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**ABSTRACTS & PROGRAMME**

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## Keynote Lectures

## Linking above and below ground plant community responses: a melting pot of interactions and soil heterogeneity

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Vegetation Science and, for extension, plant Community Ecology as a whole are profoundly limited by the fact that current empirical and theoretical models proceed from the aboveground compartment leaving almost untouched the below ground fraction. This is especially noticeable in the case where root biomass constitutes a very high fraction of the total carbon stock in the plant community such as in very stressful habitats. For instance, we have assisted to an important development of what has been called Coexistence Theory. It comprises deterministic and stochastic processes for explaining realized communities and co-occurring patterns at very fine spatial scales. Those scales where is thought that plant to plant interactions are prevalent and critical. However, these advances have been done by considering exclusively the aboveground cover. Here, we present a new picture coming from the inclusion of the root universe. This implies the development of techniques able to characterize the belowground structure and composition at the fine scales where interactions are critical (i.e metagenomics tools) in combination with new spatial point pattern analyses able to deep the so-called plant's eye perspective. And the construction of a new theoretical framework in which the two compartments are taken together.

## A sampling approach for habitat monitoring at national scale

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Achieving a relevant and measurable improvement in the conservation status of species and habitats of Nature 2000 network is one of the targets of the European 2020 Biodiversity Strategy. According to the “Directive 92/43/EEC”, this goal has to be accomplished by each EU member state, by maintaining a favourable conservation status of the habitats. Assessing, on a quantitative basis, the conservation status of habitats is therefore a major task for the European Union and for the member states. However, up to now, there is no consensus on how to achieve a statistically sound estimates of the abundance and status of the various habitat types and the member states are making national assessment by using various approaches.

Here, we present a sampling strategy we are developing for monitoring all the habitat types on the Italian territory, based on a multi-phase sampling scheme. General aim of this national plan is to generate a standardised, reliable and comparable approach for the quantitative assessment of the habitat amount and conservation status. The approach is based on three sampling phases, that are run separately per each habitat type: 1) phase 1 consists in selecting a spatially balanced sample of the grid cells of 10 km x 10 km that are reported to have the presence of habitat (Dir. Art. 17), The sample of grid cells selected per habitat types ranges from 100%, for rare habitat types, to 10%, for common habitat types, according to a monotonic function; 2) Then, each grid cell selected in the first phase is partitioned into 100 m x 100 m sub-quadrats, that are exploited as sampling units to select habitat patches by means of network sampling in order to estimate the habitat cover and/or the number of patches; 3) finally, a third phase sampling is performed in the field to estimate the habitat status by assessing typical vegetation attributes.

The sampling strategy here developed allows to achieve statistically sound estimates of habitat cover and status based on a sampling scheme that can be easily standardised and repeated over time. After validation of the standardized habitat multi-phase monitoring on the Italian territory, the possibility to apply the strategy at European scale could be an applicative achievement in building a shareable approach for maintaining a favourable conservation status of the Nature 2000 habitat network.

# Singularity of Iberian Mediterranean grasslands in the European context

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The Iberian Peninsula is characterized by a complex geology, a heterogeneous climate, and a biogeographical variability, influencing an environmental heterogeneity and a high plant community diversity. Additionally, the complex historical processes in the Mediterranean Basin have contributed to the Iberian diversity. Paleobotanical analyses of the location and composition of Iberian vegetation types during the whole Pleistocene and Holocene periods showed the existence of a complex patched landscape: *Pinus* woodlands, deciduous and mixed forests, shrublands, steppes and grasslands. Previous studies have related that Iberian glacial refugia were not limited to the southern territories and fall entirely within areas with an Iberian endemism rate of more than 10%. As consequence, Iberia flora has a high degree of originality, with an endemism rate of 24%.

The long history of pastoralism in the Iberia Peninsula for, at least, 4-5 millenia, have modelled the Mediterranean landscape. Iberian Mediterranean grasslands, including serial and permanent, can be classified into annual grasslands (*Tuberarietea*), annual vallicares (*Agrostion salmanticae*), perennial acidophilous grasslands (*Stipo giganteae-Agrostietea castellanae*), pseudosteppes on calcareous substrates (*Lygeo-Stipetea*), Mediterranean closely grazed grasslands (*Poetea bulbosae*), Mediterranean humid meadows (*Holoschoenetalia*), Iberian supra-cryoromediterranean silicicolous grasslands (*Festucetea indigestae*), Iberian supra-romediterranean dry calcicolous grasslands (*Festuco hystricis-Poetalia ligulatae*). The community diversity within each type of grasslands responds to a marked biogeographical pattern in the Iberian Peninsula.

Mediterranean acidophilous grasslands are largely and diversely represented in the Iberian Peninsula compared to other territories in the Mediterranean Region of Europe. Their conservation value seems to have been underestimated because of their lower species richness compared to Mediterranean grasslands on base-rich soils. However, the acidophilous grasslands are habitats of the Iberian endemic genera *Gyrocarpum*, *Hispidella*, *Odontitella*, *Periballia*, *Phalacrocarpum*, *Prolongoa* and *Pterocephalidium*, and of many other endemic species.

Iberian Mediterranean grasslands face similar threats that grasslands in other territories. In the Iberian Peninsula, sheep have been the most important livestock species and extensive livestock was an important socio-economic activity in Mediterranean areas. Rural exodus starting in the 60s and the consequent land abandonment and a decrease of extensive grazing, have provoked a large shrub encroachment. Moreover, the increase of the cattle rearing and the intensive management are also main pressures in the grassland conservation.

## Oral presentations

**Session 1. Sand dune and Halophilous Vegetation**

## Through the lens of time: experiences from a resurveying study of coastal dune ecosystems in Central Italy

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Located at the boundary between land and sea, coastal dunes are dynamic ecotones characterized by constraining environmental conditions, notable habitat heterogeneity and a highly specialized flora. However, in spite of their prominent ecological value and a wide range of socio-economic services provided, coastal dunes are listed among the most threatened ecosystems on earth, appearing worldwide squeezed between massive urbanization and global changes. Monitoring their status through time should be therefore considered as top priority for promoting the conservation and improving the management of these vulnerable ecosystems.

By allowing the quantification of community changes and the assessment of main trends, resurveying studies proved to be effective tools to track temporal changes in a variety of natural habitats.

We hereby present results from a resurveying study performed on coastal dune ecosystems of Central Italy. A set of 334 georeferenced random plots, originally sampled between 2002 and 2007 and belonging to the first portion of the coastal vegetation zonation (from upper beach communities to coastal stable dune grasslands), was resurveyed during two sampling seasons (2017-2018). To investigate community changes in composition and abundance, beta diversity metrics based on both presence/absence and abundance data were computed for each pair of old vs new plots. Each of these metrics was tested for significant differences among vegetation communities using non-parametric tests. Furthermore, changes in occurrence frequency and cover were analyzed for a set of diagnostic species in each reference community by using McNemar's tests for paired data and Wilcoxon signed-rank tests. Results suggest how, during the investigated time-span, coastal dune communities of Central Italy experienced considerable changes affecting both species composition and dominance structure. Although all investigated communities were somehow affected, upper beach communities, embryonic and shifting dunes experienced the most important transformations, as also confirmed by the analysis of diagnostic species. Specifically, the loss in both occurrence frequency and cover of *Ammophila arenaria* subsp. *australis* appears to be particularly alarming, given the key functional role played by this perennial rhizomatous grass in the dune-building process. Overall, our results suggest that the last 10-15 years brought considerable deterioration in the conditions of coastal dunes, probably induced by the combined action of multiple natural and anthropogenic drivers, and urgently call for specific conservation efforts.

## Conservation status assessment of dune habitats in two contrasting Natura 2000 sites

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The Habitats Directive (1992/43/EEC) and the Natura 2000 network are some of the main tools of the European Union policy regarding biodiversity conservation and management. The implementation of the Directive into the French law makes compulsory the conservation status assessment of Natura 2000 habitats at site level.

If some guidelines are already available, local stakeholders find them too generic, inadequate for their sites and not very useful regarding their management concerns. These observations led to a series of case studies the goal of which was to provide a methodological framework flexible enough to fit different situations while retaining its scientific relevancy.

Two case studies focusing on the same dune habitats were conducted in two contrasting Natura 2000 sites of the Languedoc (Southern France) coast. The studied habitats were the 2110 habitat: Embryonic shifting dunes, the 2120 habitat: Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) and the 2210 habitat: *Crucianellion maritimae* fixed beach dunes. The two Natura 2000 sites differed by their size, their public use, their geomorphological and phytogeographical context.

The proposed framework uses three broad parameters, mirroring those of the Habitat Directive article 17 reporting: area, structure & functions and future prospects. It has been applied in a similar way on both sites, excepted for the area parameter which needs to be tailored to the site particularities (including already available data). The structure & functions parameter works well, on the other hand the future prospects parameter proved to be more difficult to handle.

While this framework seems to be versatile enough to give results in different situations, it still needs to be implemented by specialists. The next step would be to design a simpler version that could be used directly by site managers.

## Synthetic overview of sandy vegetation of the Pannonian and western Pontic region

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Pannonian and Pontic sand dunes are one of critically endangered habitats in Europe. This vegetation is under strong anthropogenic influence. However, its value is very high, since for such habitats are related species of narrow distribution and specific affinities. This paper analyses and synthesizes the present knowledge of dry grassland vegetation on sandy soils of the Pannonian and western Pontic region.

For our analysis, we used a dataset of 97.996 plots and 21.471 species, obtained from European Vegetation Archive (EVA) and local experts. After selection of data and removal of duplicates, harmonization and verification of taxonomy and nomenclature, removal of plots dominated by shrubs and trees, the final database was formed. The analyses have been carried out on 2.672 plots and 974 species. For classification of the dataset and determination of the diagnostic species of this groups, we used a TWINSpan classification. NMDS ordination with Borhidi's indicator values and Bioclimatic variables, but also spectra of life forms according and chorological groups were applied to show the influence of ecological conditions on species composition in classification groups.

The TWINSpan classification of the of sandy vegetation of the Pannonian and western Pontic region is revealed a predominant macroclimate and biogeographical pattern. Eleven main groups were detected. This research distinguishes inland sandy vegetation in strict sense and the vegetation on skeletal soils in the Pannonian and western Pontic region. We describe the main classification groups of this vegetation according floristic diversity and environmental conditions in the research area. The whole data set shows a strong differentiation between subatlantic sanddune vegetation and (sub)continental fescue sandy steppes in the forest-steppe and steppe zones of Europe, due to differentiation of climatic subtypes and differences in the substrate. Dissimilarity based on different stages of vegetation successions and ecological differentiation of site conditions is evaluated by Borhidi indicator values, bioclimatic variables, and distribution reflected in change of chorological spectrum and ecological differentiation of site conditions.

## Syntaxonomical approach on the fruticose halophytic vegetation of Western European territories

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Over more than ten years, we have studied some taxonomical and geobotanical aspects concerning the halophytic flora and vegetation throughout the Iberian Peninsula and Western Mediterranean territories.

After several published contributions to elucidate the high diversity of different genera, we published a first approach on *Sarcocornia* (perennial *Salicornia*) plant communities from the Iberian Peninsula and Balearic Islands. Furthermore, we recently submitted for the vegetation types structured by *Arthrocaulon* (*Arthrocnemum*) *macrostachyum* including the Canary Islands saline landscapes.

The high vulnerability of the halophytic natural vegetation growing on European saline soils, appointed as prioritized EU habitats, has lead us to present a compilation of the proposed syntaxonomical scheme focusing on these fruticose halophytic vegetation types (*Salicornietea fruticosae*).

## **Session 2. High-mountain Vegetation**



## Disentangling observer error and climate change effects in long-term monitoring of alpine plant species composition and abundance

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As climate change is already transforming alpine vegetation, long-term monitoring of species composition and abundance has become increasingly important. In order to identify climate change effects, it is essential to separate them from observer errors.

In two mountain regions in the Alps, Schrankogel (AT), Hochschwab (AT), and one in the High Tatra Mountains (SK) vascular plant species presence and cover were recorded on 10-12 1-m<sup>2</sup> plots by 13-14 observers per site. The influence of plot and species characteristics on observer errors in assessing species presence, species cover and the thermic vegetation indicator (TVI) was investigated using (generalized) linear mixed-effect models. Changes over time in species turnover, cover and TVI were related to the amount of observer error using a bootstrap approach.

Species cover was the most influential factor affecting observer errors in recording of species lists, whereas observer identity had the largest influence on errors in estimating cover. Neither plot attributes nor observer identity had an influence on deviations in the TVI. The signal (species turnover, cover and TVI changes over time) significantly exceeded noise (observer errors) in all regions when monitoring periods  $\geq 10$  years were considered.

Our results underline the importance of long time series in monitoring climate change effects and may provide a guideline for the analysis of long-term monitoring data from alpine environments.

## Biogeography of alpine plant communities in southern Europe

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Understanding the diversity and distribution of alpine vegetation at the European scale has been a major challenge for the last century of geobotanical research. The classification of alpine vegetation has been mainly based on regional or national data, and we still lack a general view of (dis)similarity patterns across mountain ranges and latitudinal or longitudinal gradients. Here, we analyze alpine grasslands as a zonal vegetation type occurring above the climatic treeline in European mountains. Our study system includes high-mountain grasslands from the European Mountain System and climatic refugia for this vegetation in Southern Europe, including the Alps, the Carpathians, the Pyrenees and the mountains of the Iberian, Italian and Balkan Peninsulas. We collected an initial number of 35,102 vegetation plots stored in the European Vegetation Archive (EVA), including new data gathered in the last year for the purpose of covering data gaps. Our results show the patterns of (dis)similarity of this vegetation at the community level, using a combination of unsupervised (e.g. TWINSpan) methods and the a-priori assignment of plots to alliances. We also present the spatial distribution of major vegetation types and the role of soil bedrock, climate and geography in explaining compositional (dis)similarity. The interpretation of our results contributes to the classification of alpine vegetation and also to the delineation of historical patterns in the connection or isolation of European mountain ranges.

# Coenological and syntaxonomical features of relic populations of two *Salix* species in the high-altitude sector of the Apennines

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In this paper the phytosociology of *Salix foetida* and *Salix hastata* in the Apennines is presented. These species exhibits a high biogeographic interest as they are located at the southernmost limit of their distribution range in relic sites which are clearly separated from their centre of distribution located in the circumboreal zone (*S. hastata*) and in the Alps and the Pyrennees (*S. foetida*) respectively. As regards the Apennine range both *S. hastata* and *S. foetida* occur almost exclusively in the Laga mountains in the central Apennines (with the only exception of some isolated populations of *S. hastata* recorded for the northern slope of the northern Apennines). The phytosociological and syntaxonomic aspects of these two species were only marginally considered for the Alps and never before described for the Apennines. In the study area the *S. hastata* communities develops on humid N-facing stable screes of siliceous matrix, in conditions of prolonged permanence of the snow within the microthermic beech-wood belt. In the same geographical area but in the *Vaccinium myrtillus* subalpine belt the *S. foetida* communities characterize the gravelly floods of high-altitude streams fed by melting snow. Although these two *Salix* species are located in different altitudinal levels their communities show remarkable floristic similarities especially as regards the high-frequency species (*Parnassia palustris*, *Carex frigida*, *Jacobea alpina*). This fact would lead to hypothesize a common (absolutely preliminary) reference for the “*Salicetum hastatae*” and the “*Salicetum foetidae*” in terms of high-rank syntaxa (*Betulo-Alnetea*; *Alnetalia viridis*). The different altitudinal belt, however, lead to considerable differences in terms of companion species. The “*Salicetum hastatae*”, is in fact characterized by the occurrence of a rich *Carpino-Fagetea* and *Molinio-Arrhenatheretea* component whereas the “*Salicetum foetidae*” undergoes the entrance of species from *Scheuchzerio-Caricetea* and *Elyno-Seslerietea*. At the alliance rank there is not a suitable reference at present due to the absolutely marginal biogeographic position of the Apennines in the arctic-alpine vegetation context. In the Alps, similar communities are currently classified in *Salicion pentandrae* (*Salicion waldsteinianae*) and *Salicion helveticae*. Other possible references, especially for the *S. hastata* communities, could be the *Salicion cinereae* or *Sambuco-Salicion capreae* (less probable). Syntaxonomic references to alliances, orders and classes with a predominantly Circumboreal or Pyrenean-Alpic distribution could appear out of place for populations so separated from the rest of the syn-distribution area of these syntaxa. However, if there is a place in the Peninsular Italy where the well-known Apennine endemic (or amphi-Adriatic) coenological identity struggles to emerge, that is the Laga

mountains flyschoid massif, where the entire high-altitude vegetation mosaic (*Kobresis myosuroides*, *Salix herbacea*, *S. retusa*, and primary *Festuca paniculata*, *Nardus strictus* and *Vaccinium myrtillus* communities) appear to be quite comparable (at least physiognomically) with what is currently present in the acidic sectors of the Alps.

## Fine-scale patterns of mountain tundra vegetation

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Seven percent of the Earth's surface is covered by tundra vegetation that is common, besides arctic areas, in numerous high mountain ranges and contains ecosystems dominated by different species. These ecosystems are vulnerable by their nature, partly due to their simple structure. On the other hand, several creatures live here very close to their survival boundaries. These characteristics suggest that species of arctic-alpine communities react to global climate change in a more sensitive and faster way compared to other taxa in other plant associations. During our research the vegetation of a Norwegian tundra area has been assessed by 292 fine-scale relevés and methods of geographic information science (ArcGIS). The assessment has included the values and spatial patterns of different plant functional groups, species richness, total plant cover, Shannon diversity index and dominance relations as well as the exposition, relative altitude, slope and distance from the nearest water body. Altogether 85 plant species emerged in the relevés. As for the total cover, lichens were followed by moss species and dwarf shrubs. Concerning dominance relations of the quadrates nearly 30 patch types have been identified based on principal component analysis. As far as life forms are concerned, the share of geophytes and chamaephytes was also remarkable beside thalloid chamaephytes. The average value for Shannon diversity was 1.26, although surprisingly high figures (exceeding 2) has been calculated in four patches. The GIS maps are suitable for both long- and short-term monitoring of vegetation dynamic changes in the examined area. The research has justified that the fine-scale vegetation pattern could indicate key abiotic factors and connected to plant functional types.

## Counteracting summer drought: Osmolyte accumulation in orophytes of Mediterranean high-mountain communities

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In Mediterranean high-mountains, the constraining weight of summer drought over plant life has derived in a series of adaptations to ameliorate its impact on plant physiology such as osmolyte accumulation, i.e. proline and non-structural carbohydrates (NSC). However, such mechanisms remain unknown. We selected seven species, descriptive of the phylogenetic diversity of the high-mountain communities of Sierra de Guadarrama (central Spain), to evaluate the effects of summer drought on proline and NSC buildup along the altitudinal gradient in Bola del Mundo summit. Fully developed leaf samples were analyzed via the ninhydrin-based colorimetric assay and HPLC to quantify proline and NSC content, respectively.

Our findings revealed the essential role of osmotic regulation in Mediterranean high-mountain flora to counteract the effects of summer drought, identifying proline as the main osmolyte involved in the drought-stress response in the studied chamaephytes and hemicryptophytes. In addition, NSC buildup was also involved in counterbalancing drought stress in these species, suggesting proline and NSC accumulation are not mutually excluding mechanisms and feasibly act together to achieve optimal drought endurance in these specialists. Our results demonstrated how drought acts via thresholds in these species, triggering a response when subject to a certain drought level. Drought-thresholds and osmolyte accumulation varied among functional groups, and were strongly connected to the length and severity of drought stress. Despite these differences among species in osmolyte content, it was possible to classify them based on summer drought-induced responses as: a) resilient, i.e. most herbaceous hemicryptophytes; or b) as robust, comprising chamaephytes, plus two hemicryptophytes. Finally, these findings also underline the high resilience of these plants to summer drought. Nonetheless, their significant reaction to extreme climatic episodes highlights the potential liability of the high-mountain grassland communities from the Sistema Central to the impending coarsening of summer stress conditions in the Mediterranean basin.

