of integrated conservation strategies that harmonise local stewardship with global conservation goals.

Keyword: biosphere reserve, biodiversity hotspot, Conservation strategies, Global environmental sustainability

P87

GEOREFERENCING AND MAPPING “MONTE PALACE MADEIRA – TROPICAL GARDEN” BOTANICAL COLLECTION: FIRST RESULTS

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The “Monte Palace Madeira - Tropical Garden” owned by businessman José Manuel Rodrigues Berardo since 1987 and open to the public since October 5, 1991, is a late 19th-early 20th historical garden. It was first planned as a pleasure garden, “Quinta do Prazer”, later transformed into a hotel and finally to a private park with public use. The property is currently managed by the “Associação de Coleções”, comprising ca. 70,000m², the garden occupying ca. 60,000m². The garden's biological richness is vast, but, due to the successive stages in which it was formed, until now not fully assessed. Its inventory began in January 2023, focusing on the tree and shrub

specimens, an ongoing project led by GBM (Madeira Botanical Group). It encompasses the identification and detailed mapping of all specimens. The resulting information will then be included in a georeferenced database, along with taxonomic details and varied information about all species present.

We present the first results of this project. Until now, 8251 specimens were labeled and mapped. 287 herbarium specimens, corresponding to almost 150 taxa, were deposited in the UMad herbarium, some of which are endangered taxa. The garden's botanical diversity includes several critically endangered species, namely a cycads collection and the most important garden repository of the Madeira endemic Pittosporaceae, *Pittosporum coriaceum*. Its presence in the garden can be traced back to the 19th century.

A detailed map of all cycads is presented, as an example of the many map layouts which can be obtained from the georeferenced database.

Keyword: biosphere reserve, biodiversity hotspot, Conservation strategies, Global environmental sustainability

P88

CATTLE DUNG CONTRIBUTES RESTORE DEGRADED GRASSLANDS, BUT CAUTION ON INVASIVE SPECIES TRANSFER

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Endozoochory is one of the main strategies of species dispersal in grasslands under extensive grazing. We examine species dispersal by cattle dung and its potential to enrich degraded grasslands in Uruguay. A donor grassland was selected and characterized in terms of species composition and cover in late summer. Fecal samples were collected from 25 cattle depositions to evaluate: 1) species germination potential in a greenhouse, and 2) its uses for restoration in a field experiment. In the greenhouse, dung samples were placed in pots to evaluate seedling emergence. The restoration experiment consisted in two treatments (n=5) in a receptor site (i.e. tree invaded area with herbicide removal): control and sown with cattle dung. Seasonal surveys were carried out during two years. The soil seed bank of the receptor site was also assessed in a greenhouse. We identified 64 species in the donor grassland, of which 64% were in reproductive phase. In the greenhouse, 40 species and 2291 seedlings were registered in the cattle dung, representing 62% of the species transfer from the donor site. Among these, the invasive *Cynodon dactylon* was one of the most abundant. Sown communities were enriched by 127% in species number, and increased their similarity to the donor site (36% and 23% for sown and control plots, respectively). Although cattle could be a simple and inexpensive method of transferring species to degraded communities, it also represents a dispersal strategy for invasive species. This study highlights the importance of conserving grasslands as donor sites for restoration purposes.

Keyword: grasslands, endozoochory, seed dispersal

Posters – Abstracts – Thursday 19 (session P3-A)

P89

URBAN GRASSLANDS' PATCHES – ISLANDS IN THE CITYSCAPE

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Due to global changes, the city area is still growing, and the percentage of people living there is increasing. In the cities, the green areas, including urban grasslands, support biodiversity and provide various ecosystem services and functions. Urban grasslands need to be species-rich to fulfil the services and functions. Unfortunately, they are usually managed as species-poor, short-cut lawns, creating so-called novel ecosystems due to their 'unnatural' species composition. The spontaneous plant migration and soil-seed bank effect, which can increase their biodiversity, are limited. At the same time, seed mixtures typically used for urban grassland creation or renovation are usually species-poor and contain seeds of ornamental, ruderal species of different origins. Moreover, the urban environment, primarily because of high fragmentation and patch isolation, can lead to genetic drift and further reduce biodiversity.

Here, we present the results of our study on urban grassland vegetation performed in the city of Wrocław, southwestern Poland, Central Europe. Firstly, we examined the connectivity of urban grasslands and prioritized the grassland patches based on their role in urban landscape (cityscape) connectivity. Secondly, we investigated the cityscape's impact on the genetic diversity within- and among-population of *Trifolium pratense*, a common species found in urban grasslands worldwide. Lastly, we evaluated the effectiveness of adding seeds from different sources to create high-quality urban grasslands. We used ecological knowledge and methodology to equip urban planners with the necessary information to enhance ecosystem services provided by urban grasslands.

Keyword: Connectivity assessment, Plants genetic diversity, Isolation by distance and resistance, Pollinator-friendly seed mixtures, Flower meadows

P90

OLD-FIELDS RESTORATION IN URUGUAYAN GRASSLANDS: THE RESILIENCE OF THE NATIVE COMMUNITY ★

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Grasslands are severely threatened by agricultural and forestry expansion. The Eastern Uruguayan Plain is one of the most transformed areas by the advance of agriculture in the Río de la Plata Grasslands, despite their conservation importance. We analyze post-agricultural vegetation dynamics and restoration potential, using successional models and the conceptual framework of Alternative Stable States. Using satellite identification, we generated a spatial chronosequence of 67 old-fields with different ages of agricultural abandonment, in which we carried out phytosociological censuses. In 28 of them we collected soil samples for physico-chemical analysis. We used Non-Metric Multidimensional Scaling (NMDS) and similarity (ANOSIM) analyses to compare the reference grassland community with five age categories of old-fields. Regression analyses were performed between soil variables and the age of sites. The results indicated that from 8 years onwards, the community starts to present a composition of functional plant types similar to the reference grassland, showing its high resilience. However, the invasion of the exotic *Cynodon dactylon* determines a deviation to an alternative state of unlikely return. Soil organic carbon content increases throughout the chronosequence, with the highest rates of carbon accumulation found in the initial years. This is probably explained by the high cover of native perennial C4 species very early in the successional process. These results contribute to a better understanding of grassland restoration in agricultural landscapes and provide key information for understanding ecological thresholds and their incorporation in biodiversity management and conservation.

Keyword: Old-fields restoration, Grassland restoration, Alternative stable states, Spatial chronosequence, Carbon stock

Restoration, Conservation, and Vegetation Management

P91

IMPACT OF MOWING INTENSITY ON PLANT DIVERSITY OF CENTRAL EUROPEAN BROAD-LEAVED GRASSLANDS

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Central European grasslands have been historically shaped by traditional management practices that established a fragile equilibrium, resulting in high species richness, diversity of rare species, and numerous ecosystem services. Socioeconomic changes since the 1950s led to a shift of management practices from traditional ones to those motivated by nature conservation to prevent biodiversity losses. A popular approach to support all facets of the grassland ecosystem is extensive and irregular mowing.

Our study aims to assess the effects of mowing intensity on broad-leaved grasslands in Central Europe (*Cirsio-Brachypodium pinnati*). We sampled 98 vegetation plots at 53 sites of South Moravia in May–June 2023. We compared at-site estimated community properties, ecological indicator values, and representation of specific species groups under different mowing regimes: abandonment, irregular mowing, and regular mowing. Abandoned sites differed by a significant accumulation of dry biomass (litter), enhancing the encroachment of woody species, and decrease in species richness, diversity indices, and abundance of rare species. The number of specialised species of target habitats decreased, while an abundance of generalist and expansive species increased with abandonment. Sites with irregular or low-intensity mosaic mowing resembled the same trend as abandoned sites, only to a lesser extent.

We conclude that extensive and irregular mowing, which often results from mosaic mowing, is insufficient for preventing changes in grassland communities and maintaining their diversity in Central European broad-leaved grasslands. We call for further research on mowing intensity that would consider other taxonomic groups to seek compromised solutions supporting all facets of the grassland ecosystem.

Keyword: conservation, grassland, management, mowing, species richness

P92

ANTHROPOGENIC CHANGES IN THE VEGETATION OF ERMAKIV ISLAND (DANUBE DELTA, UKRAINE)

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Ermakiv Island (area 2300 hectares) is a part of the Danube Biosphere Reserve and is located in the Kilian arm of the Danube Delta. Until the 60s of the last century, the vegetation has been affected by local changes caused by hay harvesting and cattle grazing. In the 1960s, the island was completely dammed to grow *Phragmites australis* on an industrial scale. The vegetation of the newly formed habitats was characterized by low productivity, therefore the harvesting of *Phragmites australis* was suspended. Until 2009, the territory was intensively used for year-round cattle and horse keeping. In 2009, at the initiative of the WWF, holes were made in the dams, in several places to restore the original vegetation.

The change which occurred as a result of the undamming of the island, led to catastrophic and subsequent succession of vegetation cover. Catastrophic areas occupied 30–40% of the areas and strongly affected the communities of tree, swamp, and halophytic vegetation. Consecutive changes did not lead to the restoration of the original vegetation after undamming due to the siltation of the island's

hydrological network and the presence of more than 90% of dams. In addition, the vegetation of the island was strongly affected by the introduction of wild ungulates, according to the program of rewilding works. As a result of overpopulation, the grass and shrub vegetation has been completely changed. It is proposed to complete the gradual undamming of the island, restoration of the intra-island water network, and optimization of the number of ungulates.

Keyword: anthropogenic changes, protected area, restoration, Ukraine

P93

FOREST UNDERSTOREY ON THE EDGE: UNRAVELING DIVERSITY DRIVERS IN MESIC-OAK FORESTS

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Forest fragmentation is widely recognized as one of the main causes of the current biodiversity crisis, often resulting in a loss of forest diversity. There are different mechanisms underlying this biological decline, mostly linked to the edge effect, which involves outcomes such as alteration of microclimatic conditions and biological invasions. Since a high percentage of the world's forest areas lies near of a forest edge, it is crucial to deepen our understanding of how edge affects forest diversity.

Our study aims to understand how forest edge affects the microclimate and the herb layer composition in mesic-oak forests at their southwestern European limit. Our main objectives are to describe the microecological and plant community changes along the forest edge-interior gradient and to unravel the factors driving alpha and beta diversity in fragmented temperate deciduous forests. We selected three island forests in the subcantabric region of the Basque Country (northern Spain) and laid six NW-SE oriented 100 m long transects from the edge to the interior of the forest in each of them. Along each transect, we placed six 10 m² plots with loggers to gather temperature and humidity data, and sampled the herb layer composition and abundance, using the shoot presence method. We calculated the generalist and specialist species richness, evaluated the efficiency of Ellenberg-type indicator values, and modeled the herb layer alpha and beta diversity and the proportion of specialist species based on the distance from the edge and the microclimatic data.

Keyword: conservation, grassland, management, mowing, species richness

P94

SYMPHONY OF THE FOREST - VEGETATION, BAT ACTIVITY AND ACOUSTIC DIVERSITY

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This study delves into the intricate relationship between vegetation diversity and structure and bat activity in human-managed forest ecosystems. By unraveling these complex dynamics, we gain invaluable insights that can inform innovative strategies for forest management and the conservation of biodiversity.

Methods: In our research, we employed passive acoustic sampling techniques using Audiomoth recorders to monitor bat activity. We selected a total of 17 locations in both coniferous and deciduous forest stands located in the western region of Slovakia. During our monitoring, we collected data on various ecological parameters, including vegetation diversity, canopy cover, coverage of different vegetation layers, occurrence of deciduous trees, volume of deadwood, and tree age. To further analyze our findings, we calculated acoustic indices for the entire frequency spectrum as well as specific frequencies utilized by bats.

Results: Our research has provided evidence that microhabitat parameters have distinct impacts on individual bat species as well as bat groups. Especially vegetation diversity has had a positive impact on the bat activity. Similarly, older forest stands obviously attract Lesser noctule and Serotine bat. This observation aligns

Posters – Abstracts – Thursday 19 (session P3-B)

with the ecological strategies and adaptations exhibited by these species. Preliminary findings suggest that the acoustic diversity index with edited frequency spectrum has the potential to identify areas with significant bat activity. Also, we found relationship between this index and tree density, the cover of deciduous trees and feeding behavior of bats. Based on our results, the acoustic diversity index can be used for additional evaluation of overall ecosystem quality.

Keyword: acoustic niche usage, Biodiversity, vegetation, Monitoring, Soundscape, trait-based ecology

P95

NATURAL REGENERATION ENHANCES ECOSYSTEM MULTIFUNCTIONALITY, BUT SPECIES ADDITION INCREASES IT DURING RESTORATION

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As trait-based restoration practices continue to gain momentum, there is still an absence of effective methods to monitor ongoing restoration and, if necessary, modify its species composition to achieve multiple restoration targets. In this study, we demonstrate how adding species to ongoing restoration and explore distinct strategies considering three important aspects: (1) in a restoration landscape, different techniques and restoration campaigns are often conducted at different times, creating a heterogeneous landscape, with different levels of multiple ecosystem services (multifunctionality); (2) adding new species may be necessary to achieve restoration goals, but this must consider established species; and (3) species addition can be done in different stages of the restoration process. Using data from a 40-year ongoing quarry restoration in Portugal, we evaluated current levels of multifunctionality and how to recover or increase drought resistance, fire resistance, pollination, seed dispersal, and vegetation structure. We found that current multifunctionality is very heterogeneous across restoration sites within the restoration landscape. Natural regeneration is the main responsible for the current levels of multifunctionality, but we demonstrate it can be considerably increased by trait-based selection of new species and individuals into established plant communities. Furthermore, we show that enhanced levels of multifunctionality can be achieved in future restoration sites by using optimized species combinations. Our study provides important insights into the adaptive management of trait-based restoration and provides a framework to achieve multiple restoration objectives in ongoing restoration. We expect that the aspects highlighted here help make trait-based approaches more appealing to restoration practice.

Keyword: trait-based restoration, species selection, restoration monitoring, adaptive management, functional ecology, ongoing restoration

P96

BETA-DIVERSITY PATTERNS BETWEEN ADULTS AND JUVENILES REVEAL THE TRAJECTORY OF FOREST EXPANSION

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Forest expansion over grasslands is widespread in the South Brazilian grasslands (SBG). Here, we investigated the trajectory of forest expansion assessing beta-diversity patterns between adults and juveniles of woody communities in SBG. We used adult data from 628 100-m² plots (woody individuals with DBH>5-cm), and juvenile data from 385 16-m² plots (DBH<5-cm, height=30-130-cm). The plots

were placed inside blocks comprising forest and grasslands in 11 sites in south Brazil. We calculated β -diversity and its turnover and nestedness components (β_{turn} and β_{nest} , respectively) considering pairwise comparisons between plots inside the same blocks, but in different habitats (forest and grassland) or storeys (juvenile and adults). We assessed the effects of habitat and storey on β -diversity. Turnover was higher than nestedness for all comparisons ($\beta_{turn} = 0.582 \pm 0.004$, $\beta_{nest} = 0.216 \pm 0.003$, pseudo-R²=0.263). Total β -diversity was lower between both storeys in grassland (0.689 ± 0.006), and between adults of forest and grassland (0.689 ± 0.006) than between any other pairwise comparison (pseudo-R²=0.390). The same was also observed for β_{turn} (respectively 0.550 ± 0.008 and 0.510 ± 0.011 ; pseudo-R²=0.028). The presence of shared species between forest and grassland adults may be explained by the presence of generalists, which invaded the grassland in the past. However, juveniles and adults of grassland presented the highest number of shared species, indicating that part of the grassland specialist woody species still dominate and recolonize this habitat. This could be explained by maintained disturbance regimes, which needs to be evaluated in future studies.

Keyword: Woody encroachment, Forest-grassland ecotones, Beta-diversity, Alternative Stable States

P97

UNVEILING ABOVE- AND BELOW-GROUND ECOLOGICAL STRATEGIES UNDERLYING WOODY PLANT ENCROACHMENT IN GRASSLANDS ★

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Forests and grasslands often occur side by side in the landscape, forming a complex mosaic system with contrasting environmental conditions, maintained by different fire-vegetation feedbacks. Woody species that occur along this sharp gradient are challenged to efficiently coordinate the functioning of above- and below-ground dimensions. Here we evaluate how structural changes in vegetation are associated with shifts in community-level patterns and ecological strategies of woody species, during woody plant encroachment (WPE). We surveyed 60 permanent plots in forest-grassland mosaics at two different times (2012-2022) and used an integrated functional approach to assess the different dimensions of plant variation, including above- and below-ground traits. We found that the density of woody individuals increased in the encroached grassland after 10 years, and which structure became similar to a young forest. Interestingly, we found a clear trade-off between above- and below-ground traits among woody species. On the one hand, the species occurring in grassland had conservative leaves, thick bark, and acquisitive roots. On the other hand, forest species were usually taller and had acquisitive leaves, thin bark, and conservative root traits, suggesting an outsourcing strategy to acquire resources in nutrient-rich soils. We advanced the current understanding of WPE by showing the acquisitive vs conservative continuum of strategies runs in opposing ways from forest to grassland above and below ground, with a negative covariance between both dimensions. Our integrative trait-based approach was helpful in better understanding and managing forest-grassland mosaics in southern Brazil and analogous patchy ecosystems around the world.

Keyword: above-ground trait, below-ground trait, forest-grassland mosaics, functional coordination, functional trade-off

P98

A COMPLEX INTERPLAY SHAPES PLANT DIVERSITY PATTERNS IN MEDITERRANEAN COASTAL DUNES

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A long history of human colonisation has profoundly altered coastal plant communities of Mediterranean coastal dunes, as well as their capacity of providing ecosystem services. Analysing the drivers of plant diversity loss is thus crucial for preserving Mediterranean coastal ecosystems.

Using 20 cm resolution orthophotos, we mapped a wide Mediterranean coastal landscape and obtained a set of variables describing the distribution, abundance and size of natural (coastal dune habitats) and anthropogenic (urban areas and tourism facilities) patches. From the orthophotos, we also quantified the shoreline dynamism (coastal erosion and accretion) occurred in the area over a 10-year period. We then analysed how plant species richness, as well as the proportion of typical and ruderal plant species, related to the landscape variables and shoreline dynamism. Also, using piecewise structural equation modelling, we investigated the complex interplay between landscape variables and shoreline dynamism in shaping coastal plant diversity patterns.

The study found no negative impact of anthropogenic activities on coastal vegetation plant species richness. However, disturbances favour ruderal plant species, while typical foredune species decrease. This indicates that (i) focusing on species richness may underestimate the impact of anthropogenic activities on coastal dune vegetation; (ii) human-related activities change the composition of dune vegetation, eventually promoting the establishment of ruderal species, which cannot support the functioning of coastal ecosystems and the provisioning of the related ecosystem services. Finally, structural equation models results highlighted that coastal erosion is an indirect driver of plant diversity loss, through its influence on the coastal landscape configuration.