## Analysis of global diversity patterns of alpine vegetation

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Altitudinal treelines represent one of the most abrupt transitions in life-forms and define the starting point of the alpine zone, the only bio-geographic unit on land with a global distribution. Here, we provide a first overview of the diversity of alpine vegetation at the global scale, considering the diversity of alpine habitats across biomes and continents. We compiled a comprehensive dataset of zonal alpine vegetation, which includes dominant plant communities above the climatic treeline dominated by cryomorphic forms of vascular plants, including graminoids, forbs and dwarf shrubs. The data was initially provided by sPlot, the global vegetation database established by the German Centre for Integrative Biodiversity Research (iDiv), with a major contribution of the European Vegetation Archive for Europe and nearby regions. We complemented such data with new records from different alpine regions to create the first dataset of global alpine vegetation, including several thousands of plots spanning from the tropical alpine Andean Páramo to the temperate alpine grasslands of New Zealand's Alps. We measured community species richness at plot level and modelled it against current and past environmental and biogeographical predictors. We also estimated regional diversity in different alpine ecoregions using extrapolation techniques and explored the relationships between diversity at the two spatial scales. Our results provide the first global assessment of the distribution of plant diversity in high mountain ecosystems and its drivers.

## Ozone risk assessment for Mediterranean high mountain grasslands at the Guadarrama Mountain range

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The present study aims to characterize air pollution levels, and their possible effects on representative high mountain grasslands of the Sierra de Guadarrama Mountains, based on the absorption of the air pollutants by plant.

The ozone (O<sub>3</sub>) levels registered during the period 2005-2017 at different altitudes at Sierra de Guadarrama, 1850 and 2262 m a.s.l., presented marked seasonal and yearly variations, but background levels were permanently high. This mountain range is chronically exposed to high O<sub>3</sub> concentrations above the thresholds for plant protection set by the European Air Quality Directive (EU/50/2008), meanwhile NO<sub>x</sub> and SO<sub>2</sub> levels were usually low except during scarce and short-term episodes. The highest O<sub>3</sub> values were recorded at the highest elevation site (2262 m a.s.l.) where the *Festuca curvifolia* grasslands community grows. This community is especially rich in endemic species protected at national and European level, representing also the southern limit of some alpine species.

Ozone is considered by the Intergovernmental Panel on Climate Change as the most harmful air pollutant affecting vegetation (IPCC 2007). The high oxidative capacity of O<sub>3</sub> alters plant biochemistry and physiology, especially affecting gas exchange and carbon allocation, with consequences for plant growth, reproductive ability and, in the end, the structure and biodiversity of the community.

Ozone effects on plant species are closer related with the absorbed O<sub>3</sub>-dose through the stomatal pores (O<sub>3</sub>-fluxes), than with the concentration of the pollutant in the air. Thus, O<sub>3</sub>-risk assessments for plant protection under the Air Convention of the United Nations (CLRTAP, UNECE) are based in the O<sub>3</sub>-fluxes methodology (CLRTAP, 2016). This methodology require the calculation of the cumulative O<sub>3</sub>-stomatal flux using the DO3SE model (Deposition of O<sub>3</sub> for Stomatal Exchange), to account for the variation in stomatal opening (and thus O<sub>3</sub> absorption) with climatic, soil and plant factors; but the model must be parameterized specifically for the different species.

Physiological plant strategies of different species sharing resources should be studied in order to understand the community response to air pollutants. Four representative species of the Guadarrama mountain grasslands were selected to study their physiological behavior under field conditions, for analyzing their potential sensitivity to the air pollutants, and to parameterize the DO3SE model: *Festuca curvifolia*, the dominant grass of the community, *Hieracium vahlii* and *Jurinea humilis*, the most abundant forbs, and *Senecio pyrenaica* an annual species. Then, the acquired database of air pollutants and meteorological parameters registered in the area from 2005-2017 were used for an O<sub>3</sub>-risk assessment thorough this period considering the selected representative species.

**Sessions 3-4. Assessment and Conservation of  
European Habitats**

## Threatened and endemic species associated with habitat types in Europe - overview

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Almost all habitat types are affected by human activities such as destruction, biological resource use, pollution, and others. This contribution deals with a quantitative analysis of five databases: *IUCN Red List of Threatened Species* (recent version 2019), *European Red List of Habitats*, *Plant Endemism Assessment of Red List Habitats in Europe* (PEARL; recent version), *EvaplantE (Endemic Vascular Plants in Europe)*, recent version), and a preliminary list of *hyperendemics*. The relating numbers indicate the meaning of different habitat types for the existence and survival of rare and threatened species.

Threats and numbers of endemics or critically endangered species of vascular plants and vertebrates are presented for various groups of habitat types - *marine intertidal, coastal/saline, freshwater, bogs/mires/swamps, grassland, scrub/heathland, forest/woodland, sparsely vegetated rocks/screes, arable, urban/horticultural land*. The numbers enable a comparison of the meaning of habitat types of the European Union (EU+) or Europe, respectively, and habitat types in other parts of the world, for example in the Americas, Africa, Asia, and Australia for the existence and survival of rare and threatened biota.

Forest, scrub and freshwater habitats harbour most critically endangered species on earth. However, the meaning and endangerment of habitats and associated species differ considerably from continent to continent. In Europe habitat types of open and semi-open landscapes harbour much more rare and threatened species than forests. Examples of endemics, critically endangered species, and habitat types may illustrate the conditions and threats in Europe. For intertidal habitats biological resource use (fishery, e.g.) in combination with pollution is the most powerful pressure on species living there. Coastal and saline habitats such as dunes and saltmarshes are heavily affected by residential, commercial and infrastructure development accompanied with a strong limitation of natural dynamics. Many terrestrial ecosystems are directly and indirectly affected by agriculture comprising e.g. tilling, plantations, intensification of use, including diverse physical, chemical and biological effects. Grasslands in Europe are not only affected by conversion to cropland or forest and intensification like in other regions of the world but also by abandonment (undergrazing). This has to do with the fact that most grassland types in Europe represent semi-natural and traditionally used grasslands. Pollution including industrial and domestic wastewater, washout of fertilizers, hormones, pesticides and other chemical components has a strong impact on plants and animals living in wetlands. However, freshwater habitats in Europe are less heavily impacted by the construction of new dams and barrages than in other parts of the world. Climate change and severe weather are relevant but of minor importance for most habitat types and the endangerment of associated biota.

## First overview on the 4<sup>th</sup> Annex I Habitats Report in Italy: methods, criticality, results and future prospects

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Like all the other EU/28 countries, in 2019 Italy developed the 4<sup>th</sup> Italian Report ex-Art. 17 on the conservation status of the Habitats of Annex I to the 92/43/EEC Directive. Institutional referent of the process, on behalf of the Ministry for Environment, Land and Sea Protection (MATTM), was the Italian Institute for Environmental Protection and Research (ISPRA) with the scientific support of the Italian Botanical Society (SBI). A huge working group composed of thematic and territorial experts was formed with the task to collect, analyse, validate the data resulting from Annex I Habitat monitoring in Italy for the period 2013-2018, whose collection is in charge to the regional administrations. Data on 124 types of terrestrial and inland water Habitats present in Italy have been processed in order to assess their overall conservation status in the Biogeographic Regions of occurrence. The carried out activity led to the compilation of 278 assessment sheets. The work included a critical analysis of the data and a broad scientific confrontation aimed at finding methodologically robust solutions to fill the gaps. The work was structured so as to guarantee the traceability of the information and to allow the collection of "gray" literature and scientific articles, phytosociological surveys and unpublished material of the specialists, composing a substantial pool of data useful for starting a long-term process to support the next reporting cycles. Cartographic outcomes, associated databases and additional data used for the assessments will be available online on the ISPRA Portal as soon as the validation process by the European Commission will be completed. A freely accessible online archive of phytosociological surveys representative of the various Annex I Habitats in Italy is being set up within the national "VegItaly" database, managed by the Italian Society of Vegetation Science, by way of a dedicated archive named "HAB\_IT". Such a long-term vision, oriented to the storage and enhancement of knowledge, represents an important innovative aspect and a significant progress towards the construction of an effective monitoring system for the conservation of Annex I Habitats in Italy.

## Monitoring and status of Natura 2000 habitats in Flanders, Belgium

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In order to report the conservation status of Natura 2000 habitats to the European Commission and to support nature policy in Flanders, a regional monitoring scheme to assess the quality of habitats has been implemented.

Habitat quality indicators and target values are defined per habitat (sub)type, summarizing current ecological knowledge. These indicators are assessed in two plots which are centered at each sampling location: a square plot for the vegetation relevés (species composition and cover for both positive and disturbance indicators) and a larger circular plot for indicators regarding habitat structure (e.g. age stages of heather, dead wood in forests). For standing water habitats the sampling units consist of the entire water body, and for running waters 100-meter sections. All field data are stored in the relevé depository INBOVEG ([www.inbo.be/en/inboveg](http://www.inbo.be/en/inboveg)). We developed an R-package ([github.com/inbo/LSVI](https://github.com/inbo/LSVI); in Dutch), which enables calculation and evaluation of the habitat quality indicators for each sampling location based on the collected field data. Next, the proportion of habitat in an unfavourable-bad condition can be estimated for the whole of Flanders. A habitat type is regionally unfavourable-bad for habitat quality (specific structures and functions) when more than 25% of its area has a bad habitat quality (upper limit set by the European Commission).

In total the monitoring scheme consists of approximately 4000 sample locations which are measured within a cycle of 12 years. Field work is organized in such a way that every three years a random subset containing 1/4th of the total set of sample points is completed. This way intermediate analysis of habitat quality provides reliable results.

The results for the 2019 EU-report show that for Flanders the specific structures and functions for 80% of the habitat types is still in unfavourable-bad status. Only 3 habitat types are in favourable status, and 2 unfavourable-inadequate for habitat quality. Important pressures are ground and surface water eutrophication, desiccation due to groundwater extraction, disruption of hydrological functioning (e.g. in the estuaries), impacts of invasive alien species, absent or inadequate management, habitat fragmentation, climate change and a continuing significant pressure from urbanization. On the other hand, the decrease in acidifying depositions leads to spontaneous recovery of weakly buffered water habitats.

The many conservation measures that have been implemented have not yet resulted in a major change in habitat quality status. However, positive trends for range and area are detected for several habitat types.

## Habitat identification by satellite images

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Remote sensing tools help vegetation scientists and ecologists to identify habitats and better understand diversity pattern and spatial distribution of target communities. Recently, software NaturaSat was developed for monitoring and identifying plant communities and habitat types by satellite images. The localization, classification and dynamic space-time segmentation and tracking were mainly based on processing and analyzing of Sentinel-2 multispectral imaging data by novel mathematical methods. Presented case studies about the suitability of this approach was performed on various vegetation types including riparian forests and alpine vegetation. The distinguishing of certain habitat types by satellite images or aerial photos is a challenge, but it is crucial for effective monitoring of Natura 2000 habitats. The field mapping of habitat borders in many environments such as rugged terrain or remote areas is very complicated and time-consuming, therefore using the satellite image segmentation methods seems to be very efficient way of monitoring these habitats.

A mean intensity color value and standard deviation of all Sentinel-2 bands for interior area of each habitat fragments in every available date of the year 2018 were calculated using NaturaSat software. The composition of these values creates a characteristic for each habitat. The first result of PERMANOVA analyses shows significant difference and subsequent feasibility to distinguish selected habitats based on satellite data.

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## Challenges in classification of mosaic vegetation and implications to ecosystem change studies in northern mires

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Vegetation classification schemes almost invariably consider homogenous vegetation and rely on relevé data from homogenous stands. However, more or less distinct mosaics of different vegetation types are common and particularly well recognized in peatlands. Mosaic forms occur in different scales. In consideration of mire complexes, regularities commonly involve differentiation between central and marginal mire areas, and classic complex types do well in describing such patterns. In irregular mire basins or in vast mire systems with many interconnected units of different peat formation and vegetation types, mire complex classification is complicated, however. In smaller scale, within hydrological mire units, mosaic patterns emerge reflecting height of peat (moss) surface above water table of hummocks, lawns, carpets, and hollows. In most classification systems, vegetation of these different microforms are treated separately.

In habitat classifications, such as EUNIS-habitats, some mosaic types are recognized (e.g. raised bog, aapa mire, palsa mire), but variation among these mosaic vegetation types is not considered. In lower hierarchic level of EUNIS-habitats, for example, aapa mire is divided between flarks (wet fen surfaces) and strings (hummock surfaces), while in reality both of these structural units have nearly as wide variation as all other EUNIS mire types, and occur in different combinations. In effect, much of diversity of mosaic mire types remains unrecognized in important typologies.

Regularly occurring mosaic mire vegetation tends to reflect particular environmental conditions as a whole, and many interactions are prerequisites for their existence. For example, patterning of aapa mires is caused by interaction of hydrology, cryoturbation, and biotic processes. Patterned aapa mires always form uniform hydrological units: strings are formed perpendicular to slope and act as dams to hold high water level in hollows, which inhibits hummock species from spreading, while ice formation accentuates the patterning. North-European aapa mire patterning is a fairly recent phenomenon, mainly originating 1000-500 yr BP and indicating high moisture surplus in cool boreal climate. In warming climate, processes maintaining such mosaic structures will likely change, while a legacy of patterning will remain for extended length of time.

Rapid pace of climate change in northern areas poses change pressure on characteristic mosaic vegetation types and recognition of interactions and mechanisms of vegetation changes is timely. In addition to existing classification of homogenous vegetation types and of mire complex types, classification of mosaic vegetation, such as patterned aapa mire vegetation, should be proceeded. Important questions of ecosystem changes connected to mosaic vegetation types concern, if different subunits respond similarly to same change pressures, or if mosaic nature will strengthen or vanish. This is a challenging task, as most approaches to vegetation classification are based on assumption of homogenous vegetation types.

## Establishing Natura2000 in Albania: state of the art and future perspectives

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The high variety of climate conditions, geology, hydrology and the geographical position is reflected in the Albanian rich and interesting flora and vegetation. In the last years, 6 protected areas in Albania, which are also identified as proposed Sites of Community Interest, have been investigated in order to obtain a broad overview of the habitats' variability of the country. The areas included *Korab-Koritnik*, *Shkodër Lake*, *Divjakë-Karavasta lagoon*, *Tomorr*, *Hotovë-Dangëlli* and *Llogora-Karaburun-Çikë-Orikum* complex site and the study has been undertaken during 2016–2018 in the frame of NaturaAL Project IPA 2013. 60 Natura 2000 habitats have been found, among them 14 are of priority interest (\*): 1150 - Coastal lagoons, 1510 - Mediterranean salt steppes (*Limnietalia*), 2250 - Coastal dunes with *Juniperus* spp., 2270 - Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*, 5230 - Arborescent matorral with *Laurus nobilis*, 6220 - Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*, 6230 - Species-rich *Nardus* grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe), 7210 - Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*, 8240 - Limestone pavements, 9180 - *Tilio-Acerion* forests of slopes, scree and ravines, 91E0 - Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*), 9530 - (Sub-) Mediterranean pine forests with endemic black pines; 9580 - Mediterranean *Taxus baccata* woods, 9560 - Endemic forests with *Juniperus* spp. Distribution maps, description and conservation status assessment are presented.



## Biotope as a syntaxa complex

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A biotope is considered as a habitat of the topological level. Although it is identified with a specific syntaxon, many biotopes, even homogeneous at first glance, are represented by a complex of syntaxa of different classes. Communities of different syntaxa within one biotope are interrelated and cannot exist independently. Such interconnections are conditioned by the nature of the biotope functioning and are determined by the influence of one or several limiting ecological factors. The structure of the biotope is determined by function, and the set of syntaxa as classification categories is allocated according to the similarity of species participation. The biotope G1.A1 *Quercus – Fraxinus – Carpinus betulus* woodland on eutrophic and mesotrophic soils (9170 *Galio-Carpinetum* oak-hornbeam forests) represented by nemoral forests identified by *Carpinion betulis* and characterized by the development of communities of different classes that develop on trunks of trees: algal coenoses of *Trebouxia* sp., lichen coenoses of *Graphidion scriptae* (cl. *Arthonio radiatae-Lecidelletea elaeochromae*), bryo-coenoses of *Ulotion crispae*, *Leskeion polycarpae* (cl. *Frullanio dilatatae-Leucodontetea sciuroidis*), and *Neckerion complanatae* (cl. *Neckeretea complanatae*). Rocky biotope H3.1 Acid siliceous inland cliffs is characterized by a combination of epilyte lichen (cl. *Rhizocarpetea geographici*, *Umbilicarium hirsutae*) and chazmophytic (*Asplenium septentrionalis*) coenoses of vascular plants, and horizontal surfaces – H3.1B Bare siliceous inland cliffs (8230 Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of the *Sedo albi-Veronicion dillenii*), in addition to the mentioned alliances (cl. *Sedo-Scleranthetea*) includes lichen communities of the *Parmelion conspersae* (cl. *Rhizocarpetea geographici*), bryo-communities of *Grimmion commutatae* (cl. *Racomitrietea heterostichi*), but in shaded places also *Grimmia hartmanii-Hypnion cupressiformis*. In the biotope C1.12 Hard water springs (7220 Petrifying springs with tufa formations (*Cratoneurion*)) the background is molded with cushions of mosses *Cratoneuretum filicino-commutati*, columns of *Didymodon tophaceus* are formed below, and on a stone substrate, where water drops, the communities of the *Cladophora glomerata* s.l. (cl. *Stigeocloniotea tenuis*, *Stigeoclonion tenuis*) are develop, but on the periphery of the moss communities, where the substrate has indirect moisturizing, *Scytonema myochrous* (cl. *Gloeocapsetea sanguineae*) grows. Based on this understanding of a biotope structure, an impact of external threats is determined, the value and ecosystem services are assessed, and management plan for their conservation as integral ecosystems is developed.

## Discovering missing parts in an island ecosystem

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Oceanic islands harbor a disproportionate fraction of terrestrial biodiversity in relation to their reduced contribution to emerged lands. This diversity is very fragile and extremely sensitive to the impact of human pressure and the species that we bring with. Not surprisingly, the arrival of humans to islands is followed by numerous extinctions, no matter the size of the island and the biome. In some cases, species may not become extinct but may become restricted to marginal habitats where they escape from impact of humans, natural hazards or invasive species. When these species are keystone taxa, this may lead to deep changes in ecosystem composition. Identifying these missing taxa and promoting the recovery of their former ecological role contributes to recover former island ecosystems.

This work explores the role of Canary cedar (*Juniperus cedrus* Webb. & Berthel) as a former key component of Teide National Park shrubland. In order to do that, we aged and measured annual growth rates along Canary cedar population in Teide National Park. Our results indicate a sharp contrast in age structure and growth rates between cedar population in cliffs and in flat areas. Whereas individuals in cliffs were several hundred years old and showed reduced growth rates, most individuals in flat areas established only after National Park banned goat herds (the 1960s). Individuals in flat areas had very fast growth rates and some years showed an almost indistinguishable transition between annual rings, suggesting low climatic stress. Nevertheless, individuals in flat areas could be very old, as the existence of a tree of more than 1,000 years old remarks. This result adds to previous archeological and ecological pieces of evidence that suggest that Canary cedar was widespread in National Park areas in the past, but that the pressure of goat herds and direct pressure on their wood restricted its distribution to inaccessible cliffs far from axe and goat teeth. Given its high resistance to drought and its potential longevity, promoting the expansion of this species would not only contribute to primeval ecosystem recovery, but also to its resilience to climate change.

## Syntaxonomical diversity of Strazhata hill in the central part of north Bulgaria

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**Aim:** The aim of this study is to analyze the syntaxonomical diversity of all vegetation types on the territory of Strazhata hill, Bulgaria.

**Material and methods:** During 2018 field season 303 relevés were collected following the Braun-Blanquet approach. The nomenclature of species was standardized according to the Euro+Med PlantBase. This initial dataset was analyzed using EuroVegChecklist Expert System and PC-ORD in JUICE programme for determination of vegetation classes. PC-ORD hierarchical clustering was also used for classification below class level - from order to association and community levels. For all syntaxa diagnostic, constant and dominant species were determined.