Keyword: aerial orthophotos, coastal erosion, coastal tourism, dune vegetation, habitat types, land cover map, remote sensing, species guilds, typical species

P99

PLOUGHING LEGACY IN TRADITIONAL CARPATHIAN GRASSLANDS

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Long-term crop cultivation can strongly affect semi-natural grasslands, potentially resulting in drop of biodiversity, especially during the early successional phases, a change of soil properties, microclimate, etc. However, the degree and scale of this effect may vary depending on many factors, such as land-use patterns. In this study,

we focus on the legacy effect of ploughing on species-rich mountain grasslands in Poienile de sub Munte (Maramureş, Romania). We sampled 56 grassland parcels in the studied village. For each plot, we obtained detailed information from farmers regarding recent and historical management practices, i.e. the year of last ploughing, ploughing continuity and last cultivated crop. Overall, never-ploughed permanent grasslands were the richest in species numbers of all (max. 83) and vascular plants (69), as well as bryophytes (14), while the mean values of species were consistently higher or similar to those found in fallows. There was no significant correlation between ploughing impact and the richness of vascular plant and bryophyte species. Species composition was not affected by ploughing; in contrast, it was best explained by mowing frequency, grazing intensity and soil parameters (calcium and phosphorus content, and pH). To promote faster grassland recovery, farmers usually planted alfa-alfa as the last crop, maintained traditional mowing schedules, applied hayseed, farmyard dung and ash. Our study could help to better understand the impact of traditional grassland management on vegetation, as well as the grassland recovery and restoration process. Financial support: APVV-0226, VEGA 02/0065/23, 09103-03-V01-00018.

Keyword: Grassland management, Ploughing, Manuring, Mowing, Plant diversity, Traditional agriculture

P100

DROUGHT MITIGATION STRATEGIES TO PROMOTE SUSTAINABLE LIVESTOCK PRODUCTION IN THE GRASSLAND AND SAVANNA BIOMES IN SOUTH AFRICA

Andiswa Finca (South Africa)¹; Julius Tjelele (South Africa)¹; Igshaan Samuels (South Africa)¹; Clement Cupido (South Africa)¹; Ngoako Letsoalo (South Africa)¹; Thantaswa Zondani (South Africa)¹; Khululiwe Ntombela (South Africa)¹; Gilbert Pule (South Africa)¹; Jodene Forster (South Africa)¹

1 - Agricultural Research Council

South Africa, has recently faced consecutive years of severe drought conditions, which strained natural resources, livestock, and the livelihoods of farmers. Amidst these extended drought episodes, certain farmers exhibited greater resilience and ability to mitigate drought impacts and apply restorative measures than their peers. Therefore, this study's aim was to capture the wisdom underlying their successful mitigation strategies, with the intention to disseminate this knowledge to fellow farmers contending with similar challenges. To achieve this, a total of 60 champion farmers representing a spectrum of livestock farming enterprises and varied production systems within the savanna and grasslands biomes were selected using a purposive sampling technique. The selection criteria which was derived in workshops held with government officials, researchers and agricultural organizations was based on farmer's knowledge, skill and experience to overcome farming challenges and remain resilient. The study employed semi-structured questionnaires with open-ended questions, including demographics, effects of drought on rangeland productivity and livestock, strategies to counter drought-related challenges and restoration techniques applied after drought. The findings highlighted commonalities in coping strategies adopted by farmers across the two biomes. These strategies encompassed destocking, diversification of income streams, and vigilant veld inspection, underscoring farmers' proactive stance in confronting the adversities of drought. Moreover, to counter the effects of drought on rangeland degradation, the farmers applied restoration techniques such as rotational resting, reseeding, contouring and continuous clearing of invasive plants. By integrating the lessons learned from these resilient farmers, the efficacy of drought mitigation within the livestock sector could be enhanced.

Keyword: Drought, Rangeland

P101

MONITORING THE HEALTH OF GLOBAL FOREST ECOSYSTEMS ★

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Forests are essential natural components, giving habitat and protection to a substantial part of the world's biodiversity and providing countless benefits to humans. However, they are progressively threatened by direct and indirect pressures from anthropogenic activities, such as land conversion, unsustainable forest management and human-induced climate change. Together, these stressors negatively affect the structural and functional components of forest ecosystems and compromise forests' long-term health and resilience. Given the worldwide importance of these systems, an understanding of the current health status of forests globally is crucial, along with the development of novel approaches capable of identifying the transition to unhealthy forest systems. Here, based on a global ground-sourced database, we analysed biomass and abundance of tree species through the abundance-biomass comparisons (ABCs), to monitor the current health status of forest ecosystems. Moreover, we employed a machine learning algorithm (Random Forest), to assess the importance of different environmental and anthropogenic variables for forest ecosystems' health. Our findings highlight the ability of the ABCs method to detect the effects of human-induced environmental stress. This study addresses the need for monitoring changes in forest health at different scales to guide new conservation strategies aimed at increasing forest resilience.

Keyword: Forest, ecosystem health, biomass

P102

UNRAVELLING THE BIASES: A SARDINIAN PERSPECTIVE ON TAXONOMIC, SPATIAL, AND TEMPORAL BIASES IN VASCULAR PLANT BIODIVERSITY DATA FROM GBIF

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¹ - University of Sassari; ² - Czech University of Life Sciences

Despite rapidly expanding on a worldwide basis, biodiversity repositories may have inherent biases. Accounting for such biases is a critical step towards increasing the accuracy and utility of these key resources for biodiversity research and conservation initiatives.

In this study, we used plant occurrence records from the Global Biodiversity Information Facility (GBIF) to quantify the bias associated with vascular plant biodiversity data from Sardinia (Italy), a Mediterranean hotspot of biodiversity. We considered three dimensions of bias, taxonomic, temporal, and spatial. We used Pielou's evenness to estimate the taxonomic and temporal bias and the Nearest Neighbor Index (NNI) to estimate the spatial bias. We estimated the relationship between the biases and several environmental predictors such as road density, standard deviation of Normalised Difference Vegetation Index (NDVI), and mean roughness. The contribution of each data source within GBIF (namely Wikiplantbase, PlantNet, and iNaturalist) was also assessed alongside the environmental predictors.

The facets of biases varied throughout Sardinia, as did the different roles played by environmental predictors in determining biases. Plant occurrence records in GBIF were mainly dominated by spatial and temporal bias, and to a lesser degree taxonomic bias. Road density explained the variance of taxonomic and temporal bias, NDVI explained the variance of taxonomic bias, mean roughness explained all types of bias. The dominance of PlantNet occurrences records increased temporal bias and decreased the spatial one. Our methodology may help in directing the sampling effort to have a more comprehensive plant biodiversity databases at both local (Sardinia) and global scales.

Keyword: biodiversity database, citizen science, sampling effort, biases

Restoration, Conservation, and Vegetation Management

P103

THE PLANT AND SOIL LINKAGE DURING VEGETATION RESTORATION AT DUMP SITES OF OPEN-PIT MINE IN AN ALPINE REGION IN INNER MONGOLIA

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There were large-scale open-pit coal mines, whose ecological restoration lag in Inner Mongolia. The biodiversity and productivity of grassland ecosystem were sharply decline by the damage of mining. Ecological quadrat survey was used to investigate the plant community in four plots including different restoration periods after vegetation restoration at dump sites and one natural site as a control. The indexes of plant species composition, abundance, height and coverage were recorded. Both biodiversity index, biomass, nutrient concentrations, soil properties such as soil carbon fractions and soil fungi communities were analyzed. The results showed that following restoration, the total species number, diversity index, biomass, particulate organic matter, mineral-associated organic matter, and soil microbial biomass carbon were significantly increased over the years. Total species number increased from 16 to 31 in the four-year period after restoration. This was due to the increase in non-planted species, which increased from 6 to 19. Especially the species number significantly increased on the second year, then remained stable on third and fourth year. Compared the nutrient (N, P and K) uptake among dominated species, the results showed that there were higher nutrient contents of nitrogen in legumes and composite than in herbaceous plant. However, the fungi diversity of *Elymus dahuricus* was significantly higher than that of other plant species, while the fungi richness and diversity of *Melilotus officinalis* communities were lower. Therefore, it is suggested vegetation restoration should consider the plant and soil linkage for the species selection in such alpine regions.

Keyword: Biodiversity; Open-pit coal mine; Recovery year; Vegetation restoration

P104

PREDICTING SEED DISPERSAL BY WIND TO SUPPORT NATURAL REGENERATION IN PINE AND LARCH STANDS

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Uncertainty in seed dispersal of desired species poses a potential risk to natural regeneration. Can a seed dispersal model be applied to natural regeneration planning by predicting seed dispersal? This study aimed to test the accuracy of a seed dispersal model under natural regeneration practices in pine and larch stands in South Korea. Seed dispersal was predicted at a fine scale using the WIND-IPER model, incorporating wind distribution, topography, seed properties, and seed tree distribution as input variables. Seed dispersal was monitored using seed traps, which were checked twice during each of two seed dispersal seasons. Finally, predicted and observed values of seed inflow in each seed trap were compared. Overall, intra-stand spatial variability showed reasonable agreement between the predicted and observed values of seed inflow. However, observed values were 3–4 times greater than predicted, likely due to the inherent inter-annual variability of seed production. If seed production could be accurately estimated and incorporated into the seed dispersal model, predictions would be improved. The strip-cut stand had twice the seed inflow of the reserve-patch stand, consistent with the density of seed trees in each stand. This study validates the applicability of the seed dispersal model under natural regeneration management and suggests an improved algorithm for seed dispersal that accounts for the effects of aggregated, inhomogeneous canopy structures on wind-driven seed dispersal.

Keyword: larch, pinus, reserve-patch, seed trap, strip-cut

P105

DIFFERENCES IN VERTICAL PATTERNS OF UNGULATE BROWSING AMONG FUNCTIONAL GROUPS OF TREES

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We don't know how the vertical pattern of browsing in natural conditions affects the ability of a young tree to increase in height and escape the browsing. Our main objective was to test the hypotheses: tree functional groups differ 1. in total browsing pressure; 2. more upon the top part of the crown than in total browsing pressure was not. On the basis of measurements of over 2800 saplings collected in tree stands ranging from dense forests to large canopy gaps, we investigated the vertical distribution of browsed shoots in six tree species arranged into three functional groups; evergreen trees with monopodial branching pattern (EM), deciduous trees with monopodial (DM) or sympodial (DS) branching pattern. Trees with lower numbers of lateral shoots (DM group) are strongly limited by browsing in the upper part of their crown because of their low ability to compensate for the losses. The other groups (DS, EM), combining relatively high shade tolerance with the ability to develop many lateral shoots are less constrained by browsing pressure and retain the ability to increase in height. Without the presence of large-scale disturbances these species can dominate the next generation of forest trees.

Keyword: herbivores, forest dynamics, natural regeneration, sapling architecture, tree species composition

P106

MY WILDFLOWER GARDEN – A PROJECT TO SUPPORT NATIVE PLANT SPECIES IN RESIDENTIAL AREAS

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Among the factors threatening global biodiversity, the spread of invasive species ranks second after habitat loss. Some species prone to invasion are very popular among urban residents due to their decorative value, and are often planted in gardens and parks. Most people are not aware of the dangers of non-native ornamental plants. Our aim was to draw attention to the importance of local biodiversity and to offer an alternative to decorate green spaces. We have made the seeds of 24 native wildflower species of the Hungarian flora available to the wide public free of charge. From these, the seeds of 5 selected species could be obtained in exchange for filling out a questionnaire. Our goal with the questionnaire was to understand the reasons for choosing ornamental plant species, people's attitudes towards nature-friendly solutions as well as to gain insight into the condition of Hungarian private gardens from a nature conservation viewpoint. More than 5,500 people joined our project. 95% of respondents would replace at least some of their current ornamental plants with native flowering plants if their seeds were readily available. According to our results, flower colour is an important aspect, the purple-pink shades being the most popular, as well as the familiarity and emotional attachment to some of the species, e.g., because of childhood memories. Our ultimate goal is the development of a generally applicable seed mixture in which the species found are most widely preferred by people and can successfully establish and persist in the urban environment.

Keyword: urban biodiversity, invasive species, questionnaire, wildflower

P107

HOW MANAGEMENT PRACTICES SHAPE GRASSLAND PLANT DIVERSITY IN THE SLOVAK BORDERLAND

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Semi-natural grasslands, shaped by long-lasting low-intensity human land-use, undergo dynamic changes over time, influenced by agricultural intensification, grassland abandonment, and regional socio-economic situation. We studied grasslands both within and outside Slovakia, situated in four mountain ranges divided by state borders (White Carpathians: SK-CZ, Devín Carpathians: SK-AT, Slovak Karst/Aggtelek Mts: SK-HU, Poloniny Mts: SK-UA). Each country has implemented unique land-use policies, influenced by socio-economic factors and property rights. Between 2018 and 2021, we collected vegetation, environmental, and land use data in four Slovak villages. We then compared this data with equally gathered information from neighbouring villages located abroad but within the same mountain range. These paired grassland sites served as model locations for studying the impact of diverse land-use strategies on grassland diversity and habitat status within similar environmental conditions.

Differences in plant species richness between Slovak and non-Slovak sites were assessed by t-test, while differences in species composition were evaluated using direct gradient analysis (RDA, CCA). Additionally, we examined differences in the representation of functional groups (woody species, graminoids, other herbs, rare species), which were significant for the SK-AT and SK-HU pairs. In the SK-CZ pair, significant differences were observed in Shannon Wiener diversity and Pielou evenness. Direct gradient analyses revealed that major factors influencing the variability of grasslands in the studied pairs of villages were humus and calcium content (SK-CZ, SK-HU), type of ownership (SK-AT, SK-HU), mulching (SK-AT) and ploughing (SK-UA). We interpret these results within the context of applied management practices and local habitat conditions. Funding: APVV-21-0226.

Keyword: vascular plants, cryptogams, diversity, Carpathian Mts, species richness

P108

DEMUTATION OF VEGETATION ON INDUSTRIAL SITES OF SUGAR MILLS

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The first sugar mills in Ukraine appeared at the beginning of the nineteenth century. On the territory of such industrial facilities, there are various areas that differ in substrate and anthropogenic influence on vegetation, which is due to technological processes. In order to analyze the demutation processes, a study of the change in plant cover was carried out at the disappeared, recently stopped (up to 10 years) and working sugar factories. During the study of restoration successions on the industrial sites of operating and closed sugar factories, a complex of plant communities was established, which are characteristic of different types of industrial landscapes

at different phases of demutation. Thus, at the operating sugar mills, the ruderal vegetation of annual and biennial species *Papaveretea rhoeadis*, *Chenopodietea*, *Digitario sanguinalis-Eragrostietea minoris*, *Sisymbrietea*, trampled *Polygono arenastri-Poëtea annuae*, and perennials *Artemisietea vulgaris*, *Epilobietea angustifolii*, *Robinietea* are formed. There is almost no vegetation of annuals on inactive plants, only ruderal communities of classes: *Artemisietea vulgaris*, *Robinietea*, and class *Epilobietea angustifolii*. Hygrophilous vegetation of the class *Phragmito-Magno-Caricetea* is formed on the territories of non-working pulp pits (places for the collection of pressed beet residues) and sedimentation tanks. Meadow *Molinio - Arrhenatheretea*, meadow-steppe *Festuco-Brometea*, shrub *Crataego - Prunetea* and Oak-hornbeam forests *Carpino-Fagetetea* were formed on plants that have not worked for more than 70 years. Thus, after a long time on industrial sites (more than 100 years), vegetation close to natural can be restored.

Keyword: restoration successions, anthropogenic impact, ruderal communities, biodiversity of urban areas

P109

DIFFERENCES IN FUNCTIONAL DIVERSITY BETWEEN RECENT AND ANCIENT FORESTS

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Ancient forests are defined by the absence of any agricultural land use since a given reference time. The definition does not imply the absence of management. Thus, in Europe they usually cannot be considered as old-grow due to Europe's very long history of land use changes and forestry. Conversely, recent forests developed after this reference date.

In this study we analyse how understory plant communities and their traits respond to forest succession. Our objective is to identify functional traits linked to forest continuity and maturity. For that we performed floristic inventories in 57 forests (21 recent and 36 ancient) located within 4 Spanish National Parks. Past and current orthophotos were used to ensure forest continuity since 1956.

Differences in the Community Weighting Mean of 6 functional traits (SLA, plant height, seed dry weight, biotype, seed dispersal distance and seed dispersal type), as well as disturbance indicators between ancient and recent forests were analyzed.

Plant height, presence of phanerophytes, higher seed weight and zoochore dispersal arise as indicators of recent forest, while the presence of chamaephytes and hemicryptophytes, and lower seed weight are indicators of ancient ones.

Our results may provide useful information for forest management in National Parks.

Keyword: Forest management, functional traits, ancient forest

Posters – Abstracts – Thursday 19 (session P3-C)

P110

ECOLOGICAL CONDITION MAPPING IN SOUTH AFRICA – THE SBAPP PROJECT ★

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Assessing and mapping the ecological condition of vegetation is difficult because of the unique structure, function and composition of each ecosystem and the challenges associated with detecting changes therein at broad scales. This is particularly challenging in a resource-constrained country such as South Africa. Land cover products may be able to detect contractions in the distributions of ecosystems resulting from major pressures such as urban development and agriculture. However, no single product exists to assess the true state of ecological condition to help prioritise conservation planning. With rapid advances in computing and remote sensing technology, we may now be able to detect the subtler manifestations of environmental degradation and disruption to biotic processes at the biome-level. This is the aim of the Ecological Condition Mapping component of the Spatial Biodiversity Assessment Planning and Prioritisation (SBAPP) project undertaken by the South African National Biodiversity Institute. We outline an approach guided by the IUCN Red List of Ecosystems which assesses changes in ecological condition using key indicators selected for each biome. To prioritise which aspects of ecological condition are mapped, key pressures known to disrupt ecological structure, function or composition, and thus used as proxies for ecological condition, were identified for each biome. Of these key pressures, disruption of grazing and fire regimes, bush encroachment and invasive alien woody species were ranked as the highest impact pressures in most biomes in South Africa. We highlight the benefits of adopting such an approach and the importance of expert knowledge in interpreting ecological condition.

Keyword: vegetation change, ecological condition assessments, ecological condition mapping, remote sensing, IUCN Red List of Ecosystems, grazing regime disruption, fire regime disruption, bush encroachment, climate change

P111

TOWARDS REWILDING: ESTIMATING A RESTORATION POTENTIAL INDEX FOR IBERIAN EUCALYPTUS PLANTATIONS ★

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1 - CIBIO-INBIO; 2 - Universidade de Vigo

Eucalyptus cultivation is a widespread forestry practice across Europe and especially in the Iberian Peninsula. The high productivity and relatively low maintenance of eucalyptus, together with high demand from the pulpwood industry, make it a very profitable practice for small land owners. However, the decentralized and intensive production of eucalyptus in Iberia has been consistently associated with negative impacts on biodiversity, soil composition and water resources. Many of the negative impacts of eucalyptus can be mitigated by promoting native forests, highlighting the importance of ecological restoration. Restoration efforts, however, are currently hindered by a knowledge gap on the distribution and condition of eucalyptus plantations, due to the decentralized nature of eucalyptus production and the lack of a cohesive methodology for monitoring across Portugal and Spain. In this work, we leveraged remote sensing data from the Sentinel 1 and 2 missions to address two major constraints to restoration efforts in Iberia: 1) quantify eucalyptus area and monitor its evolution; and 2) establish a map of restoration potential to identify key areas for restoration efforts. Satellite imagery was supported by field data on eucalyptus distribution, management and co-occurring native vegetation in order to estimate a restoration potential index, and an Artificial Neural Network approach

was used for predictive mapping of eucalyptus presence and restoration potential for the Iberian Peninsula. We characterized trends in Iberian eucalyptus production in recent years and present recommendations for the establishment of restoration efforts.

Keyword: Restoration, Iberian Peninsula, Eucalyptus, Remote sensing, Land cover monitoring

P112

HIGH SPECIES RICHNESS OF SHEEP-GRAZED SAND PASTURES IS DRIVEN BY DISTURBANCE TOLERANT AND WEEDY SHORT-LIVED SPECIES

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Our aim was to study the effect of sheep grazing on sand grasslands through biomass samples. For this we selected 15 study areas which are former and present sand pastures. We classified them into five grazing intensity levels based on stocking rate (livestock unit/ha), distance of drinking and resting places and number of droppings. Our questions were: i) How does increasing intensity of sheep grazing affect the amount of green biomass, species richness and their relationship in sand pastures? ii) How does increasing intensity of sheep grazing affect the biomass of perennial and short-lived graminoids and forbs? iii) How does disturbance value (expressed in the biomass ratio of disturbance tolerant and ruderal species) change along the gradient of grazing intensity? We found a unimodal relationship between green biomass and species richness. Species richness showed an increasing trend along the grazing intensity gradient. There were significant differences for green biomass, litter, graminoids and short-lived forbs. The biomass of disturbance tolerant and ruderal species increased with increasing grazing intensity. We concluded that stocking rate, and the distance of drinking and resting places jointly affected vegetation and created an uneven pattern for composition and amount of biomass in all grazing intensity levels. Our findings may yield information related to pastures in densely populated regions which are most endangered by the proliferation of disturbance-tolerant and ruderal species.

Keyword: sheep grazing, sand grassland, biomass, species richness

P113

FLORISTIC AND FUNCTIONAL ANALYSIS OF DEHESA GRASSLANDS UNDER DIFFERENT TYPES OF MANAGEMENT

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The Tablas de Daimiel National Park (Ciudad Real, Spain) acquired agricultural dehesas in 2014 that were traditionally managed under a mixed cereal-sheep system. The Park's aim is to turn pastures from agriculture into basophilous "majadales" with a sheep grazing management. Today, the *dehesa* grasslands include zones under different types of land use and management, such as, ungrazed and uncultivated former farmland since 2001, and a grazed zone that was abandoned to cultivation ten years ago, but with a low stocking rate. Within this last zone, some areas were excluded from grazing by fences of 15x15 meters. The purpose was to monitor the grazing effect on the floristic and soil composition of pastures.

We present the results of the sampling carried out in the present year.

The results show the differences on the taxonomic diversity, taxonomic group abundance and floristic composition of pastures among plots from different types of management. We also present the analysis results on the morphological and reproductive functional traits of pastures. This type of study is essential for a better understanding of the evolution and dynamic of mediterranean pastures on basic soils for their restoration and conservation.

Keyword: Grazing, Functional diversity, Oak dehesas, Pastures, Tablas de Daimiel, Taxonomic diversity

P114 BIOMASS ALLOCATION AND QUALITY IN GRASSLAND VEGETATION

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Semi-natural grasslands are vulnerable to the loss of biodiversity, but experience a decline in area. Intensification and land use abandonment are common problems in many European countries. Mowing and grazing are essential to preserving these species-rich habitats; however, in the light of rapid socio-economic changes, the utilisation of grassland biomass is challenging. In this project, we valorise the idea of extensive management, which supplies a low amount of biomass while simultaneously preventing secondary succession. Little is known about the vertical allocation of biomass and its properties in grasslands, as well as how both correlate to turnover in species composition. Here, we present the first results from the mesic grassland experiment (36 plots), where we applied three levels of cutting height. The first level (5cm) is the standard cutting height used to maximise biomass yield collection. The second level (15 cm) presumes support for diversity conservation. The third level (25cm) aims to minimise biomass yield collection. Relative to the first level, the biomass decreased by 31% and 52% with each cutting level, respectively. The nutritional value of biomass did not differ significantly between the cutting levels. Furthermore, between plots, plant species composition showed high similarity in contrast to high biomass variation. The results show that the allocation of biomass is vertically and spatially structured at a small spatial scale and poorly corresponds to spatial variability in species composition.

Keyword: mowing, extensive management, cutting height, mesic grasslands

Alien Plant Species: Invasion Trends and Impacts

P115 RESURVEY STUDY REVEALED THE PROLIFERATION OF NEOPHYTES IN OAK FORESTS IN SLOVENIA

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Forests, especially in lowland areas, are threatened by the proliferation of non-native species (neophytes). To assess the temporal dynamics of these species, a long-term resurvey study was conducted in nine oak forests in Slovenia. In 2023, we resampled 45 permanent vegetation plots that were established in 1992/93 in two oak forest types dominated by *Quercus robur* and *Q. petraea*. Over the last 30 years, the oak forests studied have experienced severe oak mortality, which was higher in the *Q. robur* forests. In the early 1990s, only three neophytes with low abundance were detected in all studied plots. However, in the 2023 resurvey, the total number of neophytes increased to 22 species, representing 7% of the total species pool in the understory layer. The increase in the number and cover of neophytes was significant in the plots dominated by *Q. robur*, but not in those with *Q. petraea*. The study found that *Impatiens parviflora*, *Solidago gigantea*, *Erigeron annuus*, and *Erechtites hieraciifolia* were the most common neophytes. The richness and cover of neophytes decreased with the cover of the tree layer. Neophytes were mainly found in disturbed areas, except for *Impatiens parviflora*, which was able to colonise less degraded and shaded sites. The proliferation of neophytes was mainly caused by habitat degradation resulting from tree mortality, as well as the effects of management-induced disturbance on the overstorey and soil conditions. In the future, disturbances are expected to continue, making forest habitats even more vulnerable to the spread of neophytes.

Keyword: long-term vegetation change, invasive non-native plants, oak mortality, *Quercus robur*, *Quercus petraea*, canopy openness, *Impatiens parviflora*



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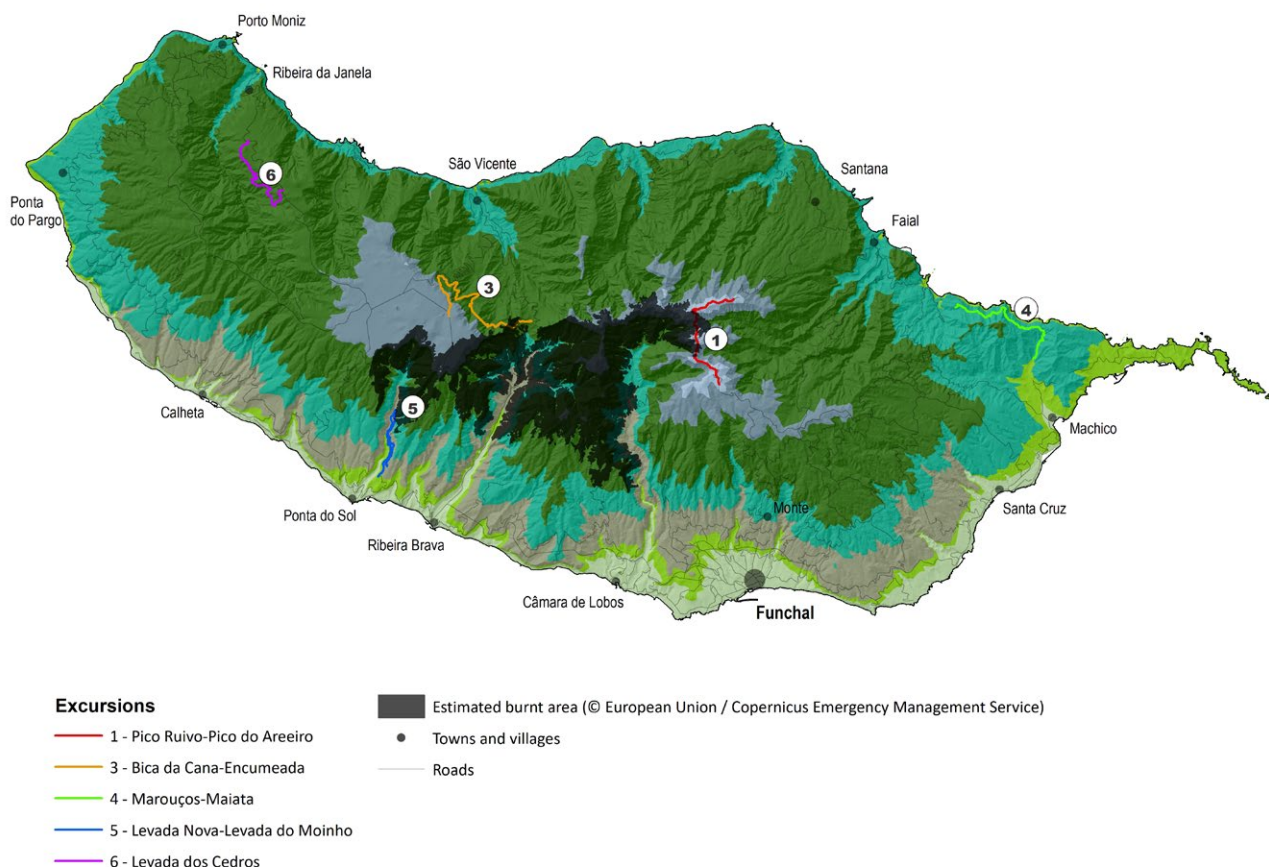
Mid-Symposium Excursions guide – Wednesday 18

Post scriptum. During the preparation of these notes on the excursions, on the 14th of August, a large wildfire started in the central area of Madeira affecting a large stretch of forest and mountain areas. The fire extended by more than 5000 ha and has been active until the 25th of August. Due to its enormous size and difficulty to control, the fire had catastrophic proportions for the people and for the ecosystems of Madeira. Because of unusual meteorological conditions: high temperature, dryness, drought period longer-than-usual and wind even some of the usually humid laurel forest nuclei were affected. Also, a large stretch of endemic mountain vegetation was burnt.

As a result, some of the excursions we have prepared were affected, either because of burnt vegetation, cut roads, trails damaged or made inaccessible for security reasons (see attached map). Since logistics of excursions take a long time, especially in an island nowadays overbooked by tourism, there is no time to fully remake the excursions. Moreover, the uncertainties on access of roads and trails will hold for some time. Therefore, we cannot predict what will be the restrictions and solutions we may find on the 18th of September. Be assured that the local organizing committee will try to replace and improvise alternative routes for the affected excursions. Also, we should be aware that natural areas unaffected by the fire will be sought by many more people than usual.

We are saddened by the loss of biodiversity, people's material goods and the disturbance on our conference. Nevertheless, we are sure colleagues will accommodate to whatever needs to be adapted and, in the end, the conference will be a good one.

The Organizing Committee.



Mid-Symposium Excursions guide – Wednesday 18

Brief notes on the Flora, Vegetation and Landscape of Madeira Island.

A companion to the mid-symposium excursions of the 2024 IAVS Annual Symposium | EVS Conference, Funchal, Madeira, Portugal

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Overview of Madeira's landscape

The Madeira archipelago includes the islands of Madeira, Porto Santo and the Desertas Islands—Deserta Grande, Bugio and Ilhéu Chão—, as well as the Selvagens Islands—Selvagem Grande and Selvagem Pequena—often described as a distinct archipelago since these are located 280 kilometres south of Madeira. The Madeira archipelago is located in the Atlantic Ocean, between latitudes 32° 20' and 30° 10' N and longitudes 15° 20' and 17° 20' W (figure 1).

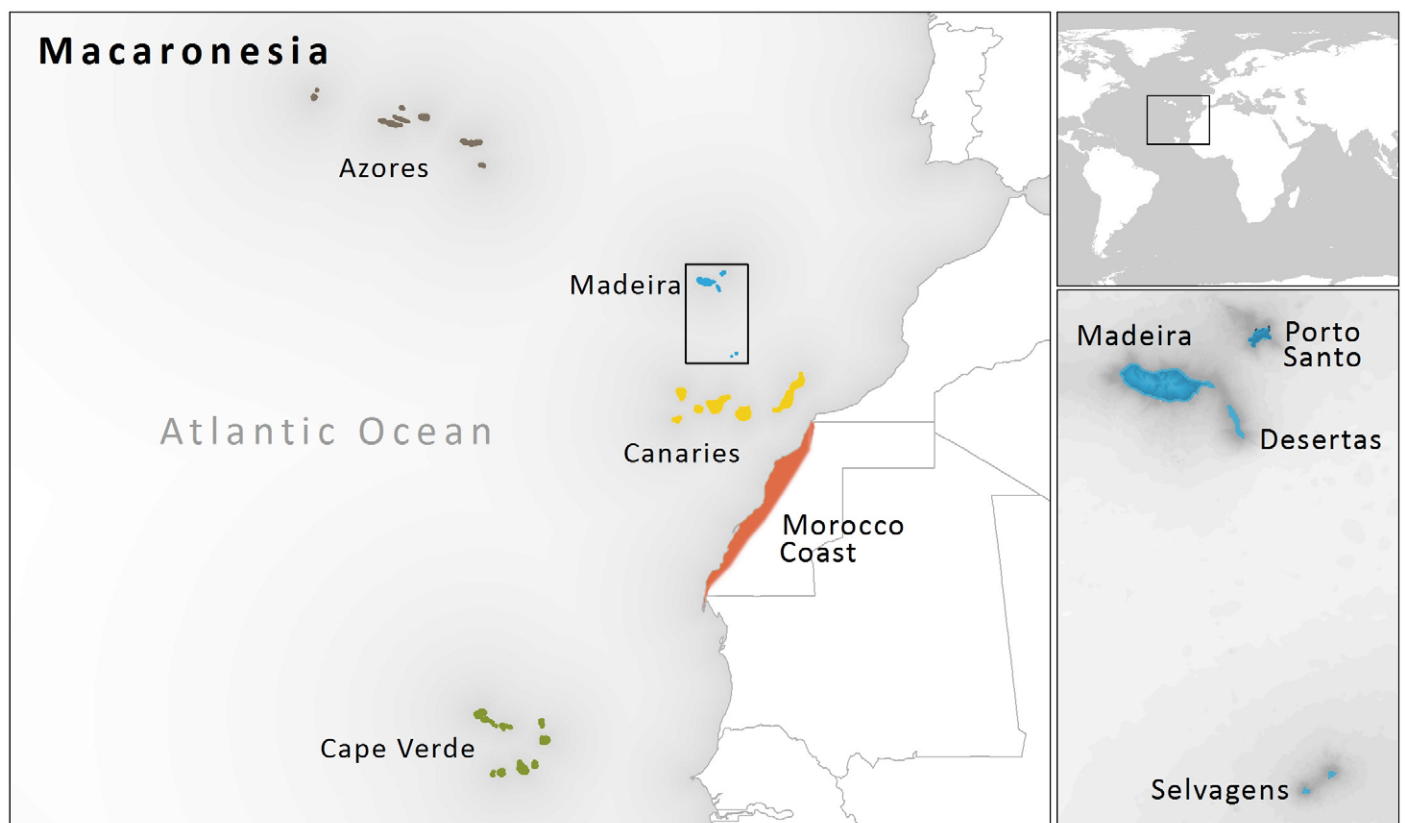


Figure 1: Madeira archipelago and Macaronesia.

All archipelagos are volcanic, although it did not all form simultaneously. The Selvagens are the oldest islands (27 million years), followed by Porto Santo (14 million years) and, lastly, Madeira, whose last volcanic activity dates to 6 to 7 thousand years ago (Geldmacher *et al.*, 2005). Madeira is the largest island, with an area of 741 Km².

Mid-Symposium Excursions guide – Wednesday 18

Madeira island is essentially the top of a shield volcano associated with uplift processes, rising out of the ocean and profoundly shaped by fluvial erosion and massive landslides. Unlike the other islands in the archipelago, Madeira is structured by a central east-west aligned ridge, which separates the north and south parts of the island (figure 2). Its highest points, Pico Ruivo (1,862 m), Pico das Torres (1,851 m), and Pico do Areeiro (1,818 m), are remnants of a primitive volcano. The highest area in the west half of the island, Paul da Serra, is an extended plateau (at an altitude of approximately 1,400 to 1,500 m), clearly contrasting with the surrounding area.

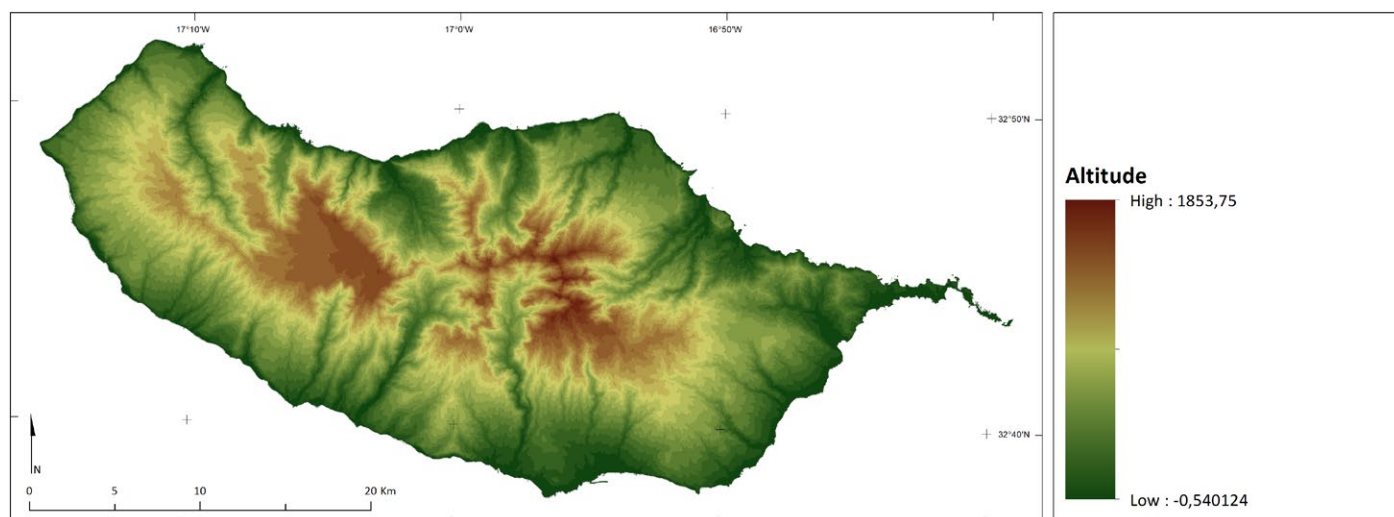


Figure 2: Elevation map of Madeira.

The volcanic edifice was subsequently modelled by erosion, resulting in a dramatic landscape, with deep valleys and ravines cut by torrential streams flowing from the central ridge to the sea. The most significant of these streams are Ribeira Brava and Ribeira dos Socorridos, on the south face of the island, and Ribeira da Janela in the north, still partially inaccessible.

The coastline is mainly formed by tall cliffs, occasionally with flat rocky wave-cut platforms below. The most striking is Cabo Girão, a 580 m high sea-cliff escarpment. Exceptions can be found at the mouth of rivers and in the Funchal bay, where the land rises gradually, forming an ample amphitheatre, cut by several ephemeral streams descending from the mountains above.

Madeira's topography is its landscape's most distinctive characteristic, with slope being the attribute that better translates its peculiarity. On three-quarters of the island, slopes are steeper than 30 %, commonly accepted as the limit for all land use types except forestry. Only roughly one-tenth of the territory is within the limit usually established for use without severe restrictions, mainly in patches that served for establishing villages around Funchal, Santana, Porto Moniz and Santo António da Serra; in narrow strips along the larger riverbeds and the hilltops; in narrow wave-cut platforms; and in Paul da Serra. As a result, a considerable part of the island is still generally inaccessible or only accessible through narrow trails.

Soils in Madeira are generally fertile and derived from basaltic rocks and pyroclastic materials. Andosols are the most frequent, deep and very fertile. Leptosols developed in particularly steep slopes and disturbed areas, also fertile but shallower and less apt for agriculture. The remaining areas correspond mostly to Cambisols, Phaeozems and Vertisols, which generally make good agricultural land (Pinto Ricardo & Madeira, 2002).