**Results:** The syntaxonomical diversity was represented by 21 classes (*Carpino-Fagetea sylvaticae*, *Quercetea pubescentis*, *Salicetea purpureae*, *Robinietaea*, *Crataego-Prunetea*, *Potamogetonetea*, *Phragmito-Magnocaricetea*, *Bidentetea*, *Asplenietaea trichomanis*, *Molinio-Arrhenatheretea*, *Festuco-Brometea*, *Trifolio-Geranietaea sanguinei*, *Sedo-Scleranthetea*, *Artemisietea vulgaris*, *Epilobietea angustifolii*, *Papaveretea rhoeadis*, *Digitario saguinalis-Eragrostietaea minoris*, *Polygono-Poetea annuae*, *Chenopodietaea* and *Sisymbrietaea*), 23 orders, 29 alliances, 30 associations and 19 plant communities. Xero-mesophytic and xerophytic woodlands and grasslands shown the widest distribution on the territory.

**Conclusions:** Strazhata hill preserves a great syntaxonomical and habitat diversity. It is characterized by the dominance of xerophytic and xero-mesophytic woodlands, shrubland and grassland vegetation types. As a result of our research two orders (*Potentilletalia caulescentis*, *Papaveretalia rhoeadis*), one alliance (*Cystopteridion*) and eight associations (*Cystopteridetum fragilis*, *Asplenietum rutae-murario-trichomanis*, *Lolio perennis-Cynosuretum cristati*, *Trifolio medii-Agrimonetum eupatoriae*, *Trifolio alpestri-Geranietum sanguinei*, *Stachyo annuae-Setarietum pumilae*, *Portulacetum oleraceae*, *Chenopodietum strictae*) were registered for the first time for Bulgaria.

**Keywords:** vegetation classification, Braun-Blanquet approach, numerical methods, syntaxonomy.

## Session 5. Vegetation patterns in the Palaearctic

## Phytosociological alliances of zonal boreal forests in Northern Europe

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We classified a dataset of over 60 000 forest vegetation-plot records from several databases of the European Vegetation Archive (EVA), including the European Boreal Forest Vegetation Database (GIVD ID: EU-00-027), and the data of the National Forest Inventories of Finland and Sweden, using unsupervised clustering. The study area extends over the boreal zone of Northern Europe (including the hemiboreal subzone) and adjacent areas, comprising Scotland, Norway, Germany, Denmark, Sweden, Poland, Finland, Estonia, Latvia, Lithuania, Belarus, and European Russia.

We investigated the correspondence of the resulting classification units with previously described phytosociological alliances and refined and unified their definitions to reflect real data across the boreal zone in Northern Europe. Thus far, a unified classification system of boreal forest communities has not yet been established in Europe, nor has there been comprehensive vegetation-plot dataset enabling such an analysis. Here, we introduce and describe the resulting system of unified phytosociological alliances of boreal forests of Northern Europe which is compatible with the EuroVegChecklist classification developed by the European Vegetation Survey.

## The temperate deciduous forests of Europe and western Asia: a survey on their biogeography and diversity

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Temperate deciduous forest biome occupies in Europe a dominant position in the areas of temperate climate, i.e. between the boreal conifer forests and the sclerophyllous Mediterranean woodlands. These formations also extend continuously along the shores of the Black Sea in northern Anatolia, Georgia, and Crimea (Euxinian area) to the Midlands of the Caucasus ranges and the northern Alborz slopes in southern Caspian Sea (Hyrceanian area). They even reach to the mid-elevations of several central Asian mountains. Deciduous forests in this vast territory present a common origin as they occupied a continuous and much broader area during the late Tertiary. During the Pleistocene climatic oscillations, went through successive reductions and expansions, and now they are restricted to the present known area. As these forests, in the different parts of their area, have suffered different pressures under these oscillations resulting in different rates of extinction of the forest flora, it can be expected that the floristic composition of the subregions will reflect this history. To analyze the biogeographical relationships existing within this biome in the mentioned territories, 9,000 vegetation plots have been selected from the EVA database. These plots have been separated into nine subsets of 1,000 plots each, geographically distributed in nine subregions as follows: 1. W Iberia + SW France; 2. British Isles; 3. Central Europe (Germany + Czech Republic); 4. Alps; 5. Italian Peninsula + N Sicily; 6. Dinaric ranges; 7. Carpathians; 8. Euxinian area; 9. Hyrcanian area. These areas encompass most of the biogeographical and ecological variability of these forests. The dataset was subjected to several homogenization procedures: geographical and heterogeneity constrained random resampling, removal of bryophytes, lichens, hybrids and names at the level of genus. Taxonomy was standardized following Euro+Med Plant Base. The remaining species were classified into the following life forms: (1) for woody plant species into trees, shrubs and dwarf-shrubs, evergreen vs deciduous, and conifers vs non-conifers; (2) for herbs into hemicryptophytes, geophytes and therophytes. Lianas and epiphytes were also considered, as well as ferns. Here we present the first analyses were performed to these data comparing the subregions and for exploring their relative similarities.

## Oak-hornbeam forests from the European perspective – Currently recognized alliances, a faithful mirror of their floristic variability?

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Oak-hornbeam forests represent one of the most frequent mesophilous deciduous forest types within Europe and adjacent areas. In their tree layer, *Carpinus betulus* and oaks play an eminent role. Forest mesophytes prevail in their herb layer. Regarding the EUNIS habitat classification, they are unified in the unit T1-E (*Carpinus* and *Quercus* mesic deciduous forests) and evaluated as near threatened. A large majority of them are traditionally assigned to the order *Carpinetalia*. For the Caucasian types, an individual order *Lathyro-Carpinetalia* was designated, however, it is sometimes merged with the former one. In the recently released EuroVeg checklist, ten geographical alliances of these forests were recognized. This traditional geographical approach to alliance delimitation mirrors the existence of numerous geographically distinctive groups of forest mesophytes (e.g. Caucasian, Euxinian and Illyrian) likely reflexing various glacial refugia of deciduous forest vegetation. Therefore the alliances are characterized by their own combination of such species groups. Nevertheless, alliances representing northern types of oak-hornbeam forests in the context of their whole distribution range (i.e. *Carpinion betuli* for Central Europe and *Quercu-Tilion* for subboreal Europe) are usually poor in geographically distinctive species and thus delimited mainly negatively. Although oak-hornbeam forests are broadly distributed and mostly well-represented by phytosociological relevés, differences in species composition among the particular alliances based on numerical data analyses have not been provided so far. Therefore the main aim of the study is to recognize main patterns in their species composition variation and subsequently to assess how well they are expressed by the alliances in the currently accepted syntaxonomical system. We used mainly phytosociological data (more than 10,000 relevés) extracted from the databases stored in the European Vegetation Archive (EVA). Vascular plant nomenclature was harmonised according to the Euro+Med Plantbase, non-vascular cryptogams were omitted. To obtain more representative dataset, we performed heterogeneity-constrained resampling. Afterwards, we applied various strategies including unsupervised and supervised classification analyses coupled with ordination analyses. The final results will be presented during the meeting.

## Benchmarking plant diversity of Palaeartic grasslands

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Background and aim: Knowledge on typical levels of plant species richness of plant communities is required both for fundamental research and biodiversity conservation. Vegetation ecologists and practitioners need reference richness values to be able to assess the diversity value of specific plant communities. Palaeartic grasslands are known to host high plant diversity at small spatial scales, some of them being the world record holders. However, there are also some very species-poor Palaeartic grasslands. In any case, maximum and minimum richness values are only a small part of the story. It is evident that for a robust knowledge on plant diversity mean values averaged using many replicates are needed.

As plant diversity is strongly dependent on spatial scale, we aimed at providing benchmarks of plant richness values of different Palaeartic grassland types at eight grain sizes: 0.0001 m<sup>2</sup>, 0.001 m<sup>2</sup>, 0.01 m<sup>2</sup>, 0.1 m<sup>2</sup>, 1 m<sup>2</sup>, 10 m<sup>2</sup>, 100 m<sup>2</sup> and 1000 m<sup>2</sup>. Previous studies have already proved that richness of vascular plants, bryophytes and lichens is not congruent across vegetation types, therefore, besides total plant diversity, we assessed separately vascular and non-vascular plant diversity, as well as the two components of the latter, bryophytes and lichens.

Location: Palaeartic grasslands and other non-forested habitats.

Taxa: Vascular plants, bryophytes and lichens.

Methods: We used data extracted from the GrassPlot database, which stores standardized vegetation-plot data sampled in precisely delimited plots. They make a total of 117,777 plots of the eight standard grain sizes, which will be analyzed together with 1,146 additional plots from M. Chytrý and colleagues. The 118,923 plots span a wide range of grassland and low scrub types, including rocky, sandy, xeric, meso-xeric, mesic, wet, Mediterranean, and alpine grasslands, as well as heathlands, thorn-scrubs, ruderal communities and azonal grasslands such as dune grasslands, salt marshes, wetlands, and rocks and screes. All these vegetation types are distributed across eight biomes throughout the Palaeartic realm.

Results and discussion: We will provide mean, minimum and maximum values of species richness for the included 18 grassland types, 8 biomes, 3 taxonomic groups, 8 grain sizes and their combinations. The results will be visualized in tables, figures and maps and be published open access in an online database. Our data will allow researchers and practitioners throughout the Palaeartic biogeographic realm to assess whether the biodiversity of a certain grassland is above or below average.

## European annual weed vegetation: first results of numerical classifications

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In the last few years large repositories of vegetation data enabled analyses of individual vegetation types on a continental scale. To explore different vegetation types of the European weed vegetation, we focused on four classes - the *Papaveretea rhoeadis*, the *Sisymbrietea*, the *Chenopodietea*, and the *Digitario sanguinalis-Eragrostietea minoris*. We compiled a large dataset, combining several vegetation databases from Europe (assisted by European Vegetation Archive) and our own European Weed Vegetation Database (GIVD ID: EU-00-028); the latter database is comprising digitalized vegetation plot records from underrepresented regions of Europe in the rest of the EVA databases. The combined original dataset comprised > 80,000 relevés. In the dataset we unified the nomenclature, removed relevés from non-target classes, deleted non-vascular plant taxa, and also species representing the cultivated element of the studied segetal vegetation. The dataset was geographically resampled to avoid oversampling in some areas. Several variants of resampling (only geographic or in a combination with heterogeneity constrained) and the following hierarchical and non-hierarchical clustering methods were tested for consistency of resulting classifications. The analyses, employing 20,000–50,000 relevés, yielded some so far well-established groups, for example the ruderal alliances *Malvion neglectae* and *Atriplicion* and the segetal alliances *Roemerion hybridae* and *Arnoseridion minimae*. Definition, basic characteristics and distributional patterns of main weed vegetation types will be given. Some clusters revealed by our analyses would be subject of further scrutiny.

## Session 6. Methods and Databases for Vegetation Studies

## **Probabilistic key for identifying vegetation types in the field: a new method and Android application**

**Tichý L & Chytrý M**

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Quick identification of vegetation types in the field, based on species composition but not requiring time-consuming plot sampling, is often needed for vegetation mapping, conservation assessment, teaching and other applications of vegetation classification. Here we propose a new method which identifies the probability of belonging to the units of an established vegetation classification for vegetation stands encountered in the field. The method is based on calculating the probability that a few species observed in the field would co-occur in a priori defined vegetation types, using the existing information on species occurrence frequency in these types. The method has been implemented in a freely available Android application called Probabilistic Vegetation Key (<https://play.google.com/store/apps/details?id=com.test.tichy.vegkey>), which makes it possible to employ it in the field using smartphones or tablets, even in the absence of internet access.

## **Using model-based classification in the phytosociology: possible solutions and examples of application**

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In the recent years, several paper criticized application of distance-based ordination methods in ecology, and suggested replacing them by model-based ordinations. However, I have not seen any publication with similar suggestion for replacing distance-based classification by model-based methods. In the presentation, I show that its reason is not the lack of model-based classification methods, and they are viable alternatives of the recently used methods.

Model-based methods – in both ordination and classification – are based on the supposed probability distribution of data, and they fit statistical models. Consequently, they allow using tools for model selection (in classification for deciding on number of clusters) and for checking the assumptions (e.g. by graphical evaluation of residuals).

In the literature, model-based classification methods are known under name of “finite mixture distribution model”. The most well-known, and widely used example of this type of models is the Gaussian mixture model. Since it assumes multivariate normality, it cannot be used for modelling abundance data. Alternatively, binomial distribution can be fitted for binary data, or negative binomial distribution for number of individuals. Until now, modelling percentage cover data was unresolved. I have tested four different alternative solutions: using presence-absence data only, applying pseudo-species with different cut levels, fitting beta and zero inflated beta distribution.

My conclusion that if vegetation types differ in species list, binomial mixture fitted on presence-absence data gives a good result. While, in cases where differences in cover also have to be considered, combination of pseudo-species approach and binomial mixture could be applied.

## Pladias.cz: an online database of the Czech flora and vegetation

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The Pladias (Plant Diversity Analysis and Synthesis) Database of the Czech Flora and Vegetation was developed in 2014–2018. The flora section of the database contains critically revised information on the Czech vascular flora, including information on 13.6 million plant occurrence records, which are dynamically displayed in maps, and information on 118 biological traits, morphological characters and ecological attributes of plants, divided into the sections Habitus and growth type, Leaf, Flower, Fruit, seed and dispersal, Belowground organs and clonality, Trophic mode, Karyology, Taxon origin, Ecological indicator values, Habitat and sociology, Distribution and frequency, and Threats and protection. The vegetation section of the database contains information on Czech vegetation types extracted from the monograph *Vegetation of the Czech Republic*. The data are supplemented by national botanical bibliographies, electronic versions of the standard national flora and vegetation monographs, and an extensive database of pictures of plant taxa and vegetation types. Data from the database are available online on a public portal [www.pladias.cz](http://www.pladias.cz), which also provides download options for various datasets and an online identification key to the Czech flora. This talk introduces the general structure and content of the database and gives examples of its application in macroecological research by combining detailed data on plant occurrence and plant characteristics. Maps of geographical

patterns across the country were prepared for individual plant characteristics in a grid of approximately 6 km × 5.5 km, summarized using the principal coordinate analysis, and interpreted in relation to the main macro-scale environmental gradients.

## Using the beta distribution to analyse plant cover data

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Plant cover is a measure of the two-dimensional projection of plant species onto the surface and is the most commonly used measure of plant abundance. There are numerous historic and current plant ecological investigations and monitoring programs where plant cover has been measured by visual estimation in plots or by the pin-point method.

The collected plant cover data has often been analyzed with standard statistical techniques without taking the typically observed spatial aggregation of plant species into account. This practice has been continued within the plant ecological community although a more suited statistical method using the beta distribution has been suggested several times in the literature for more than sixty years.

When analyzing ordinal cover data it is more precise to use a statistical models that e.g. the midpoints of the intervals.

When spatial aggregation is taken into account by fitting a parameter that measure the degree of spatial aggregation it becomes possible to study spatial aggregation as an ecological phenomenon by analyzing plot based plant cover data.

Different methods of measuring plant cover may be analyzed in a common framework in order to synthesize information across studies or time-series.

## Modelling vegetation composition and plant richness across spatial scales and environmental gradients in Central Apennines Mountains

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The patterns of plant distribution across spatial scales and environmental gradients have always been a topic of interest in vegetation science, especially in the heterogeneous landscape of high mountains. In this context, investigating the effect of spatial scale in the prediction ability of species is an important step to identify the best size of a survey area.

In this study, we investigate the effect of plot size in nested plots to predict the species richness along an elevation gradient in Central Apennines (Italy), a range known for its great diversity of vascular plants. Two transects, each 2 km wide, were chosen. The Monte Velino transect, from 1100 m up to 2487 m a.s.l, includes 83 plots, and the Montagne della Duchessa transect, from 1100 m up to 2141 m a.s.l., includes 81 plots. Plant species occurrence was collected in nested plots of the following sizes (cm): 1.56; 3.12; 6.25; 12.5; 25; 50; 100; 200; 400; 800; 1600. Liquid precipitations were measured monthly with a pair of gauges at the soil level, at a 250 m elevation interval. Air Temperature (AT) at 2 m and Soil Temperature (ST) at -10 cm were recorded with data loggers. General linear model (GLM) with quadratic terms was carried out to create the maps of the climate variables in the study areas with a resolution of 20 m<sup>2</sup>. After assessing for multicollinearity (Pearson  $r > 0.75$ ), seven variables were chosen as predictors: 2 for AT, 2 for ST, 2 for precipitation and 1 for evapotranspiration. Direct modelling (DM) of the species richness was compared with the more recent approach of stacking predictions from individual species distributions (S-SDM), and the performance of both approaches was tested. True skill statistics (TSS) and Maximum Kappa (maxK) for maps binarization in S-SDM were used to assess the performance on the plant community reconstruction after modelling each species separately. The main results show that the accumulation curves of plant species richness was significantly affected by environmental conditions. When the plot size increases, a logarithmic decrease of the number of new species per area was observed. DM of species richness for each plot size shows that small plots under 25 cm were not enough informative for prediction. For bigger plots up to 200 cm, the Root mean squared error (RMSE) between observed and predicted data was similar. For several plot sizes, DM homogenised the species richness predicted in the study area. However, for the 1600 cm plots, the S-SDM tends to conserve more the habitat heterogeneity when compared with DM. In the S-SDM predictions of species richness, the two algorithms TSS and MaxK behaved differently. With a lower RMSE, the MaxK approach showed a significantly better reliability of prediction than TSS. To conclude, this work underlies the importance of considering simultaneously several spatial scales, and the environmental gradients to understand the complex drivers of plant community in a mountain ecosystem.



## VigLib, using Python in vegetation data analysis

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Vegetation data analysis is a crucial process in vegetation classification. Hereby, I introduce the VigLib Python package in the context of data analysis for vegetation. This package provides many useful analysis processes like basic statistics, ANOVA & MANOVA, ordination, cluster analysis, Diversity modelling, Simulation studies and randomization procedures, Analysis of spatial data and Analysis of time series. The package contains many modules with classes that can be used effectively in the vegetation data analysis. Moreover, it has the power of scraping data from different offline and online resources.

## An Expert System for Dutch Plant Communities

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An Expert System is under development for the identification of vegetation relevés in the Netherlands. The system will be designed in a way that the national classification of Plant Communities is followed as good as possible. We use a large set of random relevés to develop the system, and a second set both for development and validation. The latter consists of all relevés that have been assigned to plant communities by experts. The expert rules follow a consistent approach, in which each relevé is assigned in the first place to a formation (a group of classes), using large groups of diagnostic species, next to an alliance, using smaller groups of diagnostic species, and finally to an association, using sociological species groups. On a lower level of hierarchy, relevés that not meet the criteria of the associations will be assigned to a higher level in the classification system, indicating formally described or yet undescribed basal communities. Relevés that are transitional between different plant communities will be assigned to two or more associations. The project aims at an accuracy of more than 95% in the validation, for each plant community.

The paper will discuss the aim and methodology of the expert system and its application. Further it will address some general discussion points about the development and use of Expert Systems that are being under development in increasing numbers.

**Session 7. Mediterranean and Thermophilous  
Forests**

## Preliminary results from the classification of the thermophilous oak forests in Bulgaria

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A coenological description and a new syntaxonomical framework of the thermophilous deciduous oak forests in Bulgaria are presented. The aim of this study was to classify and characterize the plant communities of the thermophilous oak forests in Bulgaria and to reveal the gradients in their floristic composition and ecology on the whole Bulgarian territory. Phytosociological classification was based of 716 relevés collected using Braun-Blanquet's approach in oak forests from the Black Sea coasts to the upper limit of the deciduous oak forests (1200 - 1400 m alt.). The relevés data set has been subjected to numerical analysis. As results 19 associations and subassociations and two communities were identified. Six new associations and three new subassociations were proposed. They have been assigned to the following alliances: *Quercion confertae*, *Quercion petraeo-cerridis*, *Carpinion orientalis* and to the new alliance *Trachystemono orientalis-Carpinion betuli*. The diversity and the ecological status of the oak forests in Bulgaria highlight the urgent need for their protection. They are in poor condition mostly due to the millennial tradition of loggings, coppicing, burning and grazing. Further research is required to investigate their diversity, ecology and dynamics – in order to gain the knowledge needed for their conservation, management and restoration.