Mid-Symposium Excursions guide – Wednesday 18

As for Madeira's climate, the difference between the north and south faces of the island is of relevance: the north face is partly protected from direct sunlight and receives the cold and moist north winds, whereas the south face, on the contrary, is quite sunny, in the rain shadow and protected from north winds. This adds to the well-known fast variation of precipitation and temperature along altitudinal gradients on islands, resulting in a wide range of climatic types in quite small areas.

Rainfall is high in the mountains, almost 3,000 mm/yr, and decreases towards sea level to 600-700 mm/yr, slowly on the north face but at a high rate on the south face. Temperature decreases with altitude, following a reverse pattern. Daily and annual thermic amplitudes are short, as expected in oceanic territories (average minimum temperatures go as low as 3° C in the mountains, but not less than 13° C in Funchal, whereas average temperatures during the hottest month range from 15° C to 23° C). As a result, and according to the bioclimatic classification system established by Rivas-Martínez et al. (2011), two major bioclimatic types can be distinguished: the coastal areas have a Mediterranean climate—hot and dry, with a distinct summer drought—, a thin strip on the north face but a large band on the south, where it reaches an altitude of 950 m (in shades of pink in map [figure 2](#)). The remaining part of the island has a Temperate climate—with a significant temperature variation throughout the year but without a dry summer season (in shades of green in map [figure 2](#)). Additionally, bioclimatic belts are defined within each bioclimate, reflecting variations in temperature and rainfall regimes. Thermotypes and ombrotypes thus established are shown in maps in [figures 3 and 4](#), as mapped by Mesquita et al. (2004).

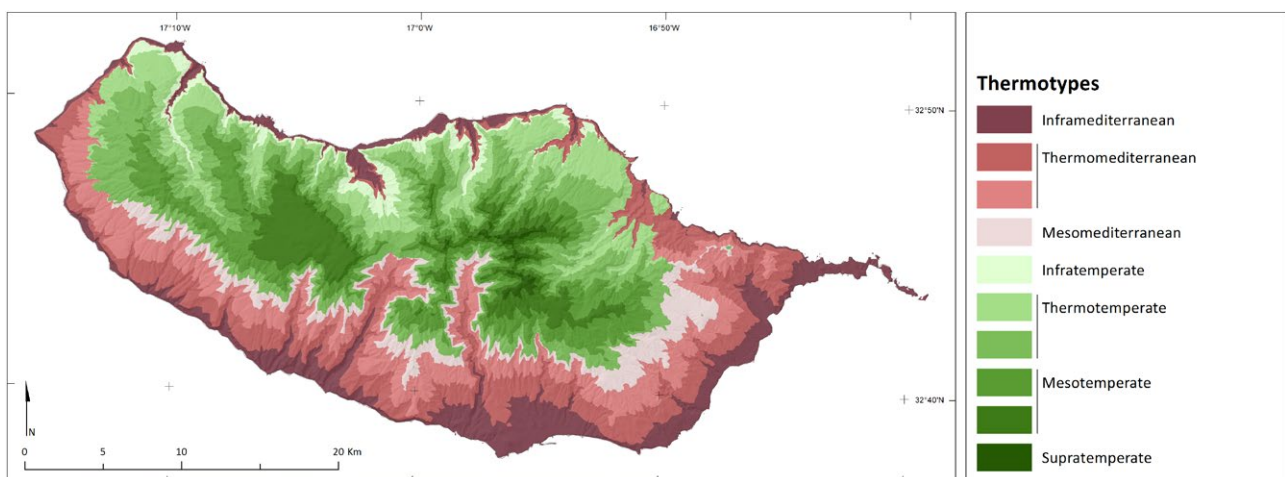


Figure 3: Madeira's thermotypes, according to the bioclimatic classification system of Rivas-Martínez et al. (2011) (adapted from Mesquita et al. (2004)).

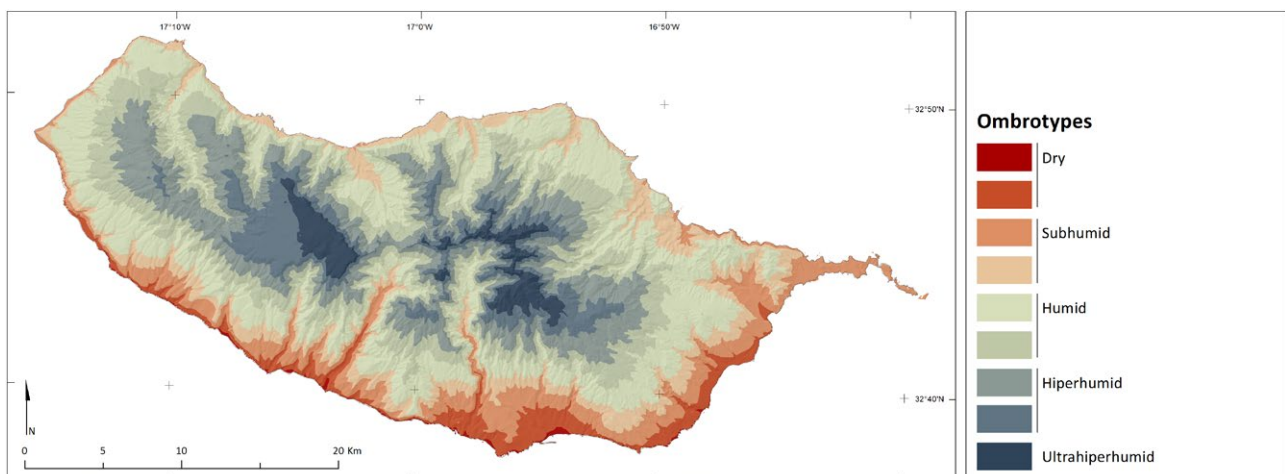


Figure 4: Madeira's ombrotypes, according to the bioclimatic classification system of Rivas-Martínez et al. (2011) (adapted from Mesquita et al. (2004)).

Mid-Symposium Excursions guide – Wednesday 18



Figure 5: Madeira's water canals: levadas.

Warm areas, without frost and suitable for agriculture during the whole year (in the infra and thermomediterranean belts) are too dry, so water had to be conducted from the temperate mountain area where rain is always abundant. From the 15th century, a system of canals, locally called levadas (figure 5), began to be built for this purpose, sided by a narrow path for maintenance (Vieira, 2015). Rainfed crops were gradually replaced by irrigated agriculture as this irrigation system was developed in subsequent centuries, forming a network of more than 500 Km of levadas, plus about 2,500 Km of secondary channels, in the 21st century (Jervis, 2021).

Originality of Madeira's flora and vegetation

Madeira's diversity of climatic conditions is reflected in an equally diverse array of habitats, typically poor in species but rich in endemic taxa, as is usual in mountainous islands (Whittaker & Fernández-Palacios, 2006). As summarised in Capelo *et al.* (2007), Madeira's native vegetation comprises Tertiary relict flora and Paleo-Mediterranean flora, as well as a second set of neo-endemic taxa, which arose recently through adaptation to insularity and specific habitat conditions that developed in Macaronesia.

Mid-Tertiary volcanic cycles gave rise to the arch of Atlantic archipelagos spreading from 40° to 15° N along the coasts of Europe and Africa, informally known as Macaronesia ("the Fortunate Islands"): Azores, Madeira, Salvage Islands, Canary Islands and Cape Verde (see figure 1). The sequential setting of the archipelagos and their approximately parallel position in relation to the African and European mainland are paramount to hypothesis explaining actual "Macaronesian" flora and vegetation features, namely colonization, dispersion and speciation events.

Traditionally, the extremely original and highly endemic vegetation of these islands has been interpreted as being basically of relictual character from the sub-tropical Tertiary vegetation around the archaic basin of the Tethys Ocean – the 'Geoflora vegetation' (coarsely the Mediterranean Sea, spreading eastwards to include the actual Black and Aral seas, reaching the Indian Ocean). In continental areas around the Tethys, several violent disruptive environmental events took place during the mid and late Tertiary period, associated with the alpine tectonic cycle. The emergence of a summer-dry Mediterranean climate led to dramatic disruption, extinction and new evolutionary pressures on the vegetation of continental areas. Moreover, new migrant floras benefited from a global opportunity to establish

Mid-Symposium Excursions guide – Wednesday 18

themselves, either from central Eurasia (Neomediterranean flora) or from high northern latitudes (Artho-Tertiary deciduous flora). Oceanic islands were not significantly affected by such complex phenomena during the Tertiary period, thus retaining part of the paleo-subtropical vegetation in relatively high latitudes. Further biogeographical relationships, mostly with the Mediterranean and with Africa, were conditioned by long-range dispersal events. Meanwhile, extensive speciation phenomena took place, based both on the ancestors from the Tertiary elements and on later newcomers from the continental areas. Examples of relict tree genera, nowadays extinct in mainland Europe, are *Apollonias*, *Ocotea*, *Persea*, *Clethra*, *Picconia* and *Dracaena* (figure 6). Many fern species are also part of the archipelago's relict flora. Examples of species that developed in the mainland after such catastrophic events, already under Mediterranean climate, reaching the islands and colonising the lowlands, are *Olea maderensis*, *Maytenus umbellata*, *Sideroxylon mirmulans* and *Rhamnus glandulosa* (figure 7). The processes which led to this outcome are detailed in Fernández-Palacios *et al.* (2017).



Figure 6: Examples of Late-Tertiary relict flora (left to right): *Apollonias barbujana*, *Clethra arborea*, *Ocotea foetens*, *Ilex perado*.



Figure 7: Examples of Paleo-Mediterranean relict flora (left to right): *Olea maderensis*, *Maytenus umbellata*, *Sideroxylon mirmulans* and *Rhamnus glandulosa*.

The most striking floral elements of the Atlantic islands are woody endemics in taxonomic groups normally herbaceous in continental areas, among which the island taxa have their ancestors. Several genera, subgenera or sections extant only in one archipelago or in several are common in the Asteraceae (*Asteriscus*, *Tolpis*, *Sonchus*, *Pericallis*), Boraginaceae

Mid-Symposium Excursions guide – Wednesday 18

(*Echium*), Campanulaceae (*Musschia* in Madeira, *Azorina*, *Canarina* and *Campanula* in the Azores, Canary Islands and Cape Verde respectively), Scrophulariaceae (*Isoplexis*) and others such as *Sideritis*, *Plantago*, *Aeonium* and *Euphorbia*. These plants exhibit consistent habit and structure features, namely being caulirosetted, with candelabra habit or monocarpy. Some early authors regard such taxa, once again, as direct relics from the 'Geoflora', but molecular and phylogeographical evidence is summing up to support their derived neo-endemic synapomorphic character. Other non-forest groups such as *Aeonium* (Crassulaceae) and *Echium* (Boraginaceae) exhibit 'island woodiness' habit.

Other important groups encompassing Madeiran vegetation are paleo-mediterranean termophile sclerophylls and succulents, such as spurges - *Euphorbia* (Sect. *Pachycladae* and *Candelabra*) and *Sideroxylon*. The latter have circum-Mediterranean-African-Arabic affinities (Rand flora) and reached the islands in several cycles of colonisation. Rand Flora are floral elements made up of taxonomical non-sister clades that are found consistently with a correlated distribution area around the peripheral borders of the whole African continent and including surrounding areas of the Mediterranean and Red Sea, with no obvious relationship with inland African continental flora. Madeira may stand as an example of macaronesian with a great wealth of Rand Flora (e.g. tree *Euphorbia*, *Sideroxylon* and *Musschia*) element combined with continental elements (*Rhamnus*, *Sorbus*, *Juniperus*). Some of these species have evolved from Eurosiberian continental ancestors—*Saxifraga maderensis*, for instance—and others may have an American origin, namely *Pericallis aurita* and *Goodyera macrophylla* (Thiv et al., 2021) (figure 8).

In short, Madeira flora can be coarsely grouped in five types:

1. Paleo-endemic paleo-subtropical tree flora of Tethysian origin (e.g. *Sideroxylon*, *Pittosporum*, *Laurus*, *Ocotea*, *Apollonias*, *Picconia*, *Heberdenia*)
2. Paleo-endemic paleo-subtropical forest understory flora of Tethysian origin (most forest ferns, *Diplazium*, *Pteris*)
3. Neo-endemic macaronesian flora with island woodiness physiognomy (e.g. *Echium*, *Sonchus* sect. *Dendrosonchus*, *Isoplexis*)
4. Paleo-mediterranean xeric to semi-desert, sclerophyllous or succulent flora (e.g. *Euphorbia*, *Olea*, *Maytenus*)
5. Continental African, European, and American flora (*Rhamnus*, *Sorbus*, *Pericallis*)
6. Flora introduced by Man.

Currently, 1268 taxa (species and subspecies) occur in Madeira, of which 798 are native and the remaining introduced by man. Native taxa include 173 endemic to the archipelago, and 75 endemic to Macaronesia. Of these, 5 genera are endemic to Madeira: *Chamaemeles*, *Melanoselinum*, *Monizia*, *Musschia* and *Sinapidendron*.



Figure 8: Examples of neo-endemic flora (left to right): *Euphorbia piscatoria*, *Sonchus fruticosus*, *Musschia wollastonii* and *Pericallis aurita*.

Vegetation belts and Vegetation Series of Madeira

Vegetation zones have been outlined for Madeira Island by several authors. *E.g.*, Lowe (1857) described vegetation zones using crops to define regions below 750 m and native flora for the units above; Vahl (1904) was the first to include the asymmetry between the north and south faces of the island in the model he proposed; Sjögren (1972) also defined an asymmetrical model, with two major vegetation units, each divided into two variants, using a phytosociological approach, but failed to recognise the diverse vegetation types developing at low altitudes, of which only small patches remain. The model proposed in Capelo *et al.* (2004) and Capelo *et al.* (2019) aimed at expressing the spatial distribution of native vegetation assuming the complexes of plant communities connected by ecological succession as mapping units, with each unit correlated to the bioclimate. The problem of recognising vegetation types in very disturbed territories, as is the case of Madeira's coastal areas, particularly on the south face (Carine & Menezes de Sequeira, 2020), was solved by using a synphytosociological approach, in which any characteristic plant community can be used as an indicator of the corresponding vegetation complex. Six vegetation units were mapped (see figure 12) and described in Capelo *et al.* (2005) as follows:

1. Madeiran oleaster tree series: *Mayteno umbellatae-Olea maderensis sigmetum*

Vegetation developing in inframediterranean dry areas, at low altitude on the south face, up to 200 m. Climax communities are micro-forests of Madeiran oleaster (*Olea maderensis*), now rare since most of the area within this unit is occupied by crops. The most common vegetation in this unit is a scrub dominated by Madeira's tree-spurge (*Euphorbia piscatoria*), pride of Madeira (*Echium nervosum*) and *Globularia salicina* (See figure 9, left).

2. Marmulano tree series: *Helichryso melaleuci-Sideroxylo marmulanae sigmetum*

This unit thrives in an inframediterranean, subhumid bioclimate, mainly on the south face, just above the Madeiran oleaster series (between 200 and 300 m). The most frequent seral stage is a community of *Helichrysum melaleucum* and *Globularia salicina*. Again, climacic micro-forests, composed of *Sideroxylon mirmulans*, *Maytenus umbellata* and occasionally *Juniperus turbinata* subsp. *canariensis*, are extremely rare and confined to inaccessible slopes, with most of its area used for agriculture (See figure 9, right).



Figure 9: Madeiran oleaster tree series vegetation (left) and Marmulano tree series vegetation (right).



Figure 10: Laurel/barbusano series vegetation (left) and Stink-laurel series vegetation (right).

3. Laurel/barbusano series: *Semele androgynae*-*Apollonio barbujanae sigmetum*

Vegetation unit from infra- and thermomediterranean, subhumid and humid territories, occurring in both faces of the island. The series climax, a thermophile Mediterranean laurisilva forest, is dominated by *Apollonias barbujana*, *Laurus novocanariensis*, *Myrica faya* and *Ilex canariensis*, with an understorey rich in climbers. Two facies are present: one from dryer (subhumid ombrotipe) areas on the south face, at altitudes up to c. 600 m, with a high-scrub community of *Hypericum canariense*; and another at higher altitudes and on the north face (humid ombrotipe), the high scrub stage, a heath community dominated by *Erica platycodon* subsp. *maderincola*, *Erica arborea* and *Morella faya*. The areas where this unit thrives, particularly those of the dryer facies, are warm and receive enough rainfall to support food crops. Well-preserved patches of laurel and barbusano forests are generally small and found among cultivated fields and scrubland (where agriculture was abandoned) (See figure 10, left).

4. Stink-laurel series: *Clethro arboreae*-*Ocotea foetentis sigmetum*

Vegetation complex developing in temperate areas, humid to hyperhumid, in deep soils. The climax community is a temperate laurisilva forest dominated by stink-laurel (*Ocotea foetens*). It is a multi-stratified forest up to 45 m high, co-dominated by several lauraceous species (e.g. *Laurus novocanariensis*, *Picconia excelsa*, *Ilex perado*), with a diverse understorey rich in ferns, mosses, and forbs. Many microhabitats are found within this forest, such as wet rock walls and waterfalls, habitats for epiphytes and riparian vegetation and, most interestingly, rocky clearings caused by landslides that are colonised by woody neo-endemic plant communities. The natural hedge of stink-laurel forests is a tall-heath community with Madeiran blueberry (*Erica platycodon* subsp. *maderincola*, *Vaccinium padifolium*). This unit comprises most of the well-preserved laurisilva of Madeira, estimated to be c. 14,000 ha in 2007 (when natural forests occupied c. 16,000 ha, 22 % of the island) (Mesquita et al., 2010) (See figure 10, right).

Mid-Symposium Excursions guide – Wednesday 18

5. High-altitude tree-heath series: *Polysticho falcinelli-Erica canariensis* *sigmetum*

This unit occurs at altitudes above 1,400 to 1,500 m, in hyperhumid to ultrahyperhumid areas, where laurisilva forests are absent due to excessive cold. The climax vegetation is a tree-heath forest (of *Erica canariensis*), probably a paraclimax of a former denser and more diverse forest, with *Sorbus maderensis* and Madeira's juniper (*Juniperus cedrus* subsp. *maderensis*), the latter heavily cut for construction and now an extremely rare tree. Most of the area within this unit is quite flat and is currently covered in allochthonous scrub after a long history of agricultural use and excessive grazing (See [figure 11](#), left).

6. High-altitude rock vegetation complex: *Armerio maderensis-Parafestuco albidae* *permasigmetum*

In supratemperate areas, above 1,650 m, forests are absent, and barren rock dominates most of the landscape. A mosaic of three permanent communities colonises these areas: tall grasslands in crevices and natural platforms; a succulent-dominated community in vertical rock walls; and a mat-forming *Thymus micans* community on flat pyroclast-derived leptosols. This unit is the nesting habitat of one of the rarest birds in the world, the Zino's petrel (See [figure 11](#), right).



Figure 11: High-altitude tree-heath vegetation (left) and high-altitude rock vegetation (right).

Mid-Symposium Excursions guide – Wednesday 18

Short notes on the mid-symposium excursions

The excursions planned for the symposium's third day aim to present an overview of the vegetation and flora of Madeira. We tried to show not only mature or pristine vegetation types, but also those representing successional responses to historical and actual human influences, such as agriculture, wildfires and the introduction of exotic alien species.

The excursions' trails are represented in figure 12, on a Vegetation Series Map. Vegetation Series is the set of potential communities, *i.e.* the community that is the Potential Natural Vegetation plus its seral stages. It is a theoretical and simplified setup of the vegetation response that would occur if succession were instantaneous in the absence of human influence and in the actual climate and environment conditions. It was produced based on actual vegetation mosaics and spatial interpolation of environmental parameters (see Capelo *et al.* 2004 for further details).