## Native forest dominance patterns in the Iberian Peninsula

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Structure is an important trait of forest stands. In particular, dominant trees have great influence in the whole biocoenosis, as foundation species. Consequently, understanding dominant tree patterns of native forests is of decisive importance for nature conservation and restoration ecology. We compiled a database of native forest relevés from the Iberian Peninsula, which collect floristic information mostly on native forests remnants. We explored dominance patterns in the Peninsula, highlighting the dominant trees or the combinations of dominant, codominant and subdominant trees. We analyse such patterns as a bipartite graph and simplify the graph by applying rules based on general landscape dominance, emanating from the graph structure. We illustrate the results spatially, mapping the patterns obtained for the Iberian Peninsula.

## Mediterranean and Submediterranean pine forests: Approaching the end of a classification tale

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A project entitled "Formalized classification of European Mediterranean and temperate pine forests" is running since October 2017. In this presentation we are presenting the final results of the first synthetic classification of Mediterranean and Submediterranean pine forest types, consisting of the newly proposed syntaxonomical scheme at the continental scale for these vegetation types.

After cleaning and stratified resampling of the data retrieved from the European Vegetation Archive (EVA) and the CircumMed Pine Forest Database, we handled 3,512 vegetation plots with 1,301 species. We classified these plots by means of an unsupervised divisive classification (Twinspan with three pseudospecies cut levels: 0-5-25% cover), resulting in 16 clusters. Some of these clusters were subsequently merged based on their similar species composition and geographical distribution. Phi coefficient was used to obtain diagnostic, constant and dominant species.

The main division separated the central-eastern versus the central-western Mediterranean and Submediterranean pine forest communities. The types were characterized, in most cases, by the dominance of one pine species. However, in some cases, more types with the same dominant pine species were identified based on the understory species composition. For both the Mediterranean and Submediterranean types our analysis showed that some communities did not correspond to any previously described syntaxon. In addition, some of the described alliances did not fit our classification (e.g. *Alkanno baeticae-Pinion halepensis*; *Pino pinastri-Juniperion phoeniceae*), probably because they were too locally distributed or data were lacking in our dataset. Moreover, our results showed that long-established pine plantations (especially those of *Pinus pinea* in the central-western Mediterranean) that until now have not been classified were grouped in the same cluster. This suggests that classification, in its broadest sense, should not disregard *a priori* long-established plantations otherwise it would risk losing a part of the picture.

## Thermophilous forest fringe vegetation in Ukraine: a review of syntaxa and habitat types

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In Ukraine, communities of the class *Trifolio-Geranietea sanguinei* T. Müller 1962 have been studied occasionally since 1990ths (Solomakha 1996). Up to now, our knowledge on diversity, dynamics, ecological peculiarities and distribution patterns of these marginal plant communities have remained insufficient.

For "Prodromus of the Vegetation of Ukraine", the extensive review based on literature data and ca 480 published and unpublished phytosociological relevés, made in Forest and Forest-Steppe regions, have been made, and syntaxonomical scheme encompasses 16 associations, 4 alliances, and 3 orders, was obtained. Accepted names, synonyms, diagnostic species mentioned in literature, habitat conditions, distribution in Ukraine and main sources are given for each association (Prodromus 2019). Forest fringes of Crimea are still poor studied, only preliminary materials have been published (Iakushenko et al. 2014, Mala 2016).

3 habitat types (thermo-xerophilous fringes, mesophilous fringes and glades on neutral and base-rich soils, and mesophilous fringes on acidic soils) were distinguished in the "National Habitat Catalogue of Ukraine". Their structure, characteristic species, ecological characteristics, distribution, representativity, conservation status, presence of rare and endangered species, threats and management are described (Iakushenko 2018).

As a results of these studies, the syntaxonomic diversity of thermophilous forest fringe and tall-herb vegetation in Ukraine is estimated in general. Comparative survey of forest fringes with the other grassland communities in broad geographical scale in Central and Eastern Europe is needed for clarification the lists of diagnostic species and correction of syntaxonomic concept.

**Session 8. Mediterranean, Temperate and Boreal  
Forests**

## Vegetation Diversity of Mediterranean Woodlands in Turkey

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Phytosociological studies based on Braun-Blanquet school has been intensively carried out in Turkey for last fifty years. “Forest Vegetation Database of Turkey”, which is one of the databases under the “European Vegetation Archive” is an initiative to collect all phytosociological works carried out in the forests of Turkey. In the dataset, almost 8500 relevés has been stored up to date and big proportion of these data belongs to the Mediterranean woodlands in Turkey. Mediterranean phytogeographical region is a big part in Turkey covering the Southern and Eastern Anatolia, while Northern and Continental Turkey are represented by Euro-Siberian and Irano-Turanian phytogeographical regions, respectively. In this work, we attempted to classify the Mediterranean woodlands to see their main vegetation types and understand the main driving macroclimatic factors on their diversity. For this goal, almost 4500 relevés from Mediterranean woodlands were subjected to the cluster analysis where Euclidean Distance Measure and Flexible Beta Analyses (-0.25) as linkage method and DCA (Detrended Correspondence Analyses). Characteristic species of vegetation types were defined by calculating species fidelity to individual clusters. Azonal woodlands were excluded from the analyses. The results show that 19 different vegetation types dominate the Mediterranean woodlands in Turkey. These are as follow: 1) Phrygana dominated by *Sarcopoterium spinosum*; 2, 3) Garigues dominated by *Cistus* spp. (*Cistus creticus* and *C. salvifolius*), *Lavandula stoechas* and *Erica manipulifera*; 4-7) Machia dominated by *Quercus coccifera*, *Arbutus andrachne*, *Olea europea*, *Ceratonia siliqua*, *Arbutus unedo* and *Quercus ilex*; 8) *Pinus brutia* forests; 9) *Quercus infectoria* and *Q. ithaburensis* dominated forests; 10) *Ostrya carpinifolia*, *Quercus trojana* and *Q. vulcanica* dominated forests; 11) *Quercus cerris* dominated forests, 12) *Cistus laurifolius* dominated scrublands, 13) *Pinus nigra* subsp. *pallasiana* dominated forests; 14) *Populus tremula* dominated forests, 15) *Juniperus communis* subsp. *nana* dominated scrublands; 16) *Juniperus excelsa* dominated forests; 17,18) *Cedrus libani* and *Abies cilicica* dominated forests; 19) Forests dominated by temperate trees like *Fagus orientalis*, *Carpinus betulus* and *Castanea sativa*. DCA showed that there is a clear geographical differentiation of Mediterranean woodlands, such as sea affected lowland Mediterranean woodlands, Mediterranean mountain woodlands and Submediterranean woodlands, which indicates the macroclimatic differences.

## Are Italian laurophylls in equilibrium with climate? From their Quaternary refugia to the potential area of spread.

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European laurophyllous species are considered a footprint of the Late Neogene laurophyllous biome. Only a few of these species had survived to the mass decline of laurophyllous forests due to environmental changes of the late Neogene and Pleistocene. However, a regional expansion of laurophylls was recorded at the end of this century in Europe. The anthropogenic global warming and the land-use changes are the most advocated explanations for the laurophylls spread. Here, we used 17,087 Italian forest plots to understand whether climate is driving native laurophylls distribution. Furthermore, we localized and mapped Quaternary refugia and potential area of spread for aggregations of native laurophylls in Italy.

We selected laurophylls considering the morphology, biogeographical history and ecological niche of species. Thus, 11 evergreen broadleaved species of late Tertiary radiation, occupying a warm and wet niche were selected by performing a Detrended Correspondence Analyses on the forest plots. Potential ranges of laurophylls were calculated using Beals' index of sociological favourability. The realized and potential range-size ratio, respectively, was calculated for each single laurophyll to understand whether it is in equilibrium with the present-day climate. Distribution patterns of realized and potential aggregations of laurophylls were mapped.

We found that the richest area in laurophylls is limited to the central Apennines. This area is known to have served as a climatic refuge during the Pleistocene. However, the Italian forests showed high potential for native laurophylls with the richest potential aggregations in the whole Apennines and in the Southern Alps. Thus, we could hypothesize that laurophylls had been slowly moving from southern refugia and expanding northward since the end of ice ages. However, intense land exploitation has likely promoted a colonization lag among laurophylls during the Holocene. The recent land abandonment and rural depopulation could have accelerated laurophylls spread. Our results suggest that the current laurophylls distribution is not in equilibrium with climate, but natural biogeography and land-use shaped it. As anthropogenic global warming and urbanization progress, laurophylls forests will likely expand in the near future.

## The forest vegetation of the middle boreal subzone high-rank syntaxonomic units review in Middle Siberia

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The syntaxonomic position of the boreal forests of The Middle Siberia (within the Krasnoyarsk Region Territory) has not been studied at all. The objective of this research was discusses the syntaxonomy only middle boreal subzone forests of this vast Region. Study area is located in the southern part of Central Siberian Plateau, with elevations 150-700 m above s.l. The territory is characterized by a continental cold climate (average annual precipitation is about 300-500 mm, average annual air tempelature is about -5 – -7°C). Studies were performed in two areas: neighborhood of Baikit settlement (61° N, 96° E) and the territory of Tungusky Reserve (60° N, 101° E). Ecological and geographical features of the vegetation cover on this territory are influenced by the following main factors: 1) general zonal position; 2) sectoral heterogeneity – the continentality of the climate increases from west to east; 3) altitudinal position due to the development of middle (in the west) and low mountain (in the east) relief; 4) features of the soil-forming rocks — trapps form the background, but intrusions of carbonate sediments are found in the valleys of large rivers; 5) heterogeneous pyrological situation that is associated with macroclimatic conditions. Anthropogenic impact on the vegetation cover of the region is minor, because of the territory is sparsely populated.

As a result of the classification and comparative syntaxonomic analysis with similar vegetation in Western and Eastern Siberia, it was possible to establish that all forests belong to the class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939 and represented by three orders:

*Ledo palustris-Laricetalia gmelinii* Ermakov in Ermakov et Alsynbayev 2004. Larch-Siberian pine boggy sparse forests spread throughout the territory, but they meet only on small areas in ecotopes with poor drainage, thick litter layer and close permafrost.

*Piceo obovatae-Pinetalia sibiricae* Ermakov 2013. In the east, there are only spruce-larch floodplain herbal forests. In the west, in a more humid climate, order communities occupy large areas, spreading from the valleys to the top of the watersheds, where they are represented by Siberian pine-fir and birch blueberry-moss forests.

*Lathyro humilis-Laricetalia gmelinii* Ermakov et al. 2002. In the east, in low-mountain relief, Scots pine-larch subshrub-moss and lichen forests are common, always with significant participation of oligotrophic species of the order *Pinetalia sylvestris* Oberd. 1957. Probably these oligotrophic species are indicating a stressful pyrological

regime. In the west, forests of this order are rare. They was found only on steep southern carbonate slopes.

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## Calcicolous rock-outcrop lime forests in the eastern part of Central Europe

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We studied the diversity of calcicolous rock-outcrop forest vegetation dominated by lime (i.e. *Tilia cordata*, *T. platyphyllos* and *T. tomentosa*) in the Czech Republic, Austria, Slovakia, Hungary, westernmost Ukraine and north-western Romania. This vegetation includes species-rich forests with a mixture of mesophilous forest species, thermophilous forest species, dry grassland species and species of rock-outcrops in the herb layer. Occurring rarely in the study area, it is usually developed on the upper parts of steep rocky slopes with shallow and nutrient-poor soil on limestone or other base-rich bedrock types. Since such conditions are unfavourable for the development of zonal forests with a closed canopy, numerous relict species of different time periods have been preserved here, including many endangered species. These forests are therefore of high conservation value.

We analysed a dataset of more than 200 relevés, including both published relevés as well as our original ones recorded during the last three years. A numerical analysis revealed that the main gradient in our dataset is linked to biogeography, distinguishing a group of Romanian relevés (*Spiraea chamaedryfolia*-*Tilia tomentosa* community) from the rest of the dataset at the first level of division. Moreover, the second level of division separated a group of relevés from the Bohemian Massif (*Seslerio albicantis*-*Tilietum cordatae* association) from the group of relevés from the Western Carpathians (*Seslerio heuflerianae*-*Quercetum petraeae* association). Several subgroups can be further distinguished, reflecting mainly different moisture and light requirements.

## Floristic and coenotic diversity of Vyatka-Kama biome

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Broad-leaved-coniferous forests of Eastern Europe belong to the most controversial in their rank and attribution to a particular chorologic unit. Using the biome concept of biosphere organization the map “Biomes of Russia” (2018) was developed in the department of biogeography of Lomonosov Moscow State University. During map preparation and justification of biogeographic boundaries in it, special attention was paid to the hemiboreal forests of European Russia. Two biomes – Smolensk-Privolzhsky and Vyatka-Kama – were substantiated in broad-leaved coniferous forests belt of the European part of Russia. Key indicators for establishing their boundaries were: biotic diversity - floristic (faunistic) and cenotic - and bioclimatic aspects (mean annual temperatures, sum of biologically active temperatures > 10 °C and average annual precipitation).

The Vyatka-Kama biome is situated in the basin of the middle Volga and its largest left tributary, the Kama. This territory is for the first time considered as a unit of such a high biogeographic level. Flora of this biome includes more than 1100 species of vascular plants. Estimation of coenotic diversity was based on the ecological-morphological classification of forests with using of original field materials (more than 1000 relevés) and published data. 62 groups of associations were identified. Woodland coverage of Vyatka-Kama biome reaches 51%, but differs significantly in the western (40-45%) and eastern parts (60-65%). Among forests, the fir-spruce (*Abies sibirica*, *Picea x fennica*, *P. obovata*) and lime-fir-spruce (*Tilia cordata*) forests and their derivatives, which account for more than 83% of the wooded area, are absolutely dominant in the area occupied. Lime-fir-spruce forests are to a certain extent unique for this biome and in many respects determine its specificity. At the same time, almost 60% of the territory falls on derivative forests with a predominance of birch (*Betula pendula*, *B. alba*) and aspen (*Populus tremula*). Spruce (1.2%) and broadleaf-spruce (1.8%), pine (*Pinus sylvestris*) (5.4%) and broadleaf-pine (3.9%), oak (*Quercus robur*) (0.7%) and lime (2.5%) forests are also presented. Not more than 2% of the territory is occupied by bogs.



**Session 10. Wetlands, Riparian and Aquatic  
Vegetation**

## **Reinforce of the network of riparian vegetation group and disseminate the current results done under COST CONVERGES**

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The main objectives of this presentation are to introduce a Cost Action CA16208 CONVERGES “Knowledge conversion for enhancing management of European riparian ecosystems and services” and to Reinforce the network of riparian vegetation group and disseminate the current results done under COST CONVERGES. Riparian ecosystems comprise the physical environment and biological communities that lay at the interface of fresh water and terrestrial systems. They are recognised as ecosystems that are highly diverse and contain specialist ecological communities, as well as providers of multiple ecosystem services.

The majority of this research has focused on riparian vegetation, as plant community is the main structural component of riparian ecosystems and thus its structure and change provide useful information on the underlying changes in the fluvial system, and is a reliable tool for monitoring riparian ecosystems state and related services. CONVERGES Action aims to bring together the diverse body of knowledge that exists across Europe for all aspects of riparian vegetation.

Within CONVERGES, a phytosociological subgroup was created for studying syntaxonomy, status and ecosystem services provided by riparian forests in south-eastern Europe and Turkey. We are currently working on establishing a Formalized classification on riparian vegetation in this region. Also we investigated diversity of *Platanus orientalis* woodlands in a regional perspective. Riparian forests are also researched on national level for the territory of Bosna and Herzegovina, Bulgaria, Macedonia, Montenegro, Slovenia and Turkey.

Some of the results will also help to serve the EU Habitats (1992, updated in 2013) and Birds (2009) Directives and the Natura 2000 network, as many species rely on riparian vegetation for all or part of their habitat requirements.

## The MedIsWet project in Sicily and Sardinia. An opportunity for improving wetland knowledge and conservation.

### Preliminary results

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The MedIsWet (Mediterranean Island Wetlands) project is responding to the Ramsar Resolution XII.14 aiming for the conservation of Mediterranean Basin islands wetlands. The project is funded by the MAVA “Foundation pour la Nature”.

MedIsWet contributes to the implementation of a network of nine Mediterranean countries involved in the completion of the inventories of all the Mediterranean islands wetlands, dissemination of knowledge and promotion of certain conservation measures at local, national and Mediterranean scale. Within the MedIsWet partnership, the University of Catania (Sicily) and the University of Cagliari (Sardinia) are adhering to the initiative by implementing the project for a large representative set of Mediterranean island wetlands.

As far as Sicily is concerned, the ongoing investigation, based on GIS tools and field trips has allowed us to catalog over 11,400 wetlands of various sizes, from around 1000 square meters to several hectares. Most of the natural wetlands fall into protected areas such as Natura 2000 sites and parks, while artificial ones are mostly related to unprotected agricultural lands. The same pattern, for the identified 2500 wetlands, was found in Sardinia.

With respect to previous knowledge, numbers are surprisingly very big, the highest for the Mediterranean Islands. Such a high number is due to the underestimation of small basins and artificial tanks connected with agricultural practices. Many of them are relatively recent, being excavated in the last twenty-thirty years thanks to the support of European funds for agriculture; nonetheless, there is also a large set of semi-natural wetlands of different sizes and in different edaphoclimatic conditions, which have been created since the Iron Age up to more recent periods. While a great deal of data was found on the vegetation of natural coastal and inland wetlands, very few was instead recorded for the artificial ones. Field surveys on a robust sample of artificial basins and all natural or semi-natural areas are going to fill the existing knowledge gap and to identify the vegetation types, habitats and their conservation status.

First results indicated that efforts in including the underrated set of artificial and semi-natural wetlands will allow to re-evaluate these areas as possible ecological corridors and, sometimes, as important sites for plant diversity.

## How to sample water-dependent protected plant species in a standardized way to be taken into account in the hydrological planning processes? Insights from Spain

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Among protected plant species, water-dependent plants (vascular and non-vascular) are those which require closer attention, due to the fact that they are currently the most threatened group of flora. There are quite reasons for this consideration. On the one hand, this group is still not very well-known, so, to date, there is an important lack of knowledge about its distribution, conservation status and detailed ecological requirements. On the other hand, the habitats where these species live are facing several impacts and pressures of high magnitude, one of which is climate change, decreasing the extension of inland aquatic environments, especially in Mediterranean countries. Given that scenario, the General Directorate for Biodiversity and Environmental Quality of the Spanish Ministry for the Ecological Transition, which has the legal duty to boost the integration of conservation objectives in other policies such as hydrological planning, took the lead and, in 2017, placed an order to the Centre for Studies and Experimentation on Public Works (CEDEX) to study the eco-hydrological requirements of those species, with the aim of including management guidelines and a proposal of conservation measures in the third-cycle River Basin Management Plans (RBMPs) 2021-2027. For this purpose, the Environmental Restoration Area of CEDEX designed a methodology proposal to sample a wide variety of habitats and biological characteristics of the different flora types (spermatophytes, pteridophytes and bryophytes) included in the working list, but linking these conditions with the parameters described in the 2000/60/CE Water Framework Directive (WFD) for assessing the ecological status of water bodies. Accordingly to this, the protocol to obtain field data was organized in six sections: i) basic data about sampling site; ii) habitat data; iii) indicators related with the WFD; iv) biological data; v) census; and vi) pressures and threats. Section iii) was the most innovative approach of the survey protocol by including parameters related to flow pattern (water flow and dynamics; connection with groundwaters), morphological conditions (width and depth variation; sediment classification; riparian vegetation structure and composition) and chemical and physicochemical indicators (temperature, oxygenation, salinity, acidification status, nutrients; specific pollutants). To cope with the great diversity of water regimes where target species were cited, we established three typologies of aquatic environment to address the parameters above. These categories were: a) *river*; b) *wetland*; and c) *hydrophilic environment*, for biotopes with high levels of humidity. The results of this survey, still under analysis, will be taken into account not only in the documentation linked to hydrological planning processes, but also in the six-year report (period 2013-2018) of the 92/43/CEE Habitats Directive.

# Calcareous fen succession in Engure Lake Nature Park in Latvia

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Vegetation of calcareous fen in Engure Lake Nature Park (West Latvia) was studied. The nature park includes coastal freshwater lake, dry pine forests on coastal dunes, swamp forests, coastal grasslands, calcareous fens, and reed swamps. Engure Lake is a lagoon lake that was formed after regression of the Littorina Sea ca. 4,000 years ago. In 1842, after artificial lowering of the water level for 1,5 m the elevations in the former lake bottom started to overgrow with *Pinus sylvestris* woodland. In lower depressions, calcareous fen vegetation developed on sand and lake gyttja deposits. The fens are young; therefore, the peat layer is very thin or absent, and due to permeable ground, the water table is highly fluctuating.

Fen vegetation was first described in 1988. It is located in a depression between the ancient coastal formations of Litorina Sea and on the former bottom of the Engure Lake. The vegetation was sampled in a transect with 57 1 x 1 m square plots using Braun-Blanquet method. Sampling was repeated in 2018, in total 114 relevés. Our aim was to reconstruct the vegetation changes during the 30-year period which might provide ideas for further management of this area.

Thirty years ago, the lowest part of the depression was covered by shallow water with sparse vegetation composed of *Phragmites australis* and *Cladium mariscus*. The elevated parts of the fen were occupied by *Schoenetum ferruginei*. During the 30-year period, the wet depression has overgrown with *Cladietum marisci* community. However, the comparison of two periods clearly show that the area of *Schoenetum ferruginei* decreases on the expense of the expanding *Cladietum marisci*.

*Schoenetum ferruginei* is a typical community in the area surrounding Engure Lake, though very rare in Latvia. The Engure fens are species-rich, always dominated by *Schoenus ferrugineus* and constantly accompanied by *Phragmites australis*, *Primula farinosa*, *Epipactis palustris*, *Carex panicea*, *C. flacca*, *C. hostiana*, *C. serotina*, *Sesleria caerulea*, *Parnassia palustris*, *Pinguicula vulgaris*, *Equisetum variegatum*, etc. Rare, protected plant species are present, e.g. *Taraxacum palustre*, *Carex scandinavica*, *Dactylorhiza cruenta*, *Dactylorhiza ochroleuca*, *Liparis loeselii*, *Ophrys insectifera*. Bryophytes, such as *Campylium stellatum*, *Calliergonella cuspidata*, *Fissidens adianthoides*, *Scorpidium scorpioides*, *Bryum pseudotriquetrum*, *Preissia quadrata*, *Riccardia multifida*, and *Aneura pinguis* are common. The highest richness of species is found in the transition stage between open fen and forest, whereas the expansion of *Cladium mariscus* in wet depressions leads to decline of species richness. *Schoenetum ferruginei* is gradually replaced by *Cladietum marisci* (typically dominated by *Cladium mariscus*, accompanied by *Scorpidium scorpioides* and few other species).

The Engure fens are slightly affected by drainage impact and cessation of traditional grazing by free-roaming cattle. This has resulted in tree and shrub encroachment and might soon lead to decline of rare plant species. Therefore, restoration of fen by blocking the ditches and clearing the trees and shrubs is planned in 2019. Vegetation monitoring is combined with hydrological monitoring, greenhouse gas measurements, and planning of management actions for longer period of time within the EC LIFE project “Reduction of CO<sub>2</sub> emissions by restoring degraded peatlands in Northern European Lowland”, LIFE 15 CCM/DE/000138, LIFE Peat Restore.

## Classification of *Schoenus ferrugineus* L. communities from eastern Baltic to the Southern Ural

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Aim of our study is classification of *Schoenus ferrugineus* L. communities at eastern edge of its distribution. Our data set had 241 relevés. We also used data from published sources. Formal definitions of fen alliances were used in classification at alliance level. Sociological groups, species dominance and logical arguments using COCKTAIL method, group aggregation (Juice version 7.0) were used to classify relevés at lower taxonomical units.

Data analysis showed, that communities with *Sch. ferrugineus* belong to three alliances: *Caricion davallianae*, *Sphagno warnstorffii-Tomentypnion*, *Stygio-Caricion limosae*.

We distinguished 20 plant communities. *Schoenus ferrugineus* was dominant or codominant in twelve communities and majority of them (10) belong to *Caricion davallianae*. However, only one of them could be assigned to *Primulo-Schoenetum ferruginei*.

We analysed pH and electrical conductivity (EC) from 33 samples with *Sch. ferrugineus* communities in Estonia. Data were recorded in extremely rich fens and in rich fens, and part of them have spring influence. Canonical correspondence analysis (CCA) (PC-Ord7.07) was used to explore the relationship between pH and EC and vegetation data. We concluded, that pH and EC explained only small variance in vegetation data. Electrical conductivity and pH were slightly higher in fens with spring influence than in fens without it. We assume, that in our sample set site hydrology parameters, such as amplitude of seasonal water level fluctuation, depth of water level, and soil organic matter content play more important role in determination of species composition than pH and EC.

## Sessions 11-13. Vegetation Dynamics and Succession in different Habitats

## Disturbance impacts in temperate forests are increasing: 10 years of monitoring understory vegetation in Slovenia

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Between 2004/05 and 2014/15, plant species diversity and composition were studied in representative Slovenian forest ecosystems. In total, 60 plots were placed across different managed forests and are part of a comprehensive international network of sites launched within the ICP Forests Programme aimed to assess the influence of various factors on EU forests. For evaluation of disturbances, which are a major driver of forest vegetation change, the Integral Stand Disturbance Index (ISDI) was developed. ISDI considers both natural and/or anthropogenic disturbances that cause significant damage to trees in forest stands, and to ground-surface layers, including ground-vegetation layers and upper-soil layers, and reflects direct and indirect disturbance impacts. Over the 10-year monitoring period, substantial vascular plant species turnover was observed. Species richness across the 10 sites (gamma diversity) significantly decreased from 273 to 244 species during the study period, while mean species richness per plot did not significantly change. The mean value of plot level diversity indices (Shannon and Simpson index) and evenness significantly increased. The frequency and cover of most common plant species increased during the monitoring period. However, the frequency of disturbance events at the stand level increased during the latter part of the monitoring period, and they caused reduction of total vegetation cover, including tree-layer cover. Median ISDI value per plot increased from 1.00 in the period 2004/05 up to 1.63 in the period 2014/15. Disturbance occurred on 75 % of all plots during the latter period, and some plots experienced the highest disturbance level of the ISDI index. Due to increased disturbance impacts in recent years, the vegetation cover and diversity may continue to change in the future.

## *Aizjoms* – ancient extensive agriculture land “behind beach” in old fishermen villages along SW coast in Latvia

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Coastal sand dune habitats are represented by 8 (eight) European Union importance habitats in Latvia. These habitats cover significant terrestrial area in Coastal Lowland of Latvia. Nevertheless, not all significant and valuable coastal plant communities and habitats are noticed and valued.

We have analysed vegetation descriptions representing *aizjoms* dominated by herbaceous plants previously not described. The aim is to clarify subtypes and successional pathways of older successional stage vegetation of *aizjoms* in the SW of the country – the main distribution area of the core subject.

*Aizjoms* is a flat, man made shaped area in the Coastal Lowland, behind foredune towards inland, surrounded by man made and shaped sand ridge, literary – an area behind beach, “beach” according to ancient local fisherman term – strech of beach where boats and fishery equipment are stored where not going in the Sea. *Aizjoms* is a flat area with sharp edges close to the sea level in coastal dune systems, which lies among ridges of coastal dune systems. It occurs within primary, secondary and relative stable dunes on post Baltic Ice Lake transition area in Latvia, including post Littorina Sea impact area in Coastal Lowland. These systems were made to get more fertile and moist area for extensive agriculture, feed by pink algae *Furcellaria lumbricaulis* etc. layers.

The compositional patterns of *aizjoms* in fishermen village *Jūrmalciems* are varied and have complex relationships. The set of species selected by indicator species analyses at a given order of site group combinations reflects the ecological drivers that filter different species traits at that scale of analysis. Second main driver is former management, indicating cultural value of these systems.

Vegetation floristic composition and spatial structure of *aizjoms* in Latvia is not homogenous. It varies from extremely dry close to foredunes to dry or wet towards inland, as well as, composition of vegetation varies. *Aizjoms* without traditional management develops in process of secondary succession towards: shrubland, wetland or forest with some stages of grasslands.

## Study of vegetation on recent lava flows in the Güímar Valley, Tenerife, Canary Islands

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In the present communication a previous study of the current situation of the processes of plant colonization by vascular plants in historic flows is provided. We have chosen almost intact, or only slightly anthropozoogenic damaged, the "malpaíses" originated during the eruption of the historic Arenas Negras volcano, in the Güímar Valley, Tenerife. This eruption began on February 2, 1705 and ended on March 27 of that year. The so-called "malpaíses" formed by relatively well preserved lava flows of *aa* type located in the municipal areas of Güímar and Arafo are included in the "Paisaje Protegido de Siete Lomas" at an altitude between 800 and 1300 m. An altitudinal transect has been carried out from 400 to 1300 meters above sea level. Numerous phytosociological relevés were made and the georeferenced disposition of the characteristic species of the main vegetation units representing the potential of the territory was recorded. It is a vegetation complex characterized by the remarkable presence of endemisms. In this context, numerous evergreen specimens of Canarian pine, *Pinus canariensis*, stand out, from recent glaucous saplings to long-lived specimens of respectable height together with other elements of the "monte verde" as *Erica canariensis*, *Morella faya*, *Ilex canariensis*. Other species as *Rumex lunaria*, the Macaronesian endemism *Rumex maderensis*, and the canary endemisms *Aeonium arboreum* ssp *holochrysum* and *Aeonium spathulatum*, as well as pteridophytes such as *Cheilanthes marantae* and *Davallia canariensis*, both in relative abundance, give predominant character to this open landscape. *Bencomia caudata*, Macaronesian endemism, has been located in a few places. In the middle of the fissures and hollows of the terrain, small layers of erosive dust materials have been deposited where micropastures of ephemeral annual nitrophilous species have developed.

## Using conjointly species abundance in plots and phylogeny to approach vegetation classification. A case-study on Macaronesia's woody vegetation

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Questions: Can co-occurrence and phylogenetic resemblance of taxa in plots be integrated in a single composite numerical framework so that vegetation classification expresses both in a single system? How should phylogenetic similarity of vicariant taxa, in synvicariant communities, be dealt with for use in formal vegetation classifications? Is Macaronesia's woody vegetation a good paradigm to trial a methodological workflow for phylogenetic-informed classification?

Location: Macaronesia: the Azores, Madeira, Canaries and Cape Verde archipelagos.

Methods: We used alongside i) co-occurrence-only and ii) phylogenetic Bray-Curtis similarity indexes in straightforward classification algorithms: Ward's method agglomerative clustering and *isopam* divisive classification. Phylogenetic distance for ii) was obtained as divergence time, from an *ad hoc* phylogenetic tree. The tree was obtained from DNA sequence alignments of *Rcbl*, *ITS* and *MatK* grafted into a *Phylomatic*-drawn genus-level phylogeny.

Results: Co-occurrence-only similarity is not a reliable predictor of phylogenetic similarity. Moreover, in the partitioning of similarity by co-occurrence vs. phylogeny, the latter dominates by large. Comparative differences in final classification issue, viz. in inter- and intra-group structure. As groups in both classifications may be equated to zonal vegetation formations, classes or orders, alternative arrangements of such appear. In general, vegetation classes are specific to each archipelago if accounting for co-occurrence-only (except for Madeira-Canaries shared mesophytic forest). Conversely, larger units spanning several archipelagos appear when phylogeny is simultaneously accounted for.

Conclusion: We come to recognize the relevance of incorporating phylogeny in the definition of formal vegetation units and thus the possibility that the concept of *syntaxon* may come to include it. Supra-class units issuing from phylogenetic similarity seem to express vegetation synvicariance which, in turn, is otherwise better expressible by biogeographical concepts (*phytochoria*). Regarding 'Macaronesia' being a consistent biogeographical unit, this is only to consider in terms of strong vicariance in *taxa* and synvicariance in *vegetation*, alias both otherwise only weakly shared among archipelagos.

## Facilitation by nurse plant *Juniperus communis* subsp. *hemisphaerica* and its role on natural regeneration of cedar forest on the southern slope of Djurdjura (Algeria)

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The main objective of this study is to determine if *Juniperus communis* subsp. *hemisphaerica*, a nurse plant, plays a facilitating role in the evolutionary dynamics of the cedar forest in the massif of Djurdjura. In order to highlight the possible effect of the presence / absence of cedar seed trees on vegetation dynamics and the natural regeneration of this species, the choice of study sites meets the criterion of representativeness and takes into account three different phytoecological situations: a dense stand of cedar, a cedar-pasture ecotone area and a juniper formation without cedar seed trees. In each type of these sites, we sampled 13 tufts of hemispherical juniper, each one representing a floristic record; the dimensions of each record are those of the patch itself. To appreciate the various correlations that may exist between the nurse plant, its biological characteristics and the facilitated species, through different parameters, such as specific diversity of the flora, number of tall scrubs and recovery of individuals of *Cedrus atlantica* within juniper thickets, we used multivariate analysis for the handling of the data collected. The dataset table contains 39 surveys and 16 dendrometric and biological variables of the juniper individuals measured at the three study sites. The results obtained make it possible to highlight the nature of the positive interactions of this juniper in the dynamics of the cedar forest. These interactions, rendered by the role of shelter provided by the tufts of hemispherical juniper, favor the emergence of a microhabitat adequate to the installation of the plant species linked to the cedar stand, thus protecting them from ecological stress in mountain and anthropogenic disturbances. Among these latter, overgrazing remains the major problem threatening the biological recovery and biodiversity of the Djurdjura massif. It would be conceivable to use this facilitation process for ecological restoration of the degraded cedar forest in Djurdjura.

## Investigation of the weed infection of baits in the Mátra Landscape Protection Area

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The effects of wild game feeding have been widely investigated, especially in the northern countries, but little has been done in Hungary due to the lower importance of winter feeding. However, feeding places for capturing and shooting (so-called baits) are spreading and they have a growing effect on the vegetation. So the aim of our study was to assess the extent of weed infestation in two different aspects. For this purpose, we selected three types of baits (located in forest, clearing and on road) in the Mátra Landscape Protection Area. Four transects were arranged from the center of the baits, each consisting of 22 1x1m tangential quadrants, in which coenological survey was carried out with estimation of percentage cover. The survey was carried out in May and August 2016 with 3-3 repetitions per baits in a total of 1584 quadrants. We detected a stress gradient along the transects: the proportion of weeds decreased from the center of the baits, while the natural species' increased. This is best done with baits on the clearings, and probably due to the lack of closure they proved to be the most infected ones. We supported it with multivariate statistical methods (PCA) as well. There was a remarkable difference between the vegetation of the examined aspects, in August T4 weeds dominated. Baits in the forest were the least weedy, their state was similar in the two surveys, typically with a sparse understory cover. Road baits revealed a notable difference: they varied depending on the canopy closure, establishing and exposure. Infection therefore typically extends to the immediate environment of the baits, but valuable habitat patches can also be destroyed and baits may be the focal points of a biological invasions.



## Vegetation succession within the last 16 years in a limestone quarry in central Spain.

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To ensure a successful process of ecological restoration in a limestone quarry located in a semiarid plateau in the centre of Spain, it is necessary to elaborate a planning that contemplates the aspects and actions that ensure the recovery of the environment. Planning an environmentally adequate restoration requires knowing the natural dynamics and the structural characteristics of vegetation. After limestone mining, the vegetation diversity inside and outside of the quarry was investigated to serve as a benchmark for the rehabilitation of the area. The vegetation was first surveyed and mapped in 2003, eight plant communities were identified, described and classified according to their floristic composition and structure. Transfer mining has facilitated a process of natural succession of vegetation over time. Succession process was reconstructed from primary colonizers until natural potential vegetation. This process was reconstructed by evaluating the degree of convergence towards the natural vegetation of the external border of the quarry (reference ecosystems). During 2019, vegetation has been newly surveyed and mapped in order to identify possible variations in floristic composition and structure occurred in the last sixteen years as result of successional process. The recognition of natural dynamics of vegetation and the processes involved in natural secondary succession allows to take decisions in order to carry out an adequate ecological restoration.

## Remote sensing techniques for investigation of plant communities' syntaxonomy: two cases from Russia

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GIS and remote sensing (RS) technologies open a vast perspective for plant community researches. Understanding the place of each certain community within the dimensions of remote sensed data help us to get ecological "portrait" of them. The technology was effectively used for syntaxonomy of fir forests in Russian Caucasus. Using remote sensing data for grassland communities is more challenging, and looks like impossible before 2016. Nowadays the improvement of data and techniques availability probably opens the new era for using RS for grassland researches. The object of our research is the remote-sensed characteristics of meadows and semi-ruderal herblands.

Methods. We used the data of 233 grassland relevés (collected in 2014 and 2018; the point was marked by GPS) from the surroundings of Polistovsky state natural reserve, Pskov region, Russia. The syntaxonomy of grassland communities was developed with Juice 7.0 (TWINSPAN). As RS data we used Sentinel-2 images (bands 02-08A, 11, 12 of 09 Aug 2017 and 03 Jun 2018) and drones data. Using ArcGIS 10.5.1, we extracted the remote sensing data (including indices values), then analyzed the distinguishing between syntaxa of classes and alliances using R 3.4.4 (Mann-Whitney test) and Random Forest predictive algorithm.

Results. Communities related to 4 classes: *Molinio-Arrhenatheretea*, *Phragmito-Magnocaricetea*, *Epilobietea angustifolii*, *Artemisietea vulgaris*; the last one contains alliances: *Filipendulion ulmariae*, *Calthion palustris*, *Arrhenatherion elatioris*, *Molinion caeruleae*. Both classes and alliances are well-distinguished within RS data dimensions. The overall accuracy of Random Forest model was 81% for classes and 64% for alliances.

The results of communities' spectral response analysis correspond their ecological characteristics. Subruderal *Artemisietea vulgaris* have the highest Greenness and Brightness indices; *Epilobietea angustifolii* – perennial grasslands on rich soils – have the highest NDVI, Chlorophyll Absorption, and Red Edge. *Filipendulion ulmariae* have a peak of Red Edge and Chlorophyll absorption in August – because of relatively long vegetation period in summer, and so on.

Thus, the methodology of improving syntaxonomy process using remote sensed data and the results for two case studies: in Russian Caucasus fir forest and North-West Grassland will be presented. The advantages, restrictions and the possible future development of the technique will be discussed.

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## Phenological trends in plant communities dominated by grasses in Mediterranean areas

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The monitoring of phenological events is of great interest as an indicator to evaluate the effects of the climate change on plant life cycle. Grasses are dominant species in plant communities growing in all types of habitats, from those of natural vegetation to those intensely anthropic. The aim of this work is to analyze possible trends in relation to changes in the phenology of grass species in Toledo (central Spain) as well as to characterize the floral phenology of the most abundant grasses in two well represented plant communities in the study area, the dry grasslands (“espartales”) dominated by *Macrochloa tenacissima* (L.) Kunth (*Lygeo-Stipetea* Rivas-Martínez 1978 nom. conserv. propos., *Lygeo-Stipetalia* Br.-Bl. & O. Bolòs 1958 nom. conserv. propos.) and the ruderal annual vegetation dominated by grasses associated to altered and nitrogen-rich soils (*Stellarietea mediae* Tüxen, Lohmeyer & Preising ex von Rochow 1951, *Thero-Brometalia* (Rivas Goday & Rivas-Martínez ex Esteve 1973) O. Bolòs 1975). In order to carry out these aims, several methodologies have been applied: 1) modeling of the flowering period of grasses by monitoring the airborne pollen concentrations along a period of 15 years; 2) field monitoring of the phenology following the international and standardized BBCH scale; 3) analysis of the digital images to obtain the Green Chromatic Coordinate index considered as vegetation index related to the plant development by the photosynthetic activity.

The results showed a statistically significant trend of advance in the start date of the pollen season. This advance is correlated to the changes occurred in this period in some meteorological variables such as temperature during the months prior to the start of the pollen season. Regarding the characterization of floral phenology, ruderal plant communities dominated in the study area by species such as *Bromus rubens* L., *Bromus tectorum* L., *Hordeum murinum* L. subsp. *leporinum* (Link) Arcang. or *Avena barbata* Link, among other species, possess an early development with a flowering period that occurs between mid-March and early May. Conversely, the broad areas covered by dry perennial grasslands (“espartales”) present a later development with a flowering period that is completed between the months of May and June. The most abundant perennial grasses constituting these grasslands comprise species such as *Macrochloa tenacissima* (L.) Kunth, *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman, *Arrhenatherum album* (Vahl) Clayton or *Melica ciliata* L. subsp. *magnolii* (Gren. & Godr.) Husn.