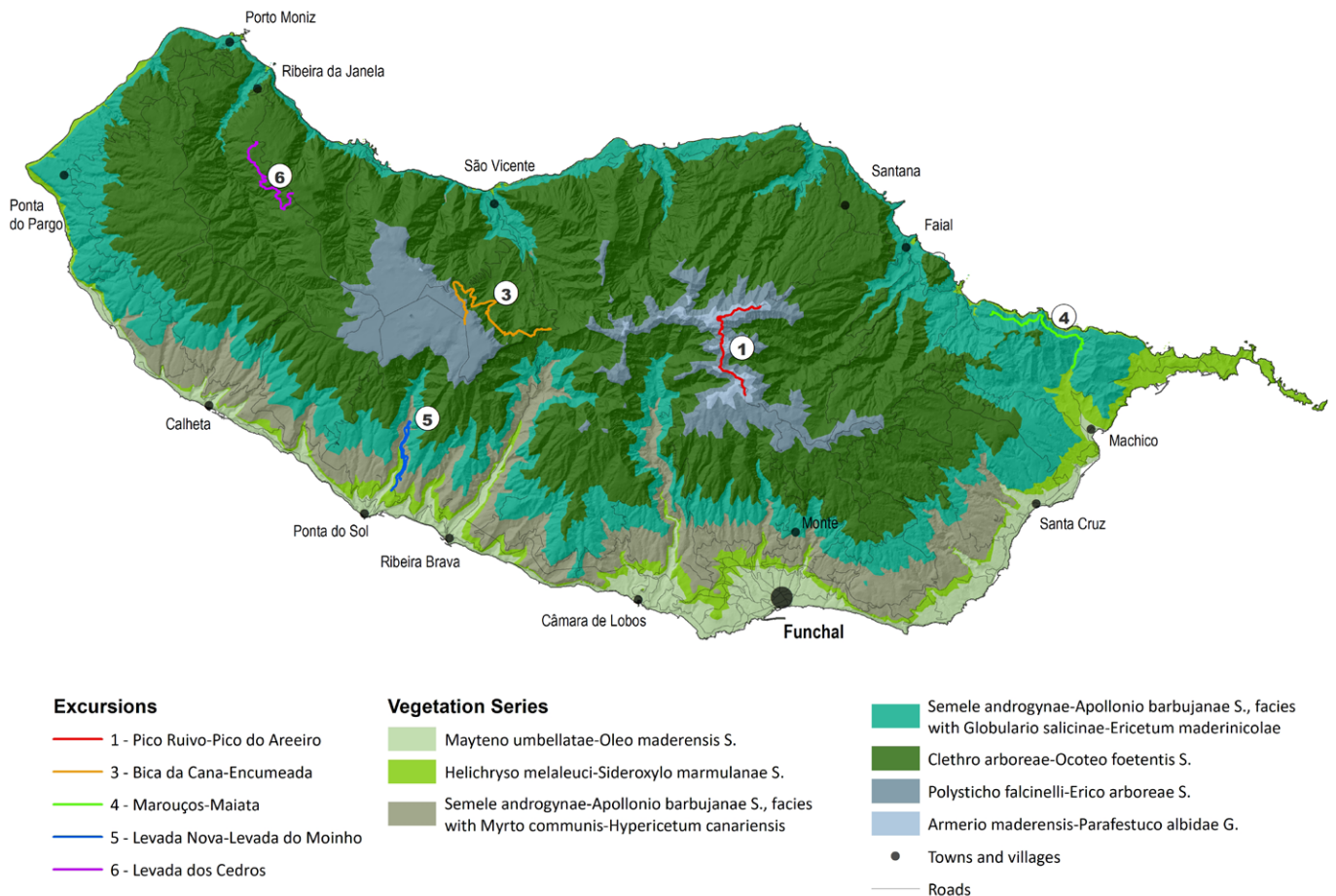
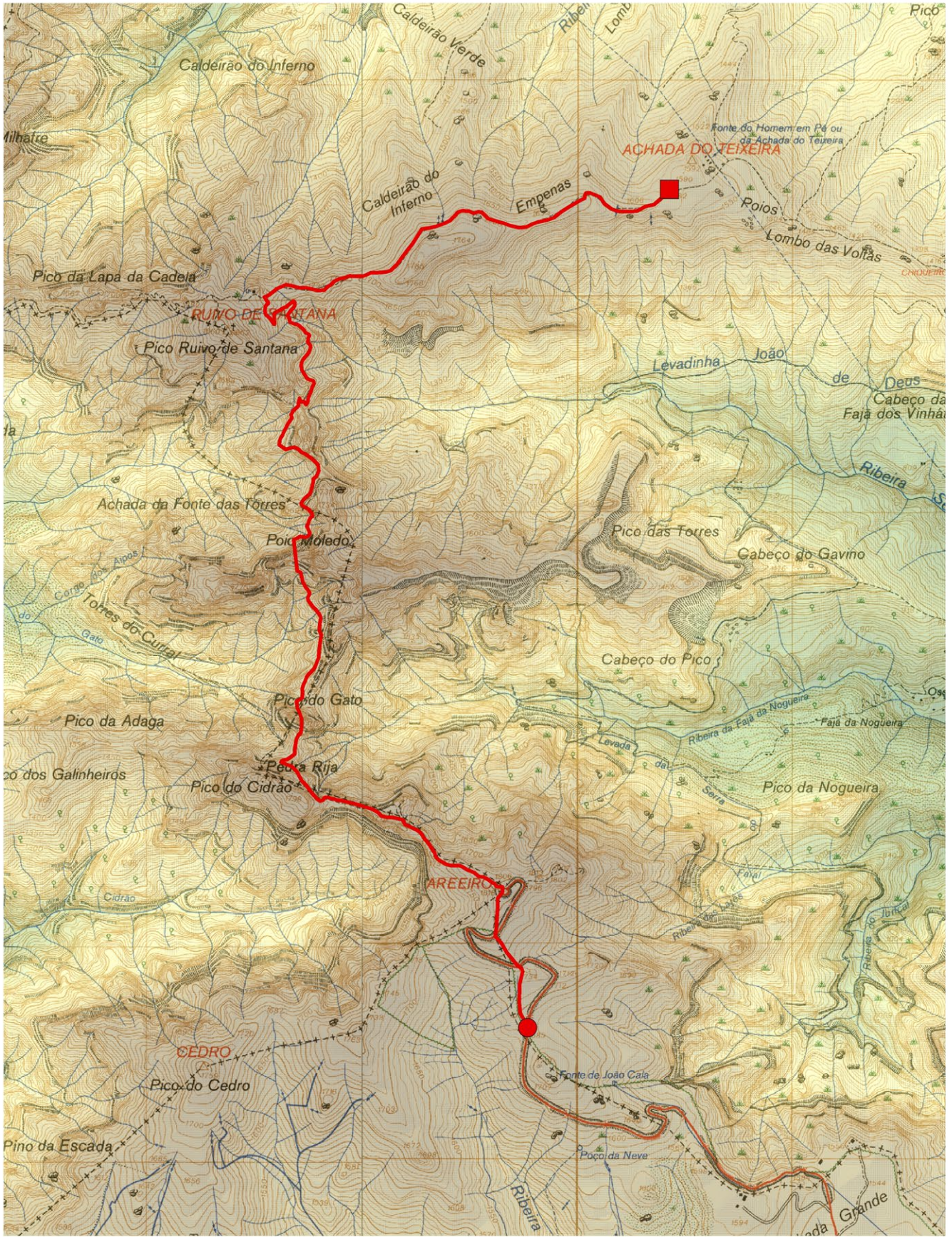


Figure 12: The mid-symposium excursions' trails, with the *Vegetation Series of Madeira Island Map* (adapted from Capelo *et al.* 2004) as basemap.



Excursion 1

- Pico Ruivo - Pico do Areiro
- Starting point
- End

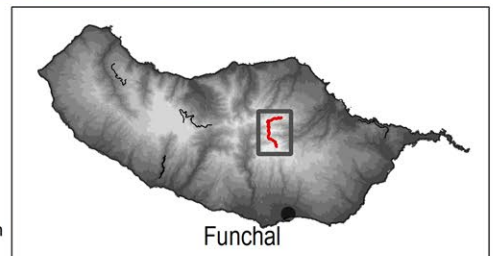
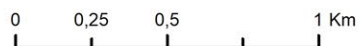


Figure 13: Excursion #1 - Peak Ruivo to Peak Areiro

Mid-Symposium Excursions guide – Wednesday 18

Excursion #1

Pico Ruivo to Pico do Areeiro

This excursion crosses a stretch in the mountain area of Madeira Island, from peak Ruivo (1,861 m) to peak do Areeiro (1,818 m). We will follow a very popular mountain trail through several vegetation types associated with the supratemperate bioclimatic belt, always above the upper limit of the laurel forest, which lies approximately at 1,500 m.

Vegetation mosaics along the trail are composed mostly of seral stages of the *Polysticho falcinelli- Erica arboreae* (canariensis) *sigmetum* vegetation series. Nevertheless, we will see some still well-preserved patches of the Canary-Madeira tree-heath forest (*Erica canariensis*), which correspond to the late-succession stages (*Polysticho falcinelli-Ericetum canariensis*). In general terms, this series' natural hedge and first seral stage is the secondary, species-poor, tall-shrub heath *Pteridio aquiline-Ericetum maderincolae*, dominated by *Erica platycodon* ssp. *maderincola*, a Madeiran endemic. This stage is very abundant and nowadays mostly co-dominated by the alien broom *Cytisus scoparius*.

The second dominant vegetation complex which can be observed along the trail is that of the permanent rock grasslands *Armerio maderensis-Parafestuco albidae geosigmetum*, a toposequence of few-stages shrubby series that follows a gradient of soil depth determined by mountain geomorphology. This complex includes: 1) *Armerio maderensis-Parafestucetum albidae* (rock grassland/cushion); 2) *Argyranthemo montanae-Ericetum maderensis* (cushion heathland) and 3) *Sinapidendro frutescentis-Aeonietum glandulosi* (vertical rock cliffs succulent communities).

After reaching the first and highest peak (Ruivo), dominant vegetation is the tree-heath complex *Polysticho falcinelli-Ericetum canariensis*, often accompanied by, in the clearing, the forbs community *Teucro francoi-Origanetum virentis* (*Trifolio-Geranietea*). Also, the shade sub-nitrophile forb communities *Vicio capreolatae-Odontitetum hollianae* will be observable. The seral stage dominated by the low heath *Erica platycodon* ssp. *maderincola* (*Pteridio-Ericetum maderincolae*), invaded by *Cytisus scoparius*, will be evident throughout the whole trail; it has been promoted by wildfires, at the expense of the declining tree-heath forest.

We will observe a wealth of flora, namely that of rock grasslands, and elements from the laurel forest from lower altitudes, like *Ilex perado*, *Euphorbia mellifera*, and madeiran endemics, e.g. *Cerastium vagens*, *Echium candicans*, *Plantago malato-belizii*, *Sinapidendron frutescens*, *Bunium brevifolium* and *Crepis andryaloides*.

This trail has become over-exploited during the last decade by excessive tourism, which, together with the ever-frequent wildfires, poses a serious menace to the conservation of Madeira's mountain flora and vegetation.



Figure 14: Excursion #1 - Landscape and vegetation types along the trail

Mid-Symposium Excursions guide – Wednesday 18

Excursion #3

Bica da Cana to Encumeada

This excursion will follow a trail crossing vegetation mosaics of two vegetation series: that of the Canary-Madeira tree-heath (*Erica canariensis*), *Polysticho falcinelli-Erico arboreae* (canariensis) *sigmetum*, in altitudes somewhat higher than 1,500 m in the beginning; and then, descending to around 1,000 m, the stink-laurel (*Ocotea foetens*) forest series *Clethro arboreae-Ocoteeto sigmetum*.

The trail starts in a park-like version of the tree-heath forest (*Polysticho falcinelli-Ericetum canariensis*) that has been traditionally used for grazing. Therefore, most of the forest nemoral understory has been replaced by swards dominated by the introduced *Agrostis castellana* (*Viola sequeirae-Agrostietum castellanae*). *Ulex europaeus* and *Ulex minor*, also found along the trail, are also alien species in Madeira, introduced from continental Europe and tending to be invasive.

At an altitude of around 1,400 meters above sea level, the first communities of the of mesotemperate laurel forest series mosaic can be seen: the mature tall-forest stage of *Ocotea foetens*, *Laurus novocanariensis* and *Clethra aborea*. This is a tall temperate evergreen forest with a wealth of nemoral plants in the understory, including many ferns, grasses, sedges and some climbers. Usually, forb communities occupy the clearings (*Pericallido auritae-Geranium palmatae*, *Trifolio-Geranietea*). The tall-hedge stage in the stink-laurel series is a heath community with Madeiran blueberries: *Vaccinio padifoli-Ericetum maderincolae*.

Moreover, along the openings in the dense crown-layer, naturally created by brooks or man-made for the construction of water channels, vegetation dominated by woody caulirosetted plants can also be observed (*Isoplexido sceptri-Euphorbietum melliferae*). Such vegetation type is an example of the dominance of neoendemics issuing from the 'island woodiness evolutionary syndrome'. Some notable examples are the nominal plants and woody *Sonchus* species: *Sonchus fruticosus* and *Sonchus pinnatus*; *Melanoselinum decipiens* (syn. *Daucus decipiens*) and the notable Campanulaceae *Musschia wollastonii*. Other common plant communities are those of waterfalls, *Deschampsietum argenteae* (Magnocarici-Phragmitetea), and, of the earthy slopes above the water channels, *Selaginelo-Cystopteridetum viridulae*.

Finally, along the streams, several types of riparian forests develop, depending on the substratum and the water flow regime: a hygrophile forest of *Persea indica* usually occurs in slow-moving streams streams (*Diplazio caudate-Perseetum indicae*); in torrential streams, rocky streams, a community of *Salix canariensis* tends to dominate (*Scrophulario hirtae-Salicetum canariensis*).

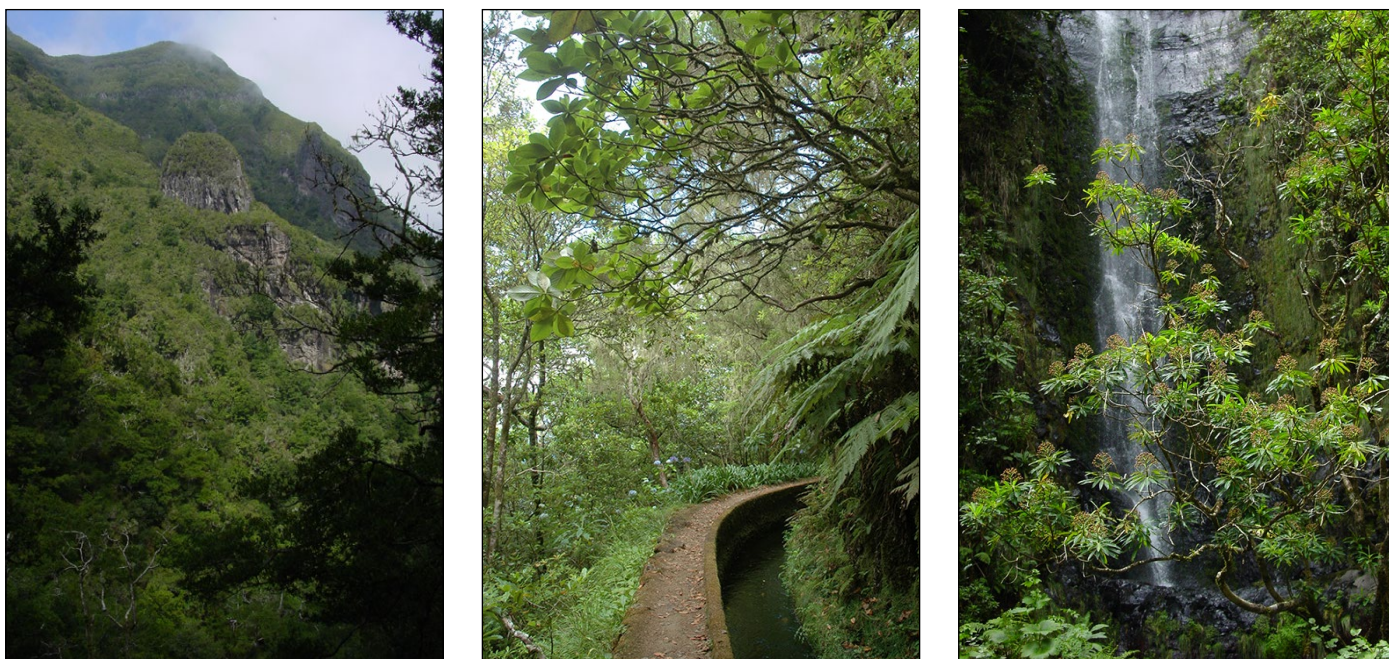
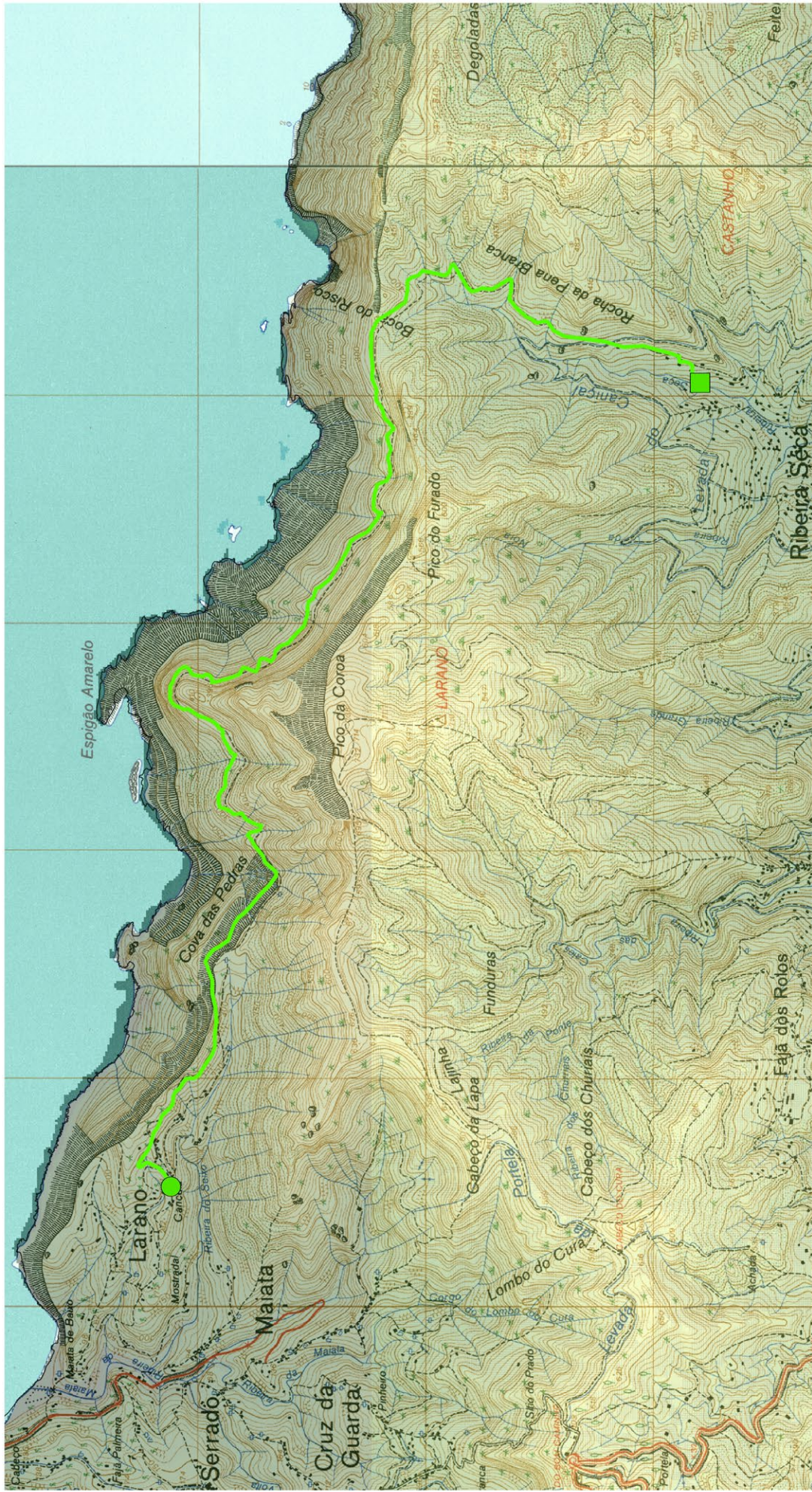


Figure 16: Excursion #3 - Landscape and vegetation types along the trail



Excursion 4

- Marouços - Maiata
- Starting point
- End

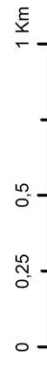
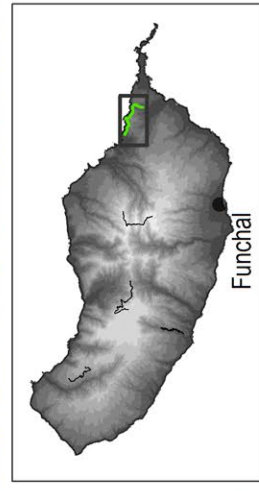


Figure 17: Excursion #4 - Marouços to Maiata

Mid-Symposium Excursions guide – Wednesday 18

Excursion #4 Marouços to Maiata

This excursion follows a trail which crosses a vegetation mosaic made up of both mature and seral stages of the series of barbusano-tree (*Apollonias barbujana*, Lauraceae): *Semele androgynae*-*Apollonio barbusanae* sigmetum. This series thrives at low altitudes, under Mediterranean climate (thermomediterranean belt), i.e., with rainy Winters and a Summer drought that extends for two or more months. Soil water compensation in the temperate belt comes from orographic rainfall, resulting from a frequent cloud belt starting at 900 m. Mediterranean barbusano forests (*Semele androgynae*-*Apollonietum barbusanae*) have a poor forb understory when compared to temperate forests, but, in turn, have a great wealth of climbers (*Smilax pendulina*, *Semele androgyna* and *Smilax canariensis*). These areas of low altitude have had a more intense historical use for agriculture and grazing, therefore the predominance of seral stages over the potential forest is higher than observed in temperate vegetation series. Moreover, and for the same reason, the trail crosses some areas with sin-anthropic vegetation types, as well as cultivated fields (with sugar cane, banana, sweet potatoes, greenhouse cultures, etc.).

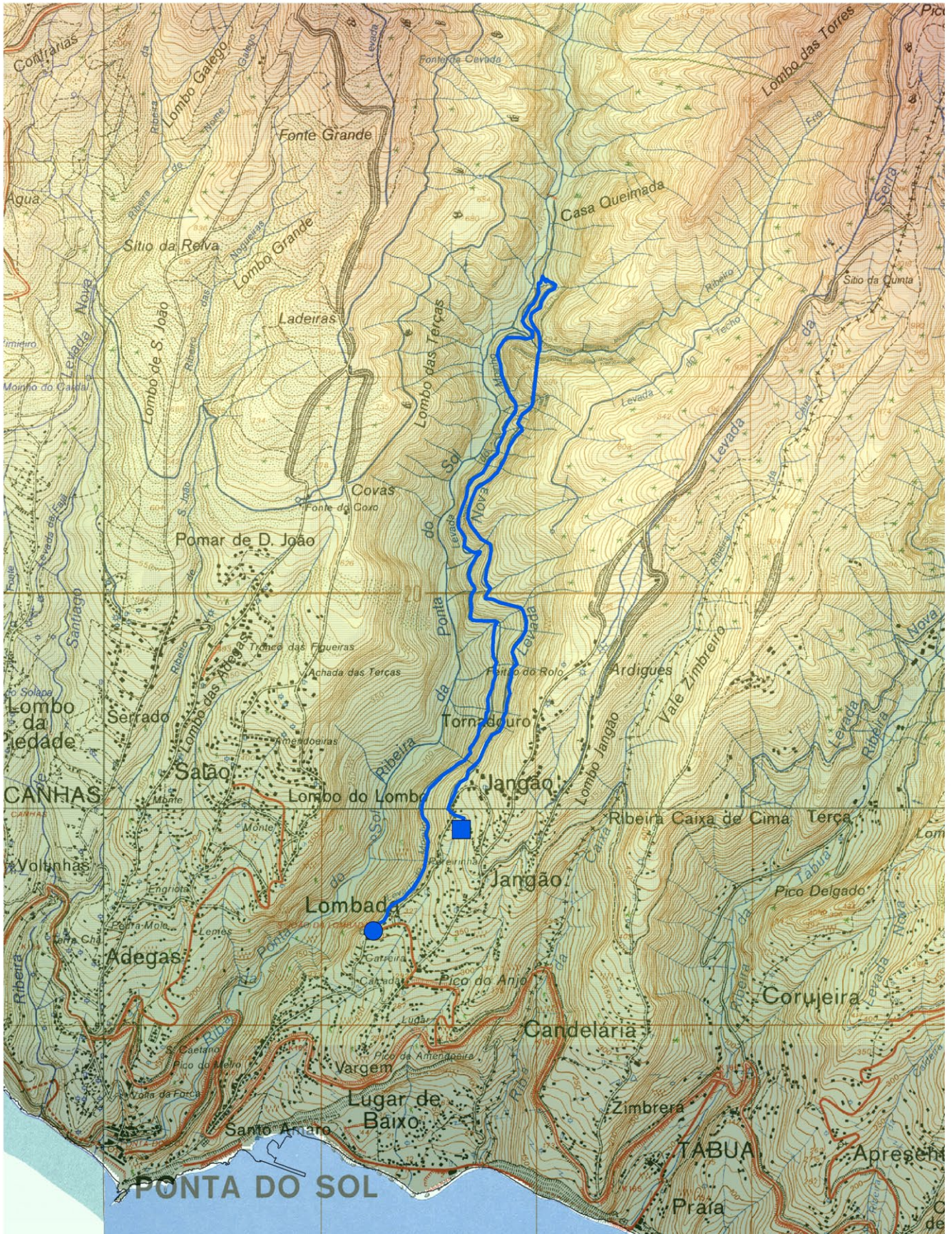
The excursion will start in a man-made landscape, an area with a vegetation cover composed of *Erica arborea*, the Australian *Acacia mearnsii*, and invader aliens such as *Pennisetum setaceum*. From here, Ponta de S. Lourenço can be seen, a semi-arid cape and the driest area in Madeira Island. Although close to this cape, the trail turns towards the north-westerly bound slope of the island, where aspect and orography lead to higher rainfall, supporting the mesic forest (*Semele*-*Apollonietum*), which is absent from Ponta de S. Lourenço.

The trail crosses an area of mediterranean heath, *Globulario salicinae*-*Ericetum arboreae*, a common mesic seral stage of the Mediterranean laurel forest. In this scrub, we may observe, besides *Erica arborea*, *Myrica faya* (syn. *Morella faya*), *Ilex canariensis*, *Jasminum odoratissimum*, *Myrtus communis*. Dry facies of this series may include, as seral stage, spurge communities with *Euphorbia piscatoria*, *Echium nervosum* and *Globularia salicina* (*Euphorbietum piscatoriae*). Rocky sea-cliffs exhibit permanent low scrub of *Helichrysum devium*, *H. obconicum* and *Argyranthemum succulentum*, relatable to the salt spray influence. A community of *Juniperus turbinata* ssp. *canariensis* may also be observed on these cliffs. As well as communities of Crassulaceae, in vertical rock walls, with *Sedum brissemoretii* and *Aeonium glutinosum*, *Synapidendron gymnocalyx* and *Mathiola maderensis* (*Sedo brissemoretii*-*Aeonietum glutinosi*).

Even within the anthropic exotic forest made up of *Eucalyptus* and *Acacia* species, some stretches of riparian laurel forest can be seen (*Diplazio caudate*-*Perseetum indicae*). Some other elements of the temperate laurel forest may be observed descending along the streams as azonal wetter vegetation: *Clethra arborea* and, eventually, *Ocotea foetens*.



Figure 18: Excursion #4 - Landscape and vegetation types along the trail



Excursion 5

- Levada Nova - Levada do Moinho
- Starting point
- End

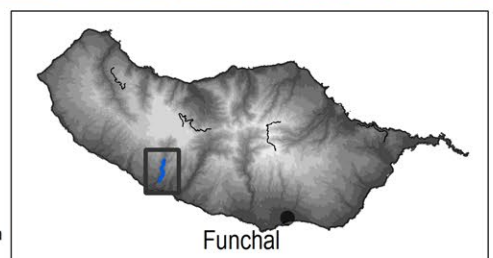
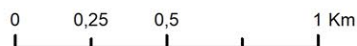


Figure 19: Excursion #5 - Levada Nova to Levada do Moinho

Mid-Symposium Excursions guide – Wednesday 18

Excursion #5

Levada Nova to Levada do Moinho

This excursion follows a trail which crosses most of the ecological amplitude of the barbusano-tree forest series (*Semele andogynae*-*Apollonietum barbusanae*), from dry to sub-humid to humid ombic stages. It is a Mediterranean thermophile type of laurel forest (laurisilva), unlike the temperate type which thrives in higher altitudes (*Clethro-Ocoteetum*). The vegetation structure and function in these forests changed as an adaptation to a summer drought of two months or more, higher temperatures and absence of frost—*i.e.*, they coevolved along with the climate's mediterraneity. Thermophile mediterranean forests do not have a notable forb diversity in the understory, as do temperate laurel forests in higher altitudes. In contrast, they exhibit a wealth of climbers, such as *Smilax pendulina*, *Semele androgyna* and *Smilax canariensis*, as well as soft-spined shrubs (e.g. *Asparagus umbellatus* subsp. *lowei*). Dry to subhumid seral stages are mostly tree-spurge formations, *Euphorbietum piscariae*. Besides *Euphorbia piscatoria*, other shrubs may be co-dominant, such as *Globularia salicina*, *Hypericum canariense* and *Olea maderensis* (syn. *Olea europaea* subsp. *cerasiformis*). Such dry extremes of the barbusano-tree series approach the potentiality of another series, of which the nominal tree may be found sometimes along the path: *Syderoxylon mirmulans* (marmulano tree, Sapotaceae). The later develops mostly on-abandoned agricultural land, mostly banana groves and sugar cane fields.

The excursion will pass through heavily modified areas, where the vegetation has been greatly altered by human activity, including exotic forests dominated by the Tasmanian *Pittosporum undulatum*, with *Brachyaria* and *Pennisetum grasslands*.

Streams may have stretches of *Persea indica* riverine forests (*Diplazio caudate-Perseetum indicae*), along slow-moving streams. Brooks with irregular flow usually have Canarian willow woodlands (*Scrophularia hirta-Salicetum canariensis*). On vertical rock walls, Crassulaceae communities can also be seen (*Sedo nudi-Aeonietum glutinosi*).

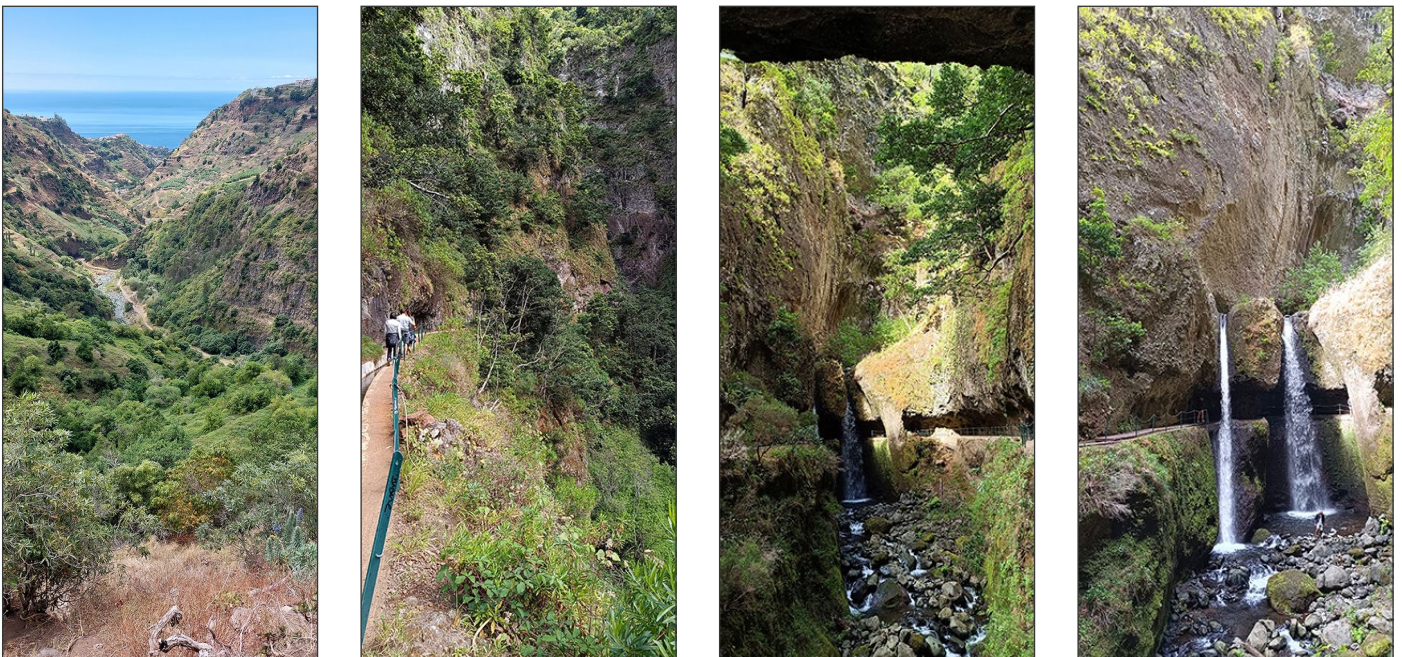


Figure 20: Excursion #5 - Landscape and vegetation types along the trail



Excursion 6

- Levada dos Cedros
- Starting point
- End

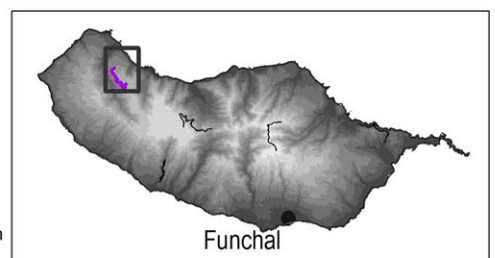


Figure 21: Excursion #6 – Levada dos Cedros

Mid-Symposium Excursions guide – Wednesday 18

Excursion #6

Levada dos Cedros

This excursion starts at the Paul da Serra plateau, circa 1,500 m above sea level, amid exotic trees (*Eucalyptus*) and heath seral stages. Further on, on deeper soils, mesic heath communities develop (*Vaccinio padifoli-Ericetum maderincolae*), bordered by tall hedges of a former forest of large tree-heaths (*Polysticho falcinellii-Ericetum arboreae (canariensis)*), sometimes as permanent vegetation of rocky and windy biotopes. Lengthy and intense agriculture and grazing lead to the predominance, in this area, of low heath species (*Pteridio aquiline-Ericetum maderincolae*). This community is often invaded by alien shrubs, namely *Ulex europaeus*, *Cytisus scoparius* and *Leptospermum scoparium*.

As we go along, descending to lower altitudes, trees proper of the stink-laurel temperate forest (*Clethro arboreae-Ocotea foetentis*) become more common: *Clethra arborea*, *Laurus novocanariensis*, *Ocotea foetens*, *Picconia excelsa*, *Ilex perado*. The stink-laurel forest has a rich understory of nemoral flora, formed by forbs, grasses, ferns and large-leaved shrubs with shiny leaves, as well as some climbers (e.g., *Rubia occidentalis*, *Rosa mandonii*). Natural clearings and edges exhibit forb communities with *Pericallis aurita* (syn. *Senecio aurita*), *Ranunculus cortusifolius* ssp. *major* and *Geranium palmarum*. Most notable are the woody tall caulirosetted communities dominated by *Sonchus fruticosus*, *Isoplexis sceptrum* (syn. *Digitalis sceptrum*), *Melanoselinum decipiens* (syn. *Daucus decipiens*), *Euphorbia mellifera* and *Musschia wollastonii* (Campanulaceae). These communities (*Euphorbion melliferae*) are an example of neoendemic flora relatable to the 'island woodiness syndrome'. Several fern communities are also present. Along the streams, riverine forests can be observed (*Diplazio caudatae-Perseetum indicae*), as well as communities dominated by the large-frond *Woodwardia radicans* (*Carici lowei-Woodwardietum radicans*). On the earthy slopes along the water channels, the fern community *Selaginello denticulatae-Cystopteridetum* is most common. Other notable communities are those of *Deschampsia argentea* on water film waterfalls; and of *Sambucus lanceolata* at the base of larger waterfalls.