## Hydrochemical and vegetation trends and dynamics across the poor-rich gradient in a boreal aapa mire over 20 years

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Fennoscandian aapa mires typically have low buffering capacity, thus being particularly sensitive to hydrological changes, acidification, and succession, potentially caused by climate change. We present results of vegetation analysis and hydrological measurements repeated after 20 years in the Härkösuu aapa mire with diverse vegetation along the poor-rich gradient. The mire and the whole catchment are in pristine state and located in a wilderness area with low atmospheric deposition levels. Vegetation in rich fens represents the alliances *Sphagno warnstorffii-Tomentypnion nitentis* and *Stygio-Caricion limosae*. Poor fens have *Sphagno-Caricion canescentis* and *Scheuchzeria palustris* communities. High hummocks and mire margin communities are also included. In 2018, we sampled vegetation, water table depth and obtained water samples from 203 repeated plots. We tested differences in plant communities, water table depth, pH, TOC, and concentrations of 11 mineral elements (Al, Ca, Cu, Fe, K, Mg, Mn, Na, Pb, Si, and Zn) between 1998 and 2018.

Despite the pristine state and remote location of the study area, and a relatively short time span, we found significant changes in species composition. Many common, generalist mire species increased in plot frequency, including *Andromeda polifolia*, *Drosera rotundifolia*, *Eriophorum vaginatum*, *Scheuchzeria palustris*, and *Vaccinium oxycoccos*. Changes in plant functional groups and species number were pronounced in high pH (> 5.4) plots, where *Sphagnum* mosses and vascular plants were significantly more abundant in 2018, both in total cover and in species richness. The absolute water table level had not changed over the 20 years, but our results showed dynamic variation of water table depth, i.e. height of moss surface above water level. Differences in water chemistry were small. In plots with originally low pH (below 4.6), concentrations of some chemical elements, such as iron and lead, were significantly lower in 2018. However, a wide pH gradient still exists and element concentrations were at the same range as in 1998.

This study provided a unique opportunity to repeat vegetation analysis and water sampling from 203 semi-permanent plots in a boreal aapa mire, demonstrating evident trends and dynamics over 20 years. Results revealed a trend of increasing abundance of common mire species and decline of some rich fen specialists. In rich fens, *Sphagnum* mosses had proliferated, potentially indicating early signs of ecosystem change towards bog succession. However, we could not clearly connect changes to water chemistry, which may indicate that other factors, such as increased productivity due to ongoing warming, have contributed to drive the changes, threatening northern rich fen ecosystems.

## Succession in soil and plant-community attributes along a chrono-sequence of abandonment vineyards

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The abandonment of large rural areas of agricultural land has been occurring in recent decades in Europe-Mediterranean countries. After this abandonment, there is a colonization of natural vegetation, changing with it the functioning of the ecosystems. The knowledge of the magnitude and direction of these changes would allow us to recognize patterns on the biological and edaphic recovery of the land that could be very useful for the management of these abandoned agricultural systems. Our main objective is to study how the age of abandonment of vineyards influences the physical, chemical and biological properties of the soil and how the vegetation responds to it.

A study on secondary succession in abandoned vineyard land was carried out by the chronosequence method. We studied a vineyard in active, a plot of land has not been vineyard at least in the last 60 years and 6 plots of land of different ages of abandonment (1, 3, 7, 11, 25 and 40 years, since 2016). We analyzed soil physico-chemical variables, the organic fraction and assimilable nutrients. We also determined the variation of the biological properties of the soils by the activities of 12 enzymes related to the cycles of the main macronutrients (C, N, P and S). In addition, we recorded certain vegetation attributes such as species density and cover of plant functional traits.

Our results showed that the abandonment caused important changes in the functioning of the ecosystems. The C and N content of the soils as well as the activity of most of the enzymes measured –more quickly during the first two decades after abandonment– was increased. It was accompanied by changes in the composition of the annual grasslands, from early Brassicaceae characterized community to late Cistaceae characterized community. With the abandonment of the vineyards there is an important sequestration of C in the soil, which is the most stable pool. The identification of the succession's state through the type of grassland community can help to the management of abandoned soils in a context policy of mitigation of climate change.

## Increased drought and high maximum temperatures alter recruitment patterns in Mediterranean forests: Linking climate, canopy cover and seedling survival in three co-occurring tree species

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It is widely accepted that the main limiting factors during plant establishment in Mediterranean ecosystems are water shortage, together with high temperatures and intense irradiance. Seedlings in the Mediterranean basin are thereby subjected to multiple co-occurring stresses whose interactions are still poorly understood. Previous studies have analysed the effect of drought on seedling survival, in field conditions in the Iberian Peninsula building rain exclusion shelters. This topic is highly relevant since climatic conditions are becoming hotter and drier due to climate change and may affect forest regeneration dynamics. However, knowledge of natural regeneration dynamics in mixed *Pinus pinea* forests growing in limestone plain areas in the Spanish Northern Plateau is still scarce. In these forests *P. pinea*, *Quercus ilex* subsp. *ballota* and *Juniperus thurifera* share the habitat. In order to identify the optimal regeneration niche for these species, we designed a factorial experiment along a light availability gradient considering two climatic scenarios for precipitation (control and exclusion). We used 3.5 years of seedling survival data from 864 seedlings of all the species of study installed under an adult canopy of the three species. Lifetime analysis techniques were employed to model seedling survival to identify the key climatic factors and optimal light environment to guarantee a successful natural regeneration in these mixtures. The optimal regeneration niche for *P. pinea* and *Q. ilex* seedlings under current and future climatic conditions (RCP 8.5 scenario) is found in microsites where canopy cover intercepts between 50-75% of total incident light. Benefits from the canopy cover in these Mediterranean mixtures are not more humid soil conditions but rather lowered radiation levels and milder soil temperature conditions. The effect of daily maximum temperatures and cumulated precipitation differed between species, seedling survival being severely compromised for *Q. ilex*. *J. thurifera* will undoubtedly keep colonising these Mediterranean mixtures, being less affected by extreme climatic factors in all levels of light availability that we evaluated.

## **Biotic and abiotic conditions and vegetation diversity during spontaneous succession on postindustrial sites – the info-geographical approach**

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The intense human mining activity is causing large part of land is becoming postindustrial areas. Coal post mining sites represent an important element of the landscapes in the Silesian Upland region in southern Poland and in the Central Europe. Huge amounts of excavated material are accumulated in waste heaps, as side effect of the mining activities. These sites represent poor mineral habitats where the ecosystem is developing "de novo", the spontaneous primary succession undergoing on these sites provides a huge experimental set where vegetation patches are present with a gradient of species richness and functional diversity. There are some data regarding the diversity of spontaneous vegetation development. However, the factors (soil substratum parameters), which are shaping the observed diversity do not explain everything. Several aspects of the chain plants-soil microbial community-SOM pool of the spontaneous succession on the post-mining sites are not fully understood yet. The biodiversity of vegetation and the associate microorganisms are connected. However, there is still lack of information about how these processes are occurring during spontaneous succession on postindustrial sites. In this respect the presented project is not only of high scientific interest but can be important from an environmental, economic and social point of view.

A particularly interesting biotic factor affecting the species and functional composition in post-industrial areas is the phenomenon of mycorrhiza. It can be assumed that mycorrhizal symbiosis brings complex and multidimensional benefits to plant hosts in all types of habitats including post-coal mine sites. The results of one of the studies plants-soil microbial community aspect has shown that the mycorrhiza colonization is higher in herb *Daucus carota* dominated vegetation patches than in the grass dominated ones (*Calamagrostis epigejos* and *Poa compressa*). The preliminary results show also, that mycorrhiza colonization is related to the higher value of vegetation diversity parameters. An attempt has been undertaken to visualize the results regarding the microorganism's diversity on numerical maps using the info-geographical approach.

The results of our study will provide also useful information for developing effective strategies to recover post-mining sites with positive consequences for the landscape and the economy of the region.

**Posters**

## National Habitat Classification of Ukraine

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The European integration processes that are currently taking place in Ukraine have significantly intensified the development of the Emerald network and the adaptation of European environmental legislation. On November 18, 2016, the Standing Committee of the Bern Convention approved the List of Officially Accepted Sites of the Emerald Network of Ukraine. The next step should be to develop management plans for all these sites with detailed habitat mapping. During the testing, different classification systems were used to identify habitats. But in all cases, there were some difficulties. The list of the Habitat Directive Annex I has been developed for the EU countries, therefore it does not contain many habitat types from Ukraine. The EUNIS classification, as well as Resolution 4, which is based on it, include a much wider list of habitats, however, they were developed mainly by European experts without sufficient consideration of peculiarities of Ukrainian habitat diversity. Taking into account these circumstances, we have decided to develop a National Habitat Catalog of Ukraine by the example of other European countries Czech Republic, Slovakia, Hungary, Romania. This Catalog should display all variety of natural habitats types of Ukraine, that would meet such criteria: 1) were suitable for mapping the sites of the Emerald network and were clearly recognizable in field; 2) are compatible with the habitat types of Resolution 4 of the Bern Convention and Annex I of the Habitat Directive and 3) would be quite simple to use the proposed system, not only by professional botanists, but also by botanists-amateurs, specialists in related specialties – geographers, zoologists, hydrobiologists, etc., who could potentially be involved in the mapping of the Emerald Network in Ukraine.

In accordance with the concept of the Catalog the description a habitat type includes 22 components - National habitat code, Ukrainian name, English name, Correspondence with other habitat classifications (EUNIS, Resolution 4 of the Bern Convention, Annex I of the Habitat Directive, UkrBiotop, Green Book of Ukraine), Syntaxonomy, Characteristic species (with limit of their number), Structure, Ecological characteristics, Distribution (in Europe and Ukraine), Representativity, Conservation status, The presence of rare and endangered species (Red Data Book of Ukraine, Annexes II and IV of Habitat Directive, Resolution 6 of the Bern Convention), Threats, Management, Literature. In general, 216 types are described in the Catalog. All habitat types of biotopes are distributed in nine groups, which are mainly in line with the major groups of the EUNIS system and indicated by the letters of the Cyrillic alphabet: M – marine (13 types); П – coastal (10); В – Inland surface waters (25); Б – Mires, bogs and

fens (12); Т – grasslands (45); Ч – scrub and heaths (26); Д – forests and woodlands (46); К – stone outcrops and other sparsely vegetated habitats (17); С – synanthropic (22).

The proposed classification can become the basis for detailed mapping of the Emerald sites, as well as the inventory of habitats of the whole territory of Ukraine with their medium-scale mapping and the creation the National cadastre of habitats of Ukraine.

The work was carried out within the framework and with the financial support of the project “Support to Ukraine in approximation of the EU environmental acquis”.

## How to develop databases for assessing the state of conservation of habitats? Example of the “VegFrance” database.

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In Europe, the last decades have allowed the gradual accumulation of an enormous amount of naturalistic data among the European states, in particular in response to the requirements of the Habitats Directive. During the same period, IT tools have become more efficient and data management is constantly improving. Today, these naturalistic and computer advances enable researchers in vegetation science, and more broadly ecologists, to consider new tools for habitat characterization. Indeed, it should be noted that the habitats as defined in the Habitats Directive, remain unclear notions and their characteristics of structure, composition and functions little understood.

The VegFrance database, gathering data on vegetation in mainland France, was initially the result of reflections allowing it to record various naturalistic information useful for habitat mapping (French national program CARHAB). This database now includes three types of information ranging from floristic survey, syntaxon and geosyntaxon, i.e. station surveys, synthetic surveys and landscape surveys. These different types of information, at least station surveys and synthetic surveys, can now be used to assess the state of conservation of habitats of Community interest. Based on vegetation repositories at infra-habitat level, lower-ranking syntaxons allow the characterization, on a floristic basis, of the structure and composition of the different habitats, taking into account their intrinsic variability.

Recently, a french national project (SurPas), supported by the French Ministry of Ecology and the French Agency for Biodiversity, focuses on assessing the state of conservation of agro-pastoral habitats of communal interest. After several discussions within a research consortium (grouping nine research teams in France), it became necessary to define reference states for habitats, taking into account their intrinsic variability to ultimately evaluate their state of conservation.

Here we present the “VegFrance” database for metropolitan France and its current evolutions in order to allow the characterization and the evaluation of the Community interest agro-pastoral habitats in the SurPas project. In this way, we hope to provide new bases for better responses to the requirements of the Habitats Directive.

## Do decision makers keep up to date with new data on EU habitat types?

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During the period from 2010-2015, EU habitat mapping was carried out all across Lithuania. The result of this inventory showed that 53 habitat types of Annex I Habitats directive occupy 4349 square kilometres or 6.66% of the country's territory.

The mapping results show that 26.86% of the area of 53 habitat types fall within the designated Natura 2000 territories: on average 47.28% per each habitat type. More than 80% of each of the 11 habitat types are found in the Natura 2000 territories, including such priority types as 1150\* Coastal lagoons, 2140\* Decalcified fixed dunes with *Empetrum nigrum*, 7110\* Active raised bogs and 7210\* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*.

Less than 40% of the total area of 9010\* Western Taïga, 9020\* Fennoscandian hemiboreal natural old broad-leaved deciduous forests, 9080\* Fennoscandian deciduous swamp woods, 9180\* *Tilio-Acerion* forests of slopes, screes and ravines, 91E0\* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*, 6120\* Xeric sand calcareous grasslands and 6230\* Species-rich *Nardus* grasslands are in Natura 2000 sites. The worst situation concerns two priority habitat types: 6270\* Fennoscandian lowland species-rich dry to mesic grasslands and 6530\* Fennoscandian wooded meadows, with 10% of the total area of each occupying the Natura 2000 territories.

Because of the obvious inadequate conservation efforts, the European Commission started infringement procedures against member state and decided to send a letter of formal notice to Lithuania over its failure to ensure the adequate protection of indigenous habitats and species by designating nature protection areas.

A surveillance scheme at national level for the habitat types of community interest has been proposed. For the evaluation of range and area changes, periodic remapping of the habitats on at least 10% of the country's territory is intended. Territories/squares for remapping are arranged randomly with some correction for habitat types having distribution borders within the country (e.g. 9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli* or 91T0 Central European lichen Scots pine forests). For specific structure and function, permanent sampling plots (transects) are designed, in which the evaluation of the most important indices (species composition, structure of vegetation layers, invasive and expansive species, physical parameters) is carried out. The number of transects depends on the frequency of habitat types and ranges from 10 to 250. For the future prospect of conservation modes, management activities, threats, etc., are foreseen. Therefore, the procedure for the assessment of the conservation status of the habitats at the site level and national level was proposed.

Unfortunately, until now this and any other surveillance scheme has not been designated and state authorities have insufficient data about the status and trends of habitats. We believe that the third member state report under Art. 17 of the Habitats Directive may not be representative enough.

## **Conservation status of Natura 2000 coastal habitat: application to French coastal Mediterranean and Atlantic habitats**

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Research investigations related to conservation status of Natura 2000 coastal habitats have significantly grown during the last decade. Most of the studies focused on assessing and mapping terrestrial coastal habitats, highlight a gap on coastal habitats knowledge and an urgent need to assess them.

Launched by the French Ministry of Ecology in 2018, and supported by various structures: universities of Brest, Saint-Étienne and Rennes 1, a research project aims to assess and set up a monitoring process of the conservation status of French Mediterranean and Atlantic coastal habitats. The objective is to answer the request of the European Habitats Directive (articles 6 and 17), in order to assess the conservation using the following status criteria: "distribution", "area", "structure and functions", "prospective trends".

Three different research axis are defined to assess and monitor conservation status of coastal habitats: (i) synsystem of Atlantic and Mediterranean coastal area ;(ii) ecological data characterizing the main ecological patterns of coastal habitats are combined with currently map of habitats in order to provide potential distribution maps of each coastal habitat; (iii) a standardized protocol will be proposed.

## European habitat types of scrub and forests in the southern part of North Macedonia

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European natural habitat types listed in the Habitats Directive Annex I inventoried and assessed in the Pelister National Park, Prespa Lake Natural Monument, and adjacent areas. Data collected during three field research in summer 2018. The main aim of this study was to collect data and to classify European habitats of scrub and forests.

Summarizing the results of field investigations and literature studies, 15 types of European habitat have been identified: 4060 Alpine and Boreal heaths (incl. *Bruckenthalion spiculifoliae* Horvat 1949 pro parte), 5130 *Juniperus communis* formations on heaths or calcareous grasslands (incl. *Bruckenthalion spiculifoliae* Horvat 1949 pro parte, *Berberidion vulgaris* Br.-Bl. ex Tx. 1952 pro parte), 91AA \*Eastern white oak woods (incl. *Quercion petraeo-cerridis* Lakušić et B. Jovanović in B. Jovanović et al. ex Čarni et Mucina 2015), 9180 *Tilio-Acerion* forest of slopes, screes and ravines (incl. *Ostryo carpinifoliae-Tilion platyphylli* (Košir et al. 2008) Čarni in Willner et al. 2016), 91BA Moesian silver fir forest (incl. *Geranio striati-Fagion* Gentile 1970 pro parte), 91E0 \*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (incl. *Alnion incanae* Pawłowski et al. 1928, *Salicion albae* Soó 1951 pro parte), 91W0 Moesian beech forests (incl. *Geranio striati-Fagion* Gentile 1970 pro parte), 9250 *Quercus trojana* woods (incl. *Carpinion orientalis* Horvat 1958), 9260 *Castanea sativa* woods (abandoned *Castanea sativa* plantation above Capari village found), 9270 Hellenic beech forests with *Abies borisii-regis* (incl. *Geranio striati-Fagion* Gentile 1970: *Abieti borisii-regis-Fagetum* (Em 1985) Matevski et al. 2011), 9280 *Quercus frainetto* woods (incl. *Quercion confertae* Horvat 1958), 92A0 *Salix alba* and *Populus alba* galleries (incl. *Salicion albae* Soó 1951 pro parte), 9560 Endemic forests with *Juniperus* spp. (incl. *Juniperion excelso-foetidissimae* Em ex Matevski et al. 2010) and 95A0 High oro-Mediterranean pine forests (incl. *Pinion peucis* Horvat 1950). 91W0 Moesian beech forests, 91AA \*Eastern white oak woods, and 95A0 High oro-Mediterranean pine forests are widespread within the investigated territory. 95A0 High oro-Mediterranean pine forests habitat type consists of two subtypes: coniferous forests – *Vaccinio-Piceetea* (with *Vaccinium myrtillus* and *Bruckenthalia spiculifolia*) and nemoral forests – *Carpino-Fagetea* (with *Pteridium aquilinum* and nemoral herbs). Therefore, syntaxonomical status of *Pinion peucis* alliance is still uncertain, because it includes one association from *Vaccinio-Piceetea* and another one from *Carpino-Fagetea* class.

The study is a part of the EU Twinning project “Strengthening the capacities for effective implementation of the acquis in the field of nature protection” (MK 13 IPA EN 02 17). In this project inventory and monitoring methods and protocols were developed to meet the requirements of the Habitat and Bird Directives.



## Continental and Mediterranean forest priority habitats in Italy: comparison between 3rd and 4th reports

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Habitats Directive constitutes a fundamental stage for nature conservation. Habitat monitoring represents a fundamental step for the knowledge concerning nature conservation at national and European level. Every six years the Ministry of the Environment sends a report to the European Commission about the status of Habitat conservation. In 2019 the Italian Vegetation Sciences Society (SISV) dealt with the implementation and drafting of the IV report Art. 17. In the context of monitoring European habitats, our work focuses on priority Continental and Mediterranean forest habitats, while paying particular attention on the Abruzzo region. The first part focused on identifying the decline and growth of forest areas in Italy through GIS analysis using satellite images following the approach published on Science by Hansen in 2013. The comparison was made using the open source platform Google Earth Engine, analyzing the images from 2000 to 2018. For priority habitats 9210 \*, 9220 \*, 9180 \*, 91AA \*, 91E0 \*, 9510 \* distribution and data availability used to prepare the IV report was reported. Specifically, a comparison between the III and IV reports is presented, both for the range and for the total area occupied. Moreover, for each habitat the final assessment is discussed in order to highlight the possible criticalities of actual and future management and monitoring. Furthermore, a special focus was dedicated to Abruzzo where the Natura 2000 Network is very extended and articulated and includes n. 4 SPAs, n. 21 SIC included in protected areas and n. 33 SCI outside the same, for a total area of 425650 ha (39.5% of the regional surface). Regarding the pre-existing data provided by the regional Administration, various improvements have been provided to get a more accurate cartographic representation of the distribution of the habitats. Through automated techniques in GIS and R studio, new methods have been developed to create a unified map of the Abruzzo habitats and to revised and correct the provided data. Beyond existing cartographic data, many recent field and literature data have been utilized in order to better define the distribution of the habitats and so achieve a map closer to their real distribution.