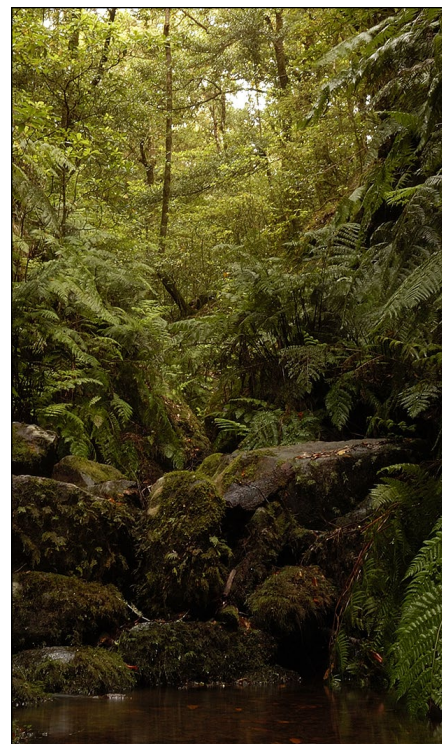
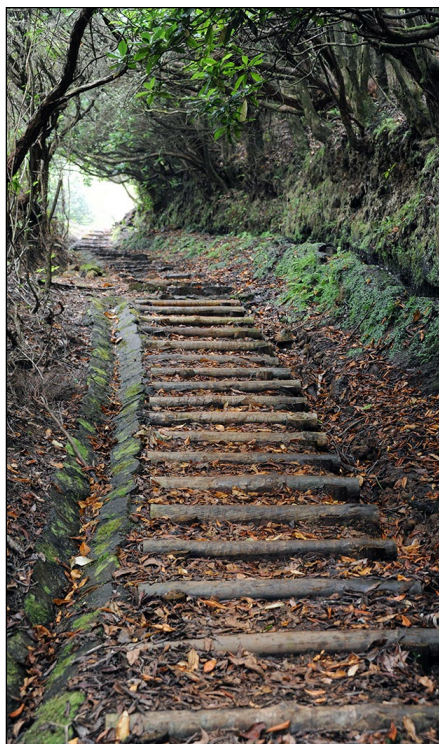


Figure 22: Excursion #6 - Landscape and vegetation types along the trail

Mid-Symposium Excursions guide – Wednesday 18

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INDEX OF AUTHORS

Index of Authors

A

Avvik, Tsipe OC58
Abdoli, Asghar OC167
Abedi, Mehdi OC32
Abella, Scott R. OC113
Ačić, Svetlana OC3; P48
Acosta, Alicia OC29; P73
Acosta, Alicia Tr P56; P98
Acuña-Tarazona, Margoth OC122
Adámek, Martin OC78
Aguair, Carlos OC34
Aguair, Francisca C. OC27
Ahmadzadeh, Faraham OC167
Aicher, Severin P24
Alberti, Davide OC137
Alberti, Giorgio OC20; OC69; P4
Alberti, Juan OC53
Alegro, Antun P55
Almeida, Rubim OC158
Altesor Hafliiger, Alice P90
Altesor, Alice OC71
Alvarez Martínez, Jose Manuel OC45
Alves, Cristiana OC34
Alves, Paulo OC34
Alvim, Francine Seehaber OC122
Anderson, Rick P81
Andjic, Branko P46
Andrade, Bianca OC71
Andrade, Tiago P5; P6; P66
Andreatta, Davide OC37
Andreiev, Artem P61
Angiolini, Claudia OC82; P98
Apostolova, Iva P1
Applová, Markéta OC108
Arenas-Castro, Salvador OC49
Argagnon, Olivier P54
Arraiano-Castilho, Ricardo OC158
Asensio, Sergio OC32
Asquini, Edoardo OC69; P4
Asri, Younes OC21
Attorre, Fabio OC18; OC124
Aubert, Michaël OC61
Augutis, Danas P74
Axmanová, Irena OC9; OC43; OC133; P57
Ayushi, Kurian OC47
Azevedo, Herlander OC158

B

Bacaro, Giovanni OC20
Bacon, Jérémy OC89
Bagella, Simonetta OC48; P102
Bairos, Célia P5; P6; P7; P66; P87
Baldauf, Selina OC24; P27
Baránková, Zuzana P84
Barbosa, Daniel E. F. OC122
Bart, Vandevoorde OC54
Barták, Vojtěch OC9; P98
Batke, Sven P. OC122
Bashirzadeh, Maral OC162
Basílio, Geicilaine A. OC122
Bátori, Zoltán P1; P62
Bazan, Giuseppe OC121
Bazzichetto, Manuele OC9; OC29; OC59; P98; P102
Beccari, Eleonora OC17; OC166
Becker, Thomas OC10
Beierkuhnlein, Carl OC113; P41
Beja-Pereira, Albano OC158
Bellingham, Peter OC56
Belmonte Torres, Jokin P93
Belote, Travis OC113
Benavides, Ana María OC122
Benesperí, Renato P2
Bergamin, Rodrigo OC71

Bergamin, Rodrigo Scarton OC1
Bergmann Carlucci, Marcos OC1; P78
Bergmann, Joana OC24
Bergmeier, Erwin OC35; P43; P51; P53
Bernhardt-Römermann, Markus OC113
Bertacchi, Andrea P98
Bertolli, Alessio OC37
Bita-Nicolae, Claudia OC130
Bittebiere, Anne-Kristel OC89
Biurrun Galarraga, Idoia OC88
Biurrun Galarraga, Miren Idoia P93
Biurrun, Idoia OC100; OC132; OC133; P25; P44
Bizilya, Andrii P79
Blaum, Niels OC32
Blumetto, Oscar P88
Blum, Christopher T. OC122
Bobek, Přemysl OC78
Boch, Steffen OC133
Boelter, Carlos R. OC122
Bogdanović, Sandro P55
Bonari, Gianmaria OC37; OC55; P98
Borovyk, Dariia OC24; OC43; OC100; P25; P27; P44; P91; P99
Borsukevych, Liubov OC136; P42; P92; P99
Borza, Sándor P62
Boscarol, Giacomo OC69; P4
Boscutti, Francesco OC20; OC69; P4
Bosiacka, Beata P68
Bosiacki, Mateusz P68
Botta-Dukát, Zoltán OC165; P1
Bragina, Tatyana P62
Brancalion, Pedro H. S. OC122
Branquinho, Cristina P95
Breg Valjavec, Mateja P23; P45
Brétt, Dominik OC78
Bricca, Alessandro OC37; OC55; OC137
Bridges, Edwin OC116
Briozzo, Ian OC83
Brožková, Lucie P72
Bruelheide, Helge OC9; OC19; OC113; P20; P41; OC170
Brúna, Josef P35
Bruzzaniti, Vanessa OC119
Brzezińska, Marta P4
Bu, Chongfeng OC32
Buday, Andrea OC154
Budzhak, Vasyi OC24; P27; P49
Buffa, Giorgio OC127
Buffi, Francesca OC18
Buisson, Elise OC7
Burns, Bruce OC56
Burrascano, Sabina P25
Burst, Maxime P54
Buzhdygan, Oksana OC24

C

Cadez, Luca OC69
Calbi, Mariasole OC114
Caleño Ruiz, Blanca Luz OC17
Calviño Cancela, Maria P111
Câmara, Maria P66
Campana, Sofia OC53
Campetella, Giandiego OC99
Campos Prieto, Juan Antonio P93
Campos, Juan Antonio OC66; OC133
Cancian, Leonardo OC155
Cangelmi, Giacomo P41
Canullo, Roberto OC99
Capelo, Jorge OC11; OC12; OC34; P59; P87
Carboni, Marta OC29; P73
Carlos Vila-Viçosa, Carlos OC49
Carlucci, Marcos P95; P96; P97

Carmine Guarino, Carmine OC121
Carmo, Marta R. B. DO OC1
Carmona, Carlos P. OC75; P9
Carmona, María Judith OC122
Čarni, Andraž OC130; OC133; P23; P45
Carsten, Hobohm OC25; OC131
Carvalho, Luciana P. OC122
Casazza, Gabriele OC83
Cascone, Silvia OC101
Casolo, Valentino P4
Castello, Miris OC20
Castillo Ruiz, Carolina P8
Castro Bermejo, Pablo P77
Castro, Sílvia P5
Catterou, Manuella OC16
Cavalin, Pedro P97
Cavalin, Pedro O. OC1
Cazzolla Gatti, Roberto P101
Celi, Luisella P36
Čeplová, Natálie OC72
Cerabolini, Bruno OC83
Červená, Lucie P72
Chase, Jonathan OC24; OC106; P27
Chelli, Stefano OC99
Chiarucci, Alessandro OC97; OC117; OC119; OC137; P41
Chiminazzo, Marco P10
Chiminazzo, Marco Antonio OC28
Chipperfield, Joseph OC57
Chmieleski, Jana P4
Chudá, Juliána P15
Chusova, Olga OC136
Chusova, Olha OC24; P24; P27
Chytrá, Helena P91
Chytrý, Kryštof P91
Chytrý, Milan OC9; OC36; OC43; OC72; OC102; OC130; OC132; P53; P57
Cianciaruso, Marcus P95
Čiliak, Marek OC41
Cingano, Paolo OC69
Cipa, Juraj OC41
Clark, Adam T OC36
Clark, Adam Thomas OC59
Clarke, Charl OC140
Closset, Deborah P58
Cobo, Mary Carmen OC159
Collado Hernández, David P109
Conley, Jordan OC51
Consortium, Darkdivnet OC74; OC75; OC77
Consortium, Eive P24
Consortium, Eva OC100; OC119
Consortium, Gloria Europe P116
Consortium, Grassplot OC100
Consortium, Square Foot OC39
Consortium, The Grassplot P25
Contributors, Lotvs OC59
Cordier, Florian OC98
Coutinho, Andre P95
Cramer, Michael OC149
Crandall, Raelene OC116; P81
Craven, Dylan OC113
Csecerits, Anikó P49; P76
Csiky, János P49
Čuda, Jan P72
Čuk, Mirjana OC81
Cupertino, Arthur OC138
Cupido, Clement OC50; OC79; P86; P100
Custerevska, Renata P46
Czarniecka-Wiera, Marta OC73; P33; P75

D

Dairel, Mariana OC31
Dalbeto, Andra OC135

Dalle Fratte, Michele OC83
Damasceno, Gabriella OC9; OC19; OC113; OC155; P10; P20; P41; P70
Danihelka, Jiří OC72
Dar, Ashaq Ahmad OC47
Data Contributors, Grassplot P44
Datsiuk, Vadym P82
Davydov, Denys P82
Davydova, Anastasia P82
Dawson, Hilary Rose OC148
Dayneko, Polina OC90; P15; P99
De Bello, Francesco OC107; OC120; OC137; P13
De Benedictis, Luciano Ludovico Maria OC99
De Brabandère, Nicolas OC85
De Oliveira, Ricardo P97
De Sanctis, Michele OC18; OC124
De Santis, Simone OC49
De Simone, Leopoldo OC82
De Toma, Andrea P73
Deák, Balázs P1; P62; P106
Dechoum, Michele OC71
Decocq, Guillaume OC15; OC16; OC169; P58
Dell'olmo, Lorella P2
Demalach, Niv OC64
Dembicz, Iwona OC100; P25; P44
Deng, Tao OC123
Dengler, Jürgen OC39; OC100; OC133; P24; P25; P44
Devánová, Katarína P107
Di Musciano, Michele OC37; OC119; P41
Di Vita, Luca OC154
Diaz Cando, Patricia Elizabeth P112
Díaz, Sandra OC113
Didukh, Yakiv OC136
Diekmann, Martin OC10
Dierschke, Jochen OC10
Dimitrellos, Georgios OC96
Dimitrov, Marius OC134
Dinis, Marco P111
Divišek, Jan OC43; OC72; P57
Do Carmo, Marta P97
Dolezal, Jiří OC113
Dölle, Michaela OC13
Domes, Gesa OC112
Dominguez Lozano, Felipe OC118; P77; P109
Donadieu, Maéva OC155
Doni, Lucia OC83
Dorigatti, Lucio OC37
Đrevojan, Pavel OC43; OC72
Du Toit, Stephen P86
Duarte, Leandro D. S. OC1
Dúbravková, Daniela P84; P85; P107
Dubyna, Dmytro P82; P92
Dufour, Simon OC138
Duke Moe, Elizabeth OC148
Dullinger, Stefan OC36
Dupouey, Jean-Luc OC16
Dupré, Cécilia OC10
Durigan, Giselda OC135
Dvorak Barboza, Adler P78
Dyderski, Marcin K. P49
Dziuba, Tetiana P49; P82
Dziuba, Tetyana P92

E

Ebrahimí, Elham OC167
Eckersley, Jake OC23
Edwards, David OC111
Egelkraut, Dagmar OC148
Einzmann, Helena J. R. OC122

Index of Authors

- Eisenhauer, Nico OC113
Eldridge, David OC32
Elias, João P.C. OC122
Elliott, Toby OC56
Engel, Rita P106
Erdős, László OC81; OC139
Erskine, Raymond OC51
Espinosa Del Alba, Clara OC129
Espinoza Ami, Francis David OC154
Essl, Franz OC9; OC36; P49
Eusebio Bergò, Simone P14; P36
Eymar-Dauphin, Pauline OC89
- F**
Fabšičová, Martina P12
Fahs, Nina OC133
Fajardo, Alex OC32
Fajmon, Karel P107
Fanfarillo, Emanuele OC82
Farcomeni, Alessio OC18
Farsund, Peter OC104
Farzam, Mohammad OC32
Fazan, Laurence OC95
Felbaba-Klushyna, Lyubov P79; P82
Feldis, Danaë OC98
Fenesi, Annamária OC154
Fernández, Manuel OC122
Fernández-González, Federico P113
Fernando T., Maestre Gil P11
Ferrara, Arianna OC137
Ferreira, Elielson P96
Ferreira, Elielson Lucas OC1
Ferreira, Maria Zita P7
Fiaschi, Tiberio OC82
Fidelis, Alessandra OC28; OC31; OC155; P10; P70
Field, Richard P41
Fill, Jennifer OC116; P81
Finca, Andiswa OC50; P100
Fischer, Felícia M. OC120
Fletcher, Linda P86
Foggi, Bruno P2; P98
Font, Xavier P53
Foremnik, Kacper OC40; P105
Forster, Jodene P100
Francesco, De Bello OC59
Franklin, Scott OC51
Fratarcangeli, Carlo OC18
Frattaroli, Anna Rita P41
Fuchs, Stefan OC70
Fujihara, Michiro P69
Fujinuma, Junichi OC17; OC76
Fujiwara, Kazue OC80
Fűrész, Attila P38
Furtado, Samyra G. OC122
- G**
Gago Pagán, Ana P109
Gaitán, Juan J OC32
Gallé, Róbert P62
Galvagno, Marta P36
Galvánek, Dobromil P84
Garbolino, Emmanuel OC133
García, Cristina OC158
García, Miriam OC46
García-Gómez, Miguel OC32
García-Mijangos, Itziar OC66
Gardossi, Anna Lilian P4
Garfi, Giuseppe OC95
Gargiulo, Sara P4
Garnier, Eric OC120
Gasper, André L. de OC122
Geange, Sony OC104
Geange, Sonya OC148
- Gebler, Daniel OC141
Genduso, Emanuele P26
Gennai, Matilde P98
Geraci, Anna OC121; P26
Gerhold, Pille P40
Gholizadeh, Hamid OC21; OC22
Giacom, Letícia P70
Giancola, Carmen P26
Gillet, François P24; P44
Gingano, Paolo P4
Glaser, Michael P49
Gliesch, Mariana OC1
Godó, Laura P62; P106
Gogniat, Lola P58
Góis-Marques, Carlos A. P8
Golub, Valentin OC130
Gomes, Catarina P5; P6; P66
Gonçalves, João OC49; P111
González Le Barbier, Jorge OC44
González-García, Víctor OC14
Götzenberger, L OC120
Götzenberger, Lars OC59; OC91; OC115; P13
Gouveia, Manuela P5; P6; P7; P66
Gozalo, Beatriz OC32
Graff, Pamela OC53
Grammer, Benedikt P116
Greve, Michelle OC149
Gristina, Alessandro Silvestre OC95; P26
Guallichico Suntaxi, Luis Roberto OC154
Guarino, Riccardo OC95; P25; P26; P44
Gudžinskas, Zigmantas P74
Guerreiro, Victor Hugo OC97
Guerrero Ramírez, Nathaly OC147
Guerrina, Maria OC83
Guido, Anaclara OC71; P88
Guiller, Annie OC16
Guirado, Emilio OC32
Gusse, Chavdar OC134
Guzmán-Jacob, Valeria OC122
- H**
Habel, Michał P4
Hähn, Georg OC19; P20
Hájek, Michal P57
Hájek, Tomáš OC91; OC109
Hajian-Forooshani, Zachary OC106
Halada, Luboš P84
Halbritter, Aud OC148
Halbritter, Aud Helen OC104
Halvorsen, Rune OC57
Hamzeh'ee, Behnam OC21
Hausharter, Johannes P116
Havlicek, Marek OC70
Hebda, Grzegorz P31
Hederová, Lucia OC62
Hédl, Radim P12
Hedwall, Per-Ola P37
Hegedúsová Vantarová, Jana P84
Hegedúsová Vantarová, Katarína P84
Hegedúsová, Katarína P85
Heinken, Thilo OC112; OC133
Heinrichs, Steffi OC13
Helm, Aveliina OC26
Helm, Norbert P116
Hennekens, Stephan P51; P53
Herben, Tomas OC105
Hering, Robert OC32
Hernández Mateo, Laura P109; OC118
Hernandez, Lucas OC15
Hietz, Peter OC122
Hipp, Andrew OC158
Ho Vu, Khanh OC81
Hoffman, Timm P110; OC149
- Hoffmann, Károly P38
Holubová, Dana OC132
Hölzel, Norbert OC5
Honrado, João OC34; OC49
Horváthné Baracsi, Éva P38
Horváthné Baracsi, Éva Horváthné Baracs P80
Hoss, Daniela OC106
Houtepen, Erik OC143
Hrázský, Záboj P72
Hrivnák, Richard OC130
Hubáčková, Barbora OC3
Hülber, Karl OC145; P116
- I**
Iakushenko, Dmytro P39
Iana Leite Jardim, Raissa OC1; P78
Iaria, Jacopo OC97
Ibáñez, Ricardo OC115
Iemelianova, Svitlana OC24; OC102; OC130; P27; P39
Indreica, Adrian OC55
Iosif, Corina P99
Irumé, Mariana V. OC122
Isbell, Forest OC113
Iuga, Anamaria P99
- J**
Jacek, Urbaniak OC163
Jakob, Aljaž P23; P45
Jamrichová, Eva P57
Janďt, Ute. OC170
Janíková, Eva OC91; OC108; OC109
Janišová, Monika OC3; P84; P99; P107
Jansen, Florian OC100; P24; P53
Janssen, Johann OC55
Janssen, John OC143
Jardim, Raissa P96
Jardim, Raissa Iana P97
Jarolímeck, Ivan OC90; P15; P49; P94
Jasprica, Nenad P3
Jehle, Janusch OC168
Jentsch, Anke OC113; P41
Jewtitz, Sabina OC30
Jílková, Veronika OC91
Jiménez-Alfaro, Borja OC22; OC122; OC128
Jiménez-López, Derio Antonio OC122
Jongepierová, Ivana P107
Jouy, Florent P4
Jucker, Tommaso OC29
Jusik, Szymon OC141
- K**
Kaasik, Ants OC58
Kadaš, Daniel P91
Kalníková, Veronika OC130
Kalusová, Veronika OC43; OC72
Kambach, Stephan OC113
Kamil, Konowalik OC163
Kanda, Naveen Babu OC47
Kardol, Paul OC104
Karner, Marina OC145
Károlyi, Evelin OC154
Kasari-Toussaint, Liis OC26
Kattenborn, Teja OC168
Kattge, Jens OC113
Kausarud, Håvard OC104
Keil, Petr OC36; OC59
Keire, Lauma P60
Kelemen, András P1; P62
Kende, Zoltán P38
Kermavnar, Janez P115
Kertész, Miklós OC87
- Kessler, Michael OC39; OC122
Khodosovtsev, Oleksandr OC136
Kieffer, Adele P58
Kindler, Christian OC94
Kish, Roman P107
Kiss, Orsolya P62
Kiss, Réka P1; P106
Kisvarga, Szilvia P80
Kitryté, Neringa P22
Klímes, Adam OC57
Klímová, Barbora OC43; OC72
Klínerová, Tereza OC62; P35
Klipel, Joice OC1
Knollová, Ilona OC9; OC43
Knopp, Vlastimil OC41
Knotková, Kateřina OC133
Kollár, Michal OC2
Kollert, Andreas P116
Kollmann, Johannes OC155
Kolombová, Natálie P72
Kolomytsev, Grygoriy OC136
Konečná, Marie OC91; OC108; OC109
Kopecký, Martin OC62; P35
Korom, Eszter P106
Korzniuk, Kirill OC144
Kotowski, Marcin Andrzej P31
Kotrík, Marek OC41
Kovács, Bence P1
Kovacsics-Vári, Gergely OC8; OC154; P112
Kovalenko, Oleksii P39
Kozłowski, Gregor OC95
Kozyr, Mykola P39
Kreft, Holger OC122; OC147
Krejčová, Michaela P91
Kreyling, Jürgen OC113
Kröel-Dulay, György OC87
Krömer, Thorsten OC122
Kupková, Lucie P72
Kupnicka, Patrycja P68
Kusak, Barbara OC30
Kushbokov, Abdubakir P106
Kušková, Klára P72
Kutlvašr, Josef P72
Kutnar, Lado P115
Kuzmko, Anna OC24; OC100; OC136; P27; P99; P107
Kůzmič, Filip P51; P53
Kvakovska, Inna P107
- L**
La Bella, Greta OC29; P73
La Montagna, Dario OC124
Ladouceur, Emma Rachel OC24; P27
Lagnaz, Danièle P4
Laiz Alonso, Pablo P35
Lájer, Konrad OC130
Landucci, Flavia OC130
Langlois, Estelle OC61
Lanta, Vojtech OC113
Larsson, Dennis OC160
Laskurain Ayastuy, Nere Amaia OC88
Laughlin, Daniel C. P20
Lázaro-Lobo, Adrián OC67
Lazzaro, Lorenzo P2
Le Gouëf, Yuna OC15
Le Roux, Peter C. OC32
Le Stradic, Soizig OC113; OC155
Le, Thuy Hang OC55
Leclere, Thomas P40
Leder, Cintia V. OC32
Lee, Seungmin OC52; P104
Lee, Sle-Gee OC52; P104
Lena, Neuenkamp P11
Lengyel, Attila P76