## Research project on the development of an expert system of vegetation in France

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Since 2012, the French Society of Phytosociology has been coordinating the description of 80 classes of the Prodromus of French Vegetations up to the association level. This project, called PVF2 (Prodromus of French Vegetations 2), has already produced publications of 41 classes (<http://www.phytosocio.org/#/prodrome>). Although this study allowed the identification of the French vegetation, there is currently no tool available to automatically and objectively identify and link the relevés to a type of vegetation.

Expert systems have developed widely in recent years and are considered as relevant and objective tools for the recognition of vegetation. They constitute a tool for identification of habitats from floristic and chorologic data can be also used within the framework of the Habitats Directive in order to monitor the conservation status of habitats.

The French Society of Phytosociology aims to update the French prodromus based on an expert system. This approach is illustrated by an example on the supra and oromediterranean vegetation of the *Carici-Genistetea lobelii* Klein 1972.

This poster is an invitation to all European colleagues who would like to help us both in terms of the methodological approach and the availability of vegetation survey data.

## Ancient burial mounds increase landscape heterogeneity and plant diversity

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Steppe vegetation in Europe have survived as small patches among agricultural fields. Therefore, understanding factors affected plant diversity in small isolated grasslands patches (such as ancient burial mounds, kurgans) is important for conservation purposes. Burial mounds in Bulgaria are widespread and numerous (> 50000), yet neither their importance as grasslands refuges nor their diversity patterns have been unexplored so far. Burial mounds represent landscape features that have been preserved for millennia due to their spiritual significance existing as man-made habitat “islands” among the agricultural “sea”. We selected 260 burial mounds spread throughout Southern Bulgaria. We estimated the land use/cover diversity of an area of 200 m buffer around each mound both by official governmental data from Land Parcel Information System (LPIS) and by visual observation of Google Earth images. Kurgans were selected to be almost entirely surrounded by agricultural fields (isolated) or entirely surrounded by semi-natural vegetation such as pastures (not-isolated). We also assessed the percentage cover of grassland vs. tree-scrubland vegetation on the mound surface according Google Earth images. To disentangle the relative importance of regional, landscape and local factors for species diversity of kurgans, we sampled 62 burial mounds. Kurgans’ size was estimated as a 3D-area (in sq. m.). On each kurgan, we recorded two measurements of species diversity: (1) overall species richness – the number of all species of vascular plant, bryophytes and lichens present; (2) species density – species richness per plot of a fixed size (1m<sup>2</sup> and 5m<sup>2</sup>). Plots were arranged as nested series, located on the N- and the S-facing slopes of the kurgan. We used model selection techniques and linear models to select relevant factors affecting measurements of species diversity on kurgans, separately for each plot size. Correlation of species richness and diversity indexed by mounds height, area, coverage type and surrounding land use were tested. We asked: (1) How species-rich are kurgans in Bulgaria in terms of overall species richness? (2) How do regional factors (climate), landscape factors (degree of isolation) and local factors (kurgan’s size, shrub encroachment, habitat heterogeneity) affect their plant diversity (species richness and density)? Through established plant diversity we could identify the significance of burial mounds for semi-natural vegetation preservation. Ancient burial mounds could serve as Ecological Focus Areas within the intensive agricultural lands because they provide several ecosystem services.

## Big data from Earth meet/join big data from space: how could we improve remote sensing studies using vegetation knowledge?

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Data from Earth Observation (EO) by remote and/or proximal sensing (RPS), are some of the most important assets brought to us new challenges in knowledge. The continuous tiles views of our planet, supplied by satellites equipped with optical high-resolution and spectral sensors (e.g. multispectral and hyperspectral), provide data for scientific research and consequently tools for decision makers to understand and protect the environment.

EO obtained from airborne, unmanned aerial vehicles (UAV) and satellites, provides data for the identification and distribution of ecosystems in several landscapes using different algorithms combined with derived information (e.g. vegetation indices, phenological key-stages). However, to date the applications of EO techniques on vegetation/habitat mapping, lacked an appropriate thematic resolution. For these reasons, vegetation researchers entrusted the habitats mapping to an accurate field sampling.

Nevertheless, recently the earth observation EU program Copernicus (i.e. Land Service), has produced technical reports evaluating the land cover change in Natura 2000 areas and how Sentinel image products can support habitat monitoring sensu habitats directive. Moreover, the coming of powerful techniques, as machine learning and similar, combined with modern devices allowed the inclusion of EO for mapping land-cover products, for understanding biodiversity distribution and dynamics and evaluating ecosystem responses to specific processes.

During last years, vegetation scientists archived thousands of vegetation plots in digital databases (i.e. European Vegetation Archive, national databases and sPlot database) with the aim of studying the species composition and functioning of vegetation types in several biomes. However, in few cases it was explored the potentiality of combining this large amount of vegetation plots and the derived ecological information with the EO. Indeed, we believe that RPS approaches need the valuable knowledge of vegetation researchers to make the difference in nature conservation.

The aim of this study is to test if the combination of vegetation plot data, their classification in homogeneous groups in terms of species composition, and their ecological characterization (i.e. environmental drivers), can improve the classification outputs from RPS, to obtain vegetation mapping products (i.e. EUNIS habitat mapping) from sub-regional to regional scale (i.e. biogeographical regionalisation).

## Prodrome of vegetation of Ukraine

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The Prodrome of vegetation of Ukraine represents the modern state of vegetation syntaxonomy in Ukraine. It is a result of more than 30 years of phytosociological researches and was created on the base of analysis of large phytosociological databases. The structure of the Prodrome on the rank of association includes their valid names and synonyms, diagnostic species, environmental conditions, distribution in Ukraine, synphytosociological status and references (including protologues). The characteristics of higher and middle rank syntaxa include their synonyms, ecological-geographical features, and diagnostic species. The development of syntaxonomical studies of vegetation in Ukraine based on Braun-Blanquet approach is also presented. The features of higher classification units are compared with European ones. The general characteristics and synonyms of higher classification units are as close as possible to EuroVegChecklist (Mucina et al., 2016). However, there are some discussion questions that require further detailed consideration and additional research, so the authors retain their concept of the content, structure, and names of classes.

Significant area of Ukraine, features of its geographical location and heterogeneity of habitats cause a high syntaxonomic diversity of plant communities, which is 1003 associations belonging to 253 alliances, 128 orders and 74 classes. The highest syntaxonomical richness is differential for *Stellarietea mediae*, *Artemisietea vulgaris*, *Festuco-Brometea* and *Phragmito-Magnocaricetea*. *Therosalicornietea*, *Salicetea purpurea*, *Bolboschoenetea maritimi*, *Koelerio-Corynephoretea canescentis*, *Ammophiletea*, *Salicetea herbaceae*, *Cakiletea maritimae*, *Crithmo-Staticetea*, *Lonicero-Rubetea plicati*, *Molinio-Betuletea pubescentis*, *Crypsietea aculeatae* and

*Carici rupestris-Kobresietea bellardii* classes have a low syntaxonomical diversity. The leading factors of the plant communities territorial differentiation in the majority of classes are relief, climatic (temperature, average annual precipitation and total amount of solar radiation) and edaphic conditions (type of soil and its structure, as well as soil humidity, salt regime, nitrogen and carbonate content). The differentiation of the coastal plant communities also determined by influence on the abrasive-accumulative activity of the sea, alpine vegetation – by altitude, aspect and slope, and anthropogenic vegetation - by the degree of habitat disturbance.

## Dry grassland habitats of Ukraine: classification, ecological differentiation and conservation

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Centuries ago xeric grassland habitats occupied more than half the area of present-day Ukraine. Currently, almost all the vast territories covered before by the steppe-like communities are ploughed up. With a few exceptions, they remained only in areas unsuitable for use. Such are outcrops, sandy areas, steep slopes etc. All remnants of dry grassland habitats are of great scientific and conservation interest. During the preparation of the National Habitat Catalogue of Ukraine (2018) we developed the classification scheme of dry grassland habitats based on their most important ecological and geographical drivers. Two main groups are climatic-driven and edaphic-driven. The first group combines habitats determined by zonal macroclimatic factors (temperature regime, precipitation etc.). The second one is differentiated by the microclimatic factors, as chemical and physical characteristics of the soil. To the first group belong such groups of habitats as meadow steppes, true steppes, desertified steppes, Mediterranean xeric habitats (on the south coast of Crimea). They are further divided into more detailed levels. Depending on the soils, we distinguish meadow steppes on chernozem, rendzina and on volcanic bedrock. True steppes are further divided by climatic factors into forb-bunchgrass and bunchgrass steppes. Desertified steppes depending on the level of salinity are divided into salt steppes (with *Artemisia taurica* Willd.) and desertified steppes not affected by salinity (with *Artemisia lerchiana* Stechm.). The second, edaphic-driven group combines primarily dry grassland habitats on sandy and on rocky soils. Sandy dry grasslands depending on the soil reaction are divided into neutral and acidic psammophilic types. Rocky dry grasslands in Ukraine are of three main types: on siliceous, chalk and limestone outcrops. They are further divided mainly by regional and orographic principles. Most of the dry grassland habitats of Ukraine more or less correspond to the existing threatened habitat types listed in Annex I of the Habitat Directive (1510, 1530, 2330, 2340, 6120, 6190, 6210, 6220, 6240, 6260, 62C0, X18) and Resolution 4 of the Bern Convention (E1.11, E1.12, E1.13, E1.2, E1.3, E1.9, E6.2). But some of them does not have correspondences or they are regional analogues or their definitions should be corrected. Such are Petrophyte steppes on siliceous substrata, Petrophyte steppes on chalk, True forb-bunchgrass and bunchgrass steppes, Desertified steppes, Salt steppes.

## Plant communities of the *Rhamno-Prunetea* class in the Western Iberian Peninsula

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In the Iberian Peninsula, there are 26 species of *Rubus* L., which form bramble communities related with different forests. These communities are very important for biodiversity conservation, especially for natural regeneration of forests. In this research, we show a review of bramble communities of the western Iberian Peninsula, based on 921 phytosociological relevés. This is the most diverse area, presenting almost 22 species. Many of them are endemic and show an uncertain distribution, because of their difficult determination, thus some of them are catalogued under DD for conservation. After a statistical analysis, we observe 7 groups of associations, related with different types of forests, biogeography and altitude. We offer new data on distribution, and a better knowledge of their dynamics and ecology, which allow a better management and conservation of these species and communities.

## Spatial relationships of forest-steppe vegetation pattern, environmental and functional variables

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The transition zones of the vegetation are sensitive to changes of environmental variables. Therefore, the impact of global climate change may be observable in spatio-temporal changes of habitats' abiotic and biotic factors, such as microclimate variables, soil parameters, indices that typify vegetation etc. In this study, a grove of poplar trees (*Populus alba*) and the surrounding grassland were investigated in Hungary (Fülöpháza region of Kiskunság National Park). Measurements of environmental and functional variables and vegetation sampling were performed in 4 transects (44 m long each) with different cardinal directions; forming together a star shape sampling arrangement with the group of trees in the middle. Species cover values were recorded in 0.5×0.5 m relevés. Air temperature, soil temperature, soil water content, soil respiration, topographic position and leaf area index were recorded along the transects. Microclimate components were measured in the herb layer with sensor network in a 24 hours period. Based on spatial plots of air temperature for 24 hours, the microclimate patterns are directly influenced by the physiognomy and patches of the vegetation. During the day, the extent and shape of shadow of the grove can be determined and the dynamics microclimate pattern also follow the received amount of solar radiation. The soil temperature shows positive correlation with the air temperature at 13 p.m. and negative correlation with leaf area-index (with group of trees). The soil respiration is positively correlated to the soil water content and negatively to the soil temperature. In the spatial patterns of the environmental parameters the group of trees can be detected. Based on the extent of shadow of the grove, we hypothesized that the discontinuities of herb layer are under the visual edges. However compared to the visual edges, these discontinuities (obtained by moving split-window analysis) shifted under the tree canopy, due to the small size of the grove and the strong effect of the much bigger surrounding grassland area. We concluded that the observed environmental variables were related to each other, to the relief and the vegetation structure. This study has provided some useful evidence concerning the effects of grove size on environmental and functional variables in a forest-steppe habitat. This knowledge is valuable for assessing the dynamics and spatio-temporal pattern of abiotic and biotic factors in this type of ecosystem, which is a natural transition zone of the temperate vegetation.

## Vegetation classification of Mount Babor Northeast Algeria

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Mount Babor, at 2004 m asl, is a Natural Reserve in the Northeast of Algeria. It is also an Important Plant Area (Key Biodiversity Areas for Plants) since it hosts 531 taxa belonging to 290 botanical genus and 73 families. Forty-nine species are nationally, five in the IUCN red list (2010) and 13 restricted range-endemics (*Abies numidica*, *Moehringia stellaroides*, *Saxifraga numidica*). The landscape is typically Mediterranean with a varied forest habitat types such as coniferous forest of *Cedrus atlantica* and *Abies numidica*; deciduous forest of *Quercus faginea*; matorral of *Quercus ilex* and prickly xerophytes and mesophyll lawns. The present study highlights the importance of remote sensing and G.I.S in vegetation mapping of Mount Babor using satellite image from Landsat 8. A supervised maximum likelihood classification was implemented in our approach. The final classification product provided identification, description and mapping of the main tree species of Babor including non-woody vegetation and relatively bare land. The satellite image captured by Landsat 8 on the 14th June 2013 was atmospherically corrected by converting the DN values to reflectance values in order to improve the classification results. For an efficient accuracy assessment of the classification, we based our work on vegetation relevés (samples taken on the field by GPS) in addition to other auxiliary data, mainly the Vegetation Map of Babor Forest, established in the 19th century by the French Water and Forest Administration. The accuracy assessment result was 71.14% and a Kappa coefficient of 0.61. The resulted vegetation map demonstrates seven classes. Four classes belong to woody forest vegetation, which are the Atlas cedar "*Cedrus atlantica*", the holm oak "*Quercus ilex*", the Canary oak "*Quercus canariensis*" and the Kabyle fir "*Abies numidica*". The three other classes represent the degraded vegetation, herbaceous vegetation and rocky terrain. This map will undoubtedly be a very important and useful tool in sustainable development policies and in decision making in management studies.

Keywords: Vegetation classification, Mapping, Remote sensing/ GIS, Biodiversity, Babor.

## Diversity of dry grasslands in Poland – a new formalised system

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The aim of our study was to revise syntaxonomy of dry grasslands using formalised classification approach based on a dataset including ca. 90 000 relevés from the *Polish Vegetation Database* (PVD). Our focus was on dry grasslands of the phytosociological classes *Koelerio-Corynephoretea canescentis* Klika in Klika et Novák 1941, *Sedo-Scleranthetea* Br.-Bl. 1955, *Trifolio-Geranietea sanguinei* Müller 1962 and *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947). We combined expert knowledge, literature's information and the computed patterns of species co-occurrence to create groups of indicator species for each syntaxonomical level. If a species was included in a group of indicators of a given syntaxonomical unit, it could not be present elsewhere, but obligatorily must be present in all superior units. For the explicit delimitation of the dry grasslands, we created Cocktail definitions for each class of non-forest vegetation in that way that single relevé cannot be matched by two different syntaxonomical units of any level. After unambiguous delimitation of classes representing dry grasslands, we created Cocktail definitions for lower vegetation units comprising association, alliance, order. The created Expert System assigns relevé to a given syntaxonomical level provided that a single relevé is also matched by definition(s) of superior syntaxonomical level(s). This expert system is the first proposal of multi-level formalised hierarchical system comprising all syntaxonomical levels for dry grasslands and resembles that we created previously for meadows of the class *Molinio-Arrhenatheretea* in Poland (Kacki et al, in. prep.). The proposed classification system is in line with the principal concept of vegetation classification by Braun-Blanquet, i.e. hierarchical nestedness of syntaxonomical units. Our study shows a high diversity of dry grasslands in Poland which is due to differentiated environmental conditions and management (or its lack). This study also reveals that only a fraction of relevés represent associations. Majority of relevés were assigned at the level of alliance. Phytosociological alliance is best-recognised unit in the field as well as in the classification process.

## Investigation on two different vegetation of cattle pastures in the Ipoly Valley

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The vegetation of two different characters of cattle pastures in the Ipoly Valley was examined in this research. One of them was wet vegetation beef cattle pasture while the other area was a dry vegetation cattle pasture. The wet pasture was mowed before 2000. Here one sour sandy vegetation (SL1) and a lower-lying, characterless, *Elymus repens* dominated grassland area (SL2), with fresh and dry patches were examined. There were also two types of vegetation analysed on the dry cattle pasture. One of them was a drier steppe under less pressure grazing (SZ1), and the other one was a heavily used, degraded steppe (SZ2) which has been used serving as a resting place. There was a significant amount of species adapted to disturbance in each plot, but their proportions were different. The lowest rate was observed in the quadrats of pastures of the dry area cattle under smaller grazing pressure (SZ1). On the basis of the recordings, on the wet area pasture the sour sandy lawn (SL1) was more sensitive, where the grazing pressure should be monitored in order to preserve the characteristics of the vegetation. On the fresh area of wet pasture (SL2) grazing after mowing favoured the appearance of species characteristic of natural vegetation. Among the examined areas, the dry cattle pasture under grazing pressure (SZ1) was found as be the most favourable in maintaining the natural vegetation. This survey was supported by the „Sustainable Conservation on Hungarian Natura 2000 sites” project as part of the Swiss-Hungarian Cooperation Programme (SH/4/8).

Keywords: grassland management, nature conservation.

## Revised syntaxonomical classification of thermophilous oak forests in Slovakia

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We present a revised and unified classification system of *Quercetea pubescentis* class in Slovakia. To assess target vegetation units we used a large data set of relevés of the Slovak forest vegetation obtained from national phytosociological database of Slovakia and private databases stored in Turbowin. Starting dataset consisted of 15 714 relevés and was harmonized and analysed using the program JUICE. The relevés of target vegetation were selected based on representation of a set of diagnostic species of *Carpinion* alliance and *Quercetea robori-petraeae*, *Carpino-Fagetum sylvaticae* and *Quercetea pubescentis* classes, as recognized in the relevant literature and were distinguished using a modified TWINSpan classification algorithm. The final data set contained 1 131 relevés. Non-metric multidimensional scaling (NMDS) was applied for visualizing of the similarity of vegetation types and for comparison of environmental conditions of individual syntaxa. For 1084 relevés were calculated 22 bioclimatic variables values from a set of global climate layers WorldClim2. Differences among groups on alliance and association level were tested using ANOVA and Tukey HSD (post-hoc) test. The identified vegetation types were classified to three alliances (*Quercion petraeae*, *Quercion pubescenti-petraeae* and *Aceri tatarici-Quercion*) and eleven associations broadly recognized by Central European phytosociologists: dry-mesic oak forest on sandy soils – *Carici fritschii-Quercetum roboris* (12 relevés), dry-mesic oak forest on acidic substrates – *Sorbo torminalis-Quercetum* (231 relevés), dry oak forest on acidic substrates – *Genisto pilosae-Quercetum petraeae* (20 relevés), dry-mesic oak forest on heavy soils – *Melico pictae-Quercetum roboris* (51 relevés), dry-mesic forest of Turkey oak – *Quercetum petraeae-cerridis* (100 relevés), dry oak forest on base-rich rocky substrates – *Lithospermo purpurocaerulei-Quercetum* (214 relevés), dealpine thermophilous oak forest on base-rich rocky substrates – *Seslerio albicantis-Quercetum pubescentis* (139 relevés), submediterranean dry oak forest on base-rich rocky substrates – *Fraxino orni-Quercetum pubescentis* (29 relevés), dry-mesic oak forest on base rich rocky substrates – *Euphorbio-Quercetum* (231 relevés), subcontinental dry oak forest on base-rich substrates – *Quercetum pubescenti-roboris* (32 relevés), subcontinental dry-mesic oak forest on base-rich substrates – *Convallario-Quercetum roboris* (72 relevés). Significant differences between the all three alliances and between some associations were recorded in bioclimatic variables as annual precipitation, precipitation of warmest quarter, mean temperature of warmest quarter, mean temperature of coldest quarter, solar radiation and water vapor pressure.