Index of Authors

Lenoir, Jonathan OC15; OC169

Lepš, J OC120

Lepš, Jan OC91; OC113; OC115

Lerda, Cristina P36

Letizia, Di Biase P56

Letsoalo, Ngoako P100

Lezama, Felipe OC71; P88

Li, Xinhao OC32

Li, Zhimin OC123

Liebenberg, Rita P86

Liira, Jaan OC33

Link, Roman Mathias P43

Linstädter, Anja P32

Lipoma, María Lucrecia OC113

Lisner, Aleš OC91; OC103; OC108; OC109

Lisztes-Szabó, Zsuzsa P38

Livornese, Martina P101

Löhmus, Kertu OC33

Lombardi, Danilo OC18

Londoño Jiménez, Manuela OC70

López-Carrasco, Celia P113

Lososová, Zdeňka OC9; P53

Lotvs Consortium, The OC120

Louw, Michelle A. OC32

Lozanovska, Ivana OC27

Lukács, Katalin P1; P106

Lynch, Kevin OC101

Lysák, Jakub P72

M

M. Schneeweiss, Gerald OC160

Maccherini, Simona OC82; P98

Macek, Martin OC62; P35

Machado, Giesta Maria O. OC122

Madalcho, Akliu B. P105

Madar, Szilvia OC8; OC154

Maděra, Petr OC124

Maestre, Fernando T. OC32

Magdalena, Szymura OC163

Magnes, Martin OC3; P99; P107

Magri, Donatella OC49

Mahdavi, Parastoo OC21

Mahecha, Miguel OC168

Makohl, Liesa OC13

Malatesta, Luca OC124

Malavasi, Marco P21; P102

Máliš, František OC41

Mandžukovski, Dejan OC134

Manganye, Fortune OC79

Mankiewicz, Agnieszka P24

Manninen, Outi OC113

Manrique, Esteban OC94

Manuel, Delgado Baquerizo P11

Manzaneda, Antonio J. OC32

Manzano, Pablo OC65

Marais, Eugene OC32

Marcenò, Corrado OC95; OC132; P26

Marcos, Bruno P111

Maria-Vázquez, Francisco OC158

Mariotte, Pierre OC113

Mariotti, Mauro OC83

Markisic, Halil P46

Marose, Itay OC64

Maroto Gimena, Teresa OC129

Marques, Márcia P97

Marques, Marcia C. M. OC1

Martínez-Meléndez, Nayely OC122

Martínez-Valderrama, Jaime OC32

Martín-González, Esther P8

Martins, Pedro Luiz S. S. OC122

Martti, Vasar P11

Marzalletti, Flavio P73

Massimi, Marco OC18

Mastrogianni, Anna OC134

Matej, Sarah P116

Matevski, Vlado P46

Matsumura, Toshikazu P18

Mayr, Andreas P116

McLaughlin, Michell OC51

Mcintosh-Buday, Andrea OC8; OC139; P112

Medina, Edier Soto OC122

Medvecká, Jana P49

Melicher, Jakub P84

Melis, Raimondo P102

Mello, Rodrigo de Macêdo OC122

Mendes, Alex F. OC122

Mendieta Leiva, Glenda OC122

Menezes de Sequeira, Miguel OC11; P5; P6; P7; P8; P59; P66; P87

Mermillod-Blondin, Florian OC89

Meserszmit, Mateusz P114

Mesipuu, Meeli OC58

Mesquita, Sandra OC11; OC12; P59

Míchalková, Michaela OC90; P15

Midolo, Gabriele OC36

Mikula, Karol OC2

Mikulenkova, Linda OC42

Milanovic, Djordjije P46

Minuto, Luigi OC83

Misuri, Alice P2

Miszalski, Zbigniew P31

Mojzes, Andrea OC87

Mola Caballero De Rodas, Ignacio P77

Molina, Cecilia OC53

Molina, José Antonio OC130

Mollashahi, Hassanali OC142; P89

Molnár V., Attila OC151

Molnár, Attila OC8

Monegi, Piet OC79

Montes Pita, Fernando OC118; P109

Moora, Mari OC74

Moore, Caitlin OC23

Mora, Juan P. OC32

Moradi, Halime P30

Morley, Terry OC101

Moro, Daniel P4

Mortara, Sara R. OC122

Morton, Oscar OC111

Mosig, Clemens OC168

Moudrý, Vítězslav P21

Moysiyenko, Ivan OC4; OC136

Mrázková, Marie P12

Mugnai, Michele P2

Müller, Elisabeth OC10

Muller, Francois OC79

Müller, Sandra C. OC1

Müller, Sandra Cristina OC7

Müllerová, Jana OC78

Muñoz Gómez, Guillermo P113

Murillo, Raytha OC156

Muschamp, Mario P81

Myśliwy, Monika P68

N

Naas, Adam OC57

Nacheva, Veradina P47

Naimi, Babak OC167

Naqinezhad, Alireza OC21; OC22; OC111; OC162

Narayanan, Ayyappan OC47

Narayanaswamy, Parthasarathy OC47

Nardy, Camila OC122

Navas Sastre, Sandra OC118; P109

Nazarov, Momchil P49

Nemček, Vladimír OC90; P94

Neto, Luiz Menini OC122

Neupert, Markus OC61

Ngoako, Letsoalo OC50

Nicolas, Gross P11

Niinemets, Ülo OC63

Nogaro, Géraldine OC98

Noroozi, Jalil OC21; OC38; OC160

Nowak, Arkadiusz P31; P33

Ntombela, Khululwe P100

Nuhličková, Soňa OC90

Nunes, Alice P95

O

Oddi, Ludovica OC127; P36

Oddo, Elisabetta P26

Oliveira, Ricardo A. C. OC1

Oliveira, Rodolfo de Paula OC122

Olmo, Valentina OC20

Ónodi, Gábor OC87

Ónodi, Ildikó OC87

Oosterlynck, Patrik OC130

Oravil, Šimon OC3

Orláci, László P80

Orzan, Lorenzo OC20

Orzell, Steve OC116

Ostrowski, Grzegorz P24

Overbeck, Gerhard OC7; OC71

Ožvat, Aneta OC2

P

Pachedjjeva, Kalina OC134; P47; P50

Pacina, Jan OC78

Padullés Cubino, Josep OC9; OC133; P116

Paganelli, Bruno P71

Palla, Balázs P38

Palpurina, Salza P1; P26; P107

Pañella, Pedro P88

Papastergiadou, Eva OC96; OC130

Parodi, Laure P58

Pärtel, Meelis OC74; OC75; OC77; P71

Pashkevych, Natalia P108

Pashkevych, Nataliia P65

Pasta, Salvatore OC95

Paura, Bruno P26

Pavanetto, Nicola OC63

Pellegrini, Elisa P4

Penksza, Károly P38

Pereira, Ana Clara A. OC122

Pereira Coutinho, António P6

Pereira Giacom, Letícia OC28; P10

Pereira, Marcelo P88

Perelman, Susana OC71

Perez Carmona, Carlos OC77

Pergl, Jan P72

Perglová, Irena P72

Perraudin, Viviane OC95

Perrone, Michela OC59; P21; P102

Perry, George OC56

Peter, Guadalupe OC32

Petruaitis, Lukas P22

Petruzzellis, Francesco OC20

Phiri, Akuonani OC148

Phoko, Motswapo OC79

Piccini, Irene OC127

Piégay, Hervé OC98

Pielech, Remigiusz OC40; OC100; P25; P44; P67

Pillaca, Luis OC122

Pillar, Valério OC164

Pillar, Valério D. OC1

Pino, Raquel OC46

Pipke, Christian OC131

Pires Ferraz Trindade, Diego OC17

Plaza, César OC32

Pollo, Alessandra OC127

Poppenwimer, Tyler OC64

Porto, Ana OC7

Postigo-Mijarra, José María P8

Potůčková, Markéta P72

Pouteau, Robin P50

Prangel, Elisabeth OC26

Preislerová, Zdenka OC132

Prigioniero, Antonello OC121

Prokopuk, Mariana P61

Prosser, Filippo OC37

Prylutskiy, Oleh OC136

Puchałka, Radosław P49

Puglielli, Giacomo OC63; OC86

Pugnaire, Francisco I. OC94

Puijalon, Sara OC98

Pule, Gilbert OC50; OC79; P100

Pulina, Antonio OC48

Pusz, Wojciech P31

Pyšek, Petr OC72

Pyšek, Petra P72

Q

Qu, Laiye P103

Quaresma, Adriano C. OC122

Quiel, Calixto Rodríguez OC122

Quintana, José Ramón OC46

R

Rabyk, Iryna P83

Rádai, Zoltán P1

Raduła, Małgorzata OC30; OC142; P33; P114

Ramos, Flavio N. OC122

Ramzi, Soghra OC21; OC22

Rašomavičius, Valerijus P74

Rasse, Léo OC98

Rédei, Tamás P49

Reich, Peter OC113

Reitalu, Triin OC26

Remy, Dominique OC35

Renault, David OC89

Renton, Michael OC23

Resurveyeurope Data Contributors OC9

ReSurveyGermany contributors OC170

Rewicz, Agnieszka P68

Rey, Pedro J. OC32

Řezníčková, Marcela OC132

Ricci, Lorenzo P41

Riibak, Kersti OC74

Rimac, Anja P55

Ríos Mendaro, Cecilia P90

Risch, Anita C. P21

Rivaes, Rui Pedro OC27

Rivieccio, Giovanni OC48

Rocchini, Duccio OC110

Rodríguez Alarcon, Slendy P9

Rodríguez González, Patricia OC88

Rodríguez-González, Patricia OC138

Rodríguez-Rojo, María Pilar P113

Roggero, Pier Paolo OC48

Roig-Gómez, Sonia P113

Roleček, Jan P49

Rolim, Rosangela OC71

Rosa-Manzano, Edilia de la OC122

Rossi, Christian P21

Rötzer, Harald P107

Rozenblit, Yuliia P64

Rozman, Andrej P52

Rueda, Marta OC63

Ruppert, Jan OC113

Ruprecht, Eszter OC139

Rusina, Solvita P60

Ružičková, Jana P85

Index of Authors

- S**
Sabatini, Francesco P20
Sabatini, Francesco María OC113
Sádlo, Jiří P49; P72
Saláta-Falusi, Eszter P38
Samuels, Igshaan OC50; OC79; P100
Sanchez De Díos, Rut P77
Sánchez-Carmona, Sara OC66
Santi, Francesco OC119
Santoianni, Lucia Antonietta P73
Santos Da Silva, Gabriela OC28; P10
Sanz-Zubizarreta, Irati OC88
Sarmati, Simona P56; P98
Sauberer, Norbert OC145
Sauerwein, Martin OC55
Sayen, Stephanie P58
Schicchi, Rosario OC121
Schlicksteiner, Julia OC148
Schmidt, Wolfgang OC113
Schüle, Maren OC112
Schumacher, Emily OC51
Schwanitz, Christofer OC112
Scuderì, Leonardo OC95
Seddon, Alistair OC57
Šegota, Vedran P55
Segrestin, Jules OC91; OC108; OC109; P13
Seifert, Andrew P20
Semelbauer, Marek OC90
Serrano-Zulueta, Rubén OC65
Seymour, Colleen P110
Sgadari, Francesco OC121
Shechepeleva, Olena OC4
Shevchyk, Vasyl P39
Shyriaeva, Dariia P107
Šibík, Jozef OC2; OC36; OC90; P15; P94
Šibíková, Mária OC2; OC90; P15; P49; P94
Siccardi, Eugenia P2
Sigura, Maurizia P4
Silc, Urban P46
Silva, Gabriela P70
Silvia, Del Vecchio P56
Silvoso, María Celeste OC53
Šimanskaitė, Viltė P22
Simon, Laurent OC89
Siniscalco, Consolata OC127; P14; P36
Sinkevičienė, Zofija OC130
Siqueira, Tadeu OC152
Širka, Pavel OC3; P99; P107
Sirvent, Laure P54
Sitzia, Tommaso P49
Skobel, Nadiia OC4
Škodová, Iveta P84; P85; P99; P107
Skokanová, Hana OC36; OC70
Skowno, Andrew OC149; P110
Slabejová, Denisa OC90; P15; P49
Smit, Imke C. OC32
Soares, Paulo OC34
Söber, Virve OC58
Sojka, Mariusz OC141
Somfalvi-Tóth, Katalin P38
Sonkoly, Judit OC8; OC151; OC154; P112
Sopotlieva, Desislava P1
Sorescu-Marinković, Annemarie OC3
Spada, Francesco OC49
Sperandii, Marta Gaia OC9; OC29; OC59; P56; P98
Splot Consortium, Splot Consortium OC19
Stančić, Zvezdana OC130
Stanisci, Angela P73
Stanisic-Vujacic, Milica P46
Stavi, Ilan OC32
Stefanidis, Kostas OC96
Sternberg, Marcelo OC60
Stesevic, Danijela P46
Strazdina, Liga P60
- Streit, Helena OC71
Strengbom, Joachim P37
Šumberová, Kateřina OC130
Sun, Hang OC123
Surmacz, Bartłomiej OC40; P67
Šuvada, Róbert P107
Süveges, Kristóf OC151
Švancárová, Tereza OC91; OC108; OC109
Svenning, Jens-Christian OC133
Svoboda, Josef OC70
Svobodová, Petra P72
Swacha, Grzegorz OC30; P114
Świerszcz, Sebastian OC30; OC73; OC142; P31; P33
Szabó-Szöllösi, Tünde Irén P38
Szatten, Dawid P4
Szél-Tóth, Katalin OC8
Szentes, Szilárd P38
Sztár, Katalin OC87
Szöke, Antal P38
Szoszkiewicz, Krzysztof OC141
Szwagrzyk, Jerzy P105
Szymura, Magdalena OC73; OC142; P33; P89
Szymura, Tomasz OC142; OC73
Szymura, Tomasz H. P33; P89
- T**
Takács, Attila OC151
Talebi, Amir OC21; OC38
Tamjidi Eramadati, Seyed Saeedeh OC21
Tamme, Riin OC17; OC75; OC77; P9
Tanda, Alberto OC48
Tarroso, Pedro P111
Tartaglia, Maria OC121
Taylor, Amanda OC122
Teder, Tiit OC58
Teixeira, Elisa P5
Teleki, Balázs OC139
Telford, Richard OC104
Teofanova, Denitsa P50
Těšitel, Jakub OC133
Testolin, Riccardo OC117; OC119
Tetzlaff, Dörthe OC141
Theurillat, Jean-Paul OC130
Thoen, Ella OC104
Thomas, Pedro OC71
Thomas, Pedro Augusto OC7
Tichý, Lubomír OC43
Tietjen, Britta OC24; P27
Tilman, David OC113
Tjelele, Julius OC50; OC79; P100
Tofan, Gabriel OC55
Tognetti, Pedro OC53
Tokura, Wataru P110
Tölgyesi, Csaba P62
Tomao, Antonio OC69
Tomasi, Giulia OC37
Tomasi, Ricarda OC148
Tomasz, Szymura OC163
Tomchenko, Olha P61
Tonkin, Curtley P110
Topper, Joachim OC57
Tordoni, Enrico OC17; OC20
Törö, Viktória OC154
Török, Péter OC8; OC139; OC151
Törö-Szigyártó, Viktória P112
Tosheva, Anita P50
Tóth, Ágnes P106
Tóth, Benedek P106
Tóth, Katalin P112
Tóthmérés, Béla OC8; OC139; OC154; P112
Toussaint, Aurèle OC17
- Travers, Samantha OC32
Tricone, Fanny P81
Trindade, Diego OC107
Troia, Angelo P26
Trotta, Giacomo OC69; P4
Tsiripidis, Ioannis OC134
Tsoukalas, Dionysios OC96
Turisová, Ingrid P84
Tymoshenko, Pavlo P82
Tyshchenko, Oksana P16
Tyshchenko, Volodymyr P16
Tzonev, Rossen OC130; OC134; P47
- U**
Ubaldi, Tristan OC169
Uhliarová, Eva P84; P107
Ujházy, Karol OC41; P84
Ujházyová, Mariana OC41; P84
Uogintas, Domas P22; P74
Ustymenko, Pavlo P82
- V**
Vakarenko, Liudmyla P82
Valencia, Enrique OC32; P13
Valerio, Mercedes OC115
Valkó, Orsolya P1; P62; P106
Vallier, Félix OC89
Van Damme, Kay OC124
Van Der Merwe, Stephni OC149; P110
Van Proosdij, Andre OC143
Van Ruijven, Jasper OC113
Vandvik, Vigdis OC57; OC104; OC148
Vassilev, Kiril P46; P49
Večeřa, Martin OC43; OC72
Vega, Michael S. OC122
Végvári, Zsolt P62
Velasco-Flores, María Del Cristo P8
Velle, Liv OC57
Velo-Antón, Guillermo P111
Velychko, Natalia OC4
Venanzoni, Roberto OC130; P26
Vermeersch, Sophie OC54
Vetaas, Ole OC6
Vetaas, Ole Reidar P41
Viciani, Daniele P2; P98
Viik, Eneli OC33
Vila-Viçosa, Carlos OC34; OC158; P111
Virók, Viktor P107
Visser, Vernon P110
Vitale, Marcello OC18
Vitek, Vojtěch P72
Vítková, Michaela P49; P72
Vol Maltitz, Graham P110
Von Lampe, Friedemann OC35; P43
Vrbničanin, Sava P48
Vuerich, Marco OC69; P4
Vuolo, Francesco OC48
Výboštok, Jozef P15
Vymazalová, Marie OC36; P12
Vynokurov, Denys OC24; P25; P27; P44; P99
- W**
Wagg, Cameron OC113
Walbrun, Britta OC10
Wang, Lixin OC32
Wardle, David OC104; OC113
Wawagner, Viktoria OC156
Werneck, Márcio S. OC122
Werner, Florian A. OC122
Widmer, Stefan OC39
Wiedenhofer, Dominik P116
Wild, Jan OC62; P35
Willner, Wolfgang OC38; OC126; OC132
Wilsey, Brien OC113

- Winkler, Manuela P116
Wion, Gwen OC51
Wirth, Christian OC113
Wolf, Jan H. D OC122
Wysocki, Adrian OC100

- X**
Xiao, Yi P103

- Y**
Yahdjian, Laura OC53
Yari, Reza OC32
Yelyzaveta, Shpilkina P11
Yoann, Le Bagousse-Pinguet P11
Yoon, Tae Kyung OC52; P104

- Z**
Zaady, Eli OC32
Zagorchev, Lyuben P50
Zannini, Piero OC119
Zardetto, Juliano OC152
Zartman, Charles E. OC122
Zelnik, Igor OC130
Zerbe, Stefan OC55
Zhang, Yuanming OC32
Zhou, Xiaobing OC32
Zhou, Zhekun OC150
Zirondi, Heloiza Lourenço OC31
Zobel, Martin OC74
Zondani, Thantaswa P100
Zotz, Gerhard OC122
Zub, Lesya P61; P65
Zuleta, Daniel OC122
Zuzolo, Daniela OC121



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