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## The importance of small-leaved forests in the vegetation cover of the middle of the Russian plain: case study of Moscow region

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The importance of small-leaved forests with dominance of *Betula pendula*, *B. pubescens*, *Populus tremula*, *Alnus glutinosa* and *A. incana* is analysed for the Moscow region. These forests dominate in relation with anthropogenic activity in the Russian plain during recent centuries. Large area of fuelwood long before 18<sup>th</sup> century appeared because of lea tillage. Forest plantations reduced area of small-leaved forests in the forest cover of Moscow region in the end of 19<sup>th</sup> – beginning of 20<sup>th</sup> century. Widespread colonization of farmlands and lack of plantations tending currently determine area extension of small-leaved forests. This type of forest makes over 55% of all forest covered area of Moscow region. Significant area of mature and over-mature forest stands is typical feature because of cutting limitations.

550 geobotanical field descriptions and remote sensing data (multispectral images and DEM) are used as informational basis of study. Inventory of small-leaved forests and study of composition and structure are carried out for the first time. The significance of these studies is underestimated both in the context of biodiversity and forest functions. The trends and factors of natural farmland colonization are identified. The reconstruction of spatial and temporal dynamics of forest communities over 40 years from the stage of scrub (2-7 years) to the stage of mature forest is accomplished.

The statistical dependence of small-leaved forests from landscape and ecological conditions of habitats is identified as well as fragmentation metrics of forests are analyzed.

## ***Calamagrostis epigeios* meadows in the transition area of the Polistovsky Nature Reserve, NW Russia**

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Semi-natural grasslands are widespread in Europe and in the forest zone connected with human activity. On the territory of Russia there was a decrease of mesic grasslands area as a result of abandonment in the past half century. The expansion of *Calamagrostis epigeios* is one of the threats to abandoned meadows, which can lead to a decrease in biodiversity. The state of *Calamagrostis* meadows is still not fully understood. Our results represent inventory of wood small-reed communities in the transition area of Polistovsky Reserve, Pskov Province, Russia.

Vegetation classification was carried out by J. Braun-Blanquet approach based on 47 relevés collected in 2012, 2014 and 2018. The data was processed using cluster analysis by the method of flexible beta in PC-ORD 6.0 program, while ecological features of the syntaxa revealed were determined using ordination approach and phytosociological assessment (Landolt's scales). The frequency of fires was identified based on the analysis of remote data using Landsat and FIRMS (Fire Information Research Management System). In order to reveal the connection between the abundance of *Calamagrostis epigeios* and the frequency of spring fires, the Spearman's rank correlation coefficient was calculated in Statistica v.12.

A preliminary classification scheme of *Calamagrostis* meadows was suggested for the study area. We identified 5 associations, 6 variants related to 5 alliance, 4 order from 3 classes: *Molinio-Arrhenatheretea*, *Epilobietea angustifolii*, *Artemisietea vulgaris*. The ordination analysis demonstrated ecological features of the syntaxa. We showed that the formation of *Calamagrostis* communities is associated with regular spring fires.

## **Classification of wet grassland of European Atlantic**

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Wet grasslands of the class *Molinio-Arrhenatheretea* may corresponded to a large variety of plant alliances, even when only Atlantic biogeographic region of Europe is considered. Up to now, there has been no agreement on their syntaxonomic classification and this work aims to handle this challenge, considering datasets collected all over the Atlantic region. We have 4 main objectives: (i) to classify the wet grassland plant communities proposed in the EVC; (ii) to identify the phytosociological alliances



of these vegetations; (iii) to outline the distribution and species composition of each alliances; an (iv) to characterize their respective to climate and soil conditions.

The analysis were run considering 6013 vegetation relevés from the European Vegetation Archive and VegFrance databases. The classification analysis used TWINSpan algorithm led to the distinction of ten alliances. The interpretation as phytosociological alliances were conducted while considering literature published. We examined and visualized the floristic contrasts among these alliances by means of Detrended Correspondence Analysis (DCA).

The main ecological factors driving the contrasts among the various wet grasslands alliances appear to be the soil moisture and nutrient conditions together with the climatic conditions. We found a north to south floristic contrast from the warm-temperate to cool-temperate wet grasslands. Diagnostic, constant and dominant species were identified for each alliance. Together, a classification expert system was developed to identify these alliances in vegetation-plot databases. We characterized these alliances regarding the climatic and soil conditions together with their biogeographical features.

In this poster, this work provides the first results of the classification of European Atlantic Wet grasslands performed with the Juice Program at the alliance level.

## Do the Central Apennines exhibit Mediterranean or Temperate bioclimate patterns?

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Different studies of bioclimatic classification at the national level have been conducted in the recent past in order to identify the limits of the Mediterranean and Temperate macrobioclimates in Italy. In the peninsular part, climatic parameters, vegetation types, and morphological and chorological traits indicate that there is a complex transitional mosaic that ranges from the coasts to the higher mountains. Recently, a significant advancement was obtained with the bioclimatic mapping of Italy, carried out using the Rivas-Martínez bioclimatic indices.

The present work shows the main weather patterns for the period 1981-2010 in the Italian Central Apennines, at a wide elevation range (260-1750 m asl), on the basis of analysis of temperature and precipitation data collected in 23 locations. We used cluster analysis to identify homogeneous areas and improved the effectiveness of the descriptors by crossing the results derived from the application of hierarchical and non-hierarchical classification techniques with categorization derived through the use of bioclimatic indices commonly used in plant ecology studies.

The results show a highly diversified picture, due to the range of latitudinal and elevational gradients and conditioned by the morphological variability expressed at the regional scale. They indicate that Mediterranean climatic features would better express the mixed characteristics of the Central Apennines. This result, considered in the context of current climate changes towards more highly variable conditions at high altitudes, emphasizes the need for climate monitoring at high altitudes to facilitate assessment of future changes and hopefully improve the management and conservation of mountain ecosystems.

## **Sigmatum, minorisigmatum, permasisigmatum and other permanent plant communities developing in the Orotemperate High Guadarrama Country of the Sierra de Guadarrama National Park**

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This contribution is part of the cooperative “Global geobotany of the Sierra de Guadarrama National Park” project conceived and carried out by a big team of botanic researchers of four universities: Complutense de Madrid, León, Oviedo and Granada, and the Phytosociological Research Center (CIF). Our main goal was to review and update the global geobotany, taxonomy, phytosociology, bioclimatology and biogeography of Sierra de Guadarrama National Park. During the last five years we have made a lot of excursions and relevés in the National Park to review the syntaxonomy, the bioindicators and the boundaries of the plant communities, bioclimatic belts and biogeographic units. The Sierra de Guadarrama (in Central System) is a mountain range in the centre of the Iberian Peninsula. It was uplifted during the Alpine orogeny and its relief was renewed during the Wurmian ice-age due to the activity of the glacial erosion in its summital part. The National Park was created through the June 25<sup>th</sup> 7/2013 law. It occupies 96,847 ha. The difference in altitude ranges from 950 m (La Pedriza) to 2428 m (Peñalara summit). The new concepts of series, permaseries and minoriseriers are used here.

## **Distribution patterns of chionophilous vegetation in the Iberian Peninsula**

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We gathered 1032 relevés representing ten phytosociological alliances of chionophilous vegetation in the Iberian Peninsula, located in the Pyrenees (divided into western, central, and eastern), Cantabrian Range, Sistema Central and Sierra Nevada. These alliances included snowbed vegetation (*Sedion candollei*, *Salicion herbaceae*, *Arabidion caeruleae*), chionophilous screes (*Saxifragion praetermissae*) and chionophilous grasslands (included within *Nardion strictae*, *Campanulo herminii-Nardion strictae*, *Primulion intricatae*, *Armerion cantabricae*, *Plantaginion thalackeri* and a particular association of *Festucion airoidis*). Our objectives were to understand the relationships between the ten phytosociological alliances and to assess species fidelity and richness by vegetation types and mountain ranges.

We classified the relevés by the K-means algorithm, which resulted into nine instead of the ten groups we expected (corresponding to the ten alliances included). Snowbed relevés were included in three groups matching to the three snowbed alliances, whereas grassland relevés experienced some changes in their classification considering the current phytosociological adscription. The more relevant mismatch was found in the relevés belonging to *Plantaginion thalackeri*, which were split into two groups: the majority merged with *Campanulo herminii-Nardion strictae* relevés and about one third merged with *Saxifragion praetermissae* ones. Also, one third of the relevés belonging to *Primulion intricatae* merged with those of *Armerion cantabricae*.

We also assessed species richness at plot level for the whole species pool and for snowbed specialists. We found that plant species richness for both the whole species pool and for only snowbed specialists, was the highest in Pyrenean-Cantabrian calcicolous grasslands (composed of *Armerion cantabricae* and *Primulion intricatae*). The poorest vegetation group for the whole species pool was the hemicryptophytic silicicolous snowbed vegetation (chiefly within *Sedion candollei*), whereas when considering only snowbed specialists the poorest group was the oromediterranean grasslands (*Campanulo herminii-Nardion strictae* and *Plantaginion thalackeri*). When analysing these patterns by mountain ranges, species richness for the whole species pool was highest in western Pyrenees, whereas for snowbed specialists the richest area were central Pyrenees. The lowest richness was found in both cases in Sistema Central.

## Floristic patterns on altitudinal gradient in Mongolian Altay: transition between steppe and high mountain belts

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The absence of a forest belt and direct transition from the steppes to high mountain vegetation are important features of arid mountains of Central Asia. Flora and vegetation of this transition has not been studied sufficiently at the present time. Most mountain ranges of Central Asia is characterized by plant communities with a high abundance of cushion species. Many of these species have a restricted area. The aim of this study was to reveal the changes in floristic patterns on altitudinal gradient in Mongolian Altay in transition from steppes to high mountain vegetation. We have studied three altitudinal profiles on the Bural-Bogdo-Ula, Hunguin-Nur and Mongolian Altai ranges. The height range was from 2,370 to 3,220 m a. s. l. During the study 51 to 53 phytosociological relevés were made on each profile. Further, the relevés of each profile were ranked by altitude. The sliding window including 5 relevés was launched on this gradient. For species inside the window, the Importance Value (*IV*) was determined – the square root of the multiplication of occurrence and the average projective cover. For each sliding window of the average altitude was determined. The result was tables ranked by altitude with *IV* of species. After that, the correlation between species *IV* was calculated, and cluster analysis was conducted to find groups of species with similar distribution on the altitude gradient. As a result of the analysis, general patterns for the three profiles were identified. The groups of species that indicate the steppe and high mountain belts in all the studied areas were identified. The first group displays a regularly decreasing *IV* as the altitude grows along with the second behaves the opposite way. Of greatest interest is a group of species centered on the transition between two belts. These species have the ecological optimum at altitudes from 2,600 to 2,900 m. They reduce their constancy and cover when moving down and up from this zone. There are such plants as *Artemisia pycnorhiza*, *Eremogone meyeri*, *Stellaria pulvinata*, *Oxytropis oligantha* etc. They have a cushion life form, which is an adaptation to dry and cold conditions. The dominance of these plant species often determines the physiognomy of communities. Based on the data obtained, we can talk about the existence of a transition zone between the steppe and high mountain belts. This is not a simple change from one flora to another; this is sub-belt of vegetation that is characterized by original flora and plant communities.

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## On the syntaxonomy of the vegetation in the treeless zone of Central Balkan Range – preliminary results

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Central Balkan Range is a part of the Alpine-Himalayan mountain chain with two high massifs in the altitudinal belt of 1800 – 2300 m a.s.l. Its vegetation has developed under the influences of many orographic, geological, climate and anthropogenic factors. The vegetation of the subalpine treeless zone is presented mainly by grasslands of *Nardus stricta*, *Agrostis capillaris*, *Festuca nigrescens*, *Lerchenfeldia flexuosa* and the *Juniperus sibirica* and *Vaccinium spp.* shrub communities, both types forming a continuum of different succession stages. This vegetation has been shaped during centuries by the pasture of the herds of nomad tribes and changed significantly. It has not been studied systematically and classified according to Braun-Blanquet's floristic approach. The present study is an attempt to classify the vegetation cover in the alpine and subalpine treeless zone of Central Balkan Range and reveal the main ecological gradients in it (orographic, phytogeographic, climatic, and anthropogenic) by the usage of standard phytocoenological methods for classification and ordination. More than 100 relevés from the mountain and (sub)alpine grasslands and shrub communities have been analyzed. Cluster analysis and indirect ordination was performed. The groups of relevés were interpreted following modern syntaxonomical and nomenclature rules and researches. Grasslands and shrub communities in the high-altitudinal zone of the mountain belong to the classes *Juncetea trifidi*, *Nardetea strictae*, *Loiseleurio-Vaccinieta* with the probable existence of new or Balkan syntaxa at an alliance and/or association level. We hypothesize that the orographic and phytogeographical factors have a leading role in the vegetation formation and the anthropogenic factors - in its succession.

## Long term analysis of Mediterranean vegetation structure: what happened on Italian and Spanish high mountains?

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High-mountain ecosystems are hot spots of biodiversity that are particularly sensitive to land-use and climate change. In this work, we investigated long-term (~50 years) changes occurred on the structure of plant communities in Mediterranean high elevation habitats (Central Apennines, Italy and Cantabric mountain range and Pyrenees o, Spain).

Using geo-referenced phytosociological relevés (stored in EVA database) we investigated changes in vegetation structure over time. First, we divided the dataset of into two time periods, namely 1958–1990 (T1) and 1991–2009 (TP2). To minimize spatial heterogeneity in our comparison, we selected plots for T1 and T2 that were in similar geographical locations and in similar vegetation EC habitat (Alpine and subalpine calcareous grasslands).

We considered the life forms, because their variation is a good proxy of vegetation response to changes of climate and anthropic pressure. Before an accurate check of Italian and Hispanic Flora we focused on life forms trends over time. Specifically we analyzed the plot frequency of life forms categories for each country (Spain and Italy) and time period (T1 and T2) and compared them by Wilcoxon-Mann-Whitney test.

We observed interesting temporal differences in the structure of the high mountain grasslands analyzed on both countries. During the last 50 years we detected significative variation of hemicriptophytes, chamephytes and geophytes frequencies.

The observed variations could be related with a termophilization process. Our results are consistent with previous studies that report relevant changes in the community assemblages of high-mountain habitats, for which climate and land-use changes are considered the prevailing driving forces. The analysis of vegetation structure dynamics of areas characterized by different flora and phylogenetic lines was possible because of the universal value of life forms and confirms its usefulness for monitoring temporal changes occurring on different Mediterranean mountain ecosystems.

We used Raunkier's system to classify in life forms the vascular plant present.

## Exploring dispersion ability of high mountain species along environmental gradients. An insight in central Apennine

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Dispersion is the mechanism used by plant species to move from their place of origin. The dispersion capacity influences the distribution of plant species at different spatial and temporal scales. In the last century plant species have shifted their distribution and dispersal ability under climate change. Actually, high mountains can be considered particularly appropriate environments to detect the effects of climate change on natural biocenoses at a global scale. As already demonstrated in several studies, many species in mountains have shifted their upper distribution limit upslope in recent decades, resulting an increase in species richness at high elevations, at least in temperate biome. Simultaneously, a decline in cold-adapted species is expected but it has only rarely been observed to date. This study is focused on the dispersal ability changes along the elevation gradient in the vegetation of Central Apennine, using the vegetation data collected during the last surveys of GLORIA project (Global Observation Research Initiative in Alpine environments) and dispersal traits extracted from LEDA database. The main trends on plant species reproductive and dispersal traits were analyzed.

The dispersal ability was estimated using the dispeRsal package. To estimate more realistic values, two algorithms that consider different plant traits were used. The first one considers the dispersal syndrome, releasing height and seed mass, the second one considers dispersal syndrome and terminal velocity. Moreover, relationship with dispersal ability and several plant life-history strategies such as life forms and grime strategies were analyzed using GLM (generalized linear model). Results highlighted that several graminoids with seeds with awns are frequent at lower elevations (subalpine belt), thus we should expect an upward shift of such species under climate warming scenarios. On the other hand, the presence of several alpine forbs characterized by nude seeds with a short dissemination distance, that feed the local seed bank, should assure the permanence of these species over the next decades. To conclude, this work can provide useful information in understanding how dispersal ability influences the different response of plants in climate change scenarios.

## Contribution of free multi-temporal satellite images for mapping plant communities within a Natura 2000 site

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Mapping plant associations is essential to assess the conservation status of natural habitats. Currently, plant community mapping is mostly based on time-consuming field surveys without considering satellite data. However, free Sentinel-2 image time-series with high spatial and temporal resolution have recently become available since 2015. This study aims to assess the contribution of Sentinel-2 images to model the spatial distribution of 18 plant communities within a 1978-hectare Natura 2000 site located on the Mediterranean coast (Corsica, France). The method was based on a random forest modeling of 6 Sentinel-2 images acquired between 2017/02/26 and 2017/10/24, which were calibrated and validated from a field vegetation map. The results show that the 18 plant communities were correctly modeled with 72% overall accuracy. The uncertainty map associated with the model indicates the areas that require additional field observations.

## Expert system and remote sensing for vegetation mapping of the Natura 2000 site "Estuaire de la Loire" (NW France)

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Vegetation maps are essential tools for biodiversity knowledge and implementing policies of nature conservation. In Europe, they can be used to identify habitats of community interest and answer at legal requirements for Natura 2000 monitoring and reporting.

However, traditional field surveys methods are expensive and time-consuming, particularly in over large areas. This is particularly the case of the Natura 2000 site "Estuaire de la Loire", an estuary forming an extended wetland of more than 22,000 hectares, in northwestern France.

Furthermore, complexity of ecological drivers that govern vegetation in estuarine marshes makes it difficult to identify and delimit them for mapping. To facilitate this process, we have developed a research project to apply innovative approaches based on statistical analysis of vegetation data and using remote sensing technologies for mapping.

Two main questions are asked:

- 1) How to have better consistency in identification of vegetation?

We use expert systems (running in the JUICE 7.0 program) as a decision-making tool for management of the Natura 2000 site. One of the main advantages of this approach is to apply classifications formalized and consistently, unlike methods based on expert knowledge which depend on subjective judgement. Expert system is used to assignment of vegetation plots to existing classifications (phytosociological classification, EUNIS habitats, Habitats Directive - EUR28). 1780 vegetation plots carried out from 1970 to 2018 in the site are used to develop and test this tool.

- 2) How to facilitate vegetation mapping over large area?

We test remote sensing to map more efficiently vegetation (profitability, reproducibility, objectivity). Several images with different characteristics (spatial resolutions, spectral resolutions, repetitivity) are analyzed to evaluate their ability to differentiate plant communities. This work is based on the Sentinel-2 satellite images as well as hyperspectral and LIDAR data acquired during a flight over the Loire estuary in spring. This poster details our methodological approach and our first results since 2018.

## Thirty years of land-cover changes around the largest Italian glacier: a remote-sensing approach

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The current retreat of glaciers due to global warming is increasing the extension of new ice-free areas. Thus, a colonization process with pioneer plants is initiating the establishment of alpine plant communities on these emerging sites. An evaluation of the time-lag between the ice retreat and the plant colonization process as well as changes in terms of occupied surface by ice and vegetation could help to make inferences on the developing landscape. Furthermore, these evaluations specified for different vegetation types, increase the understanding of the alpine communities dynamics in times of global warming.

We applied a remote-sensing approach to analyse land-cover changes of the landscape surrounding the Adamello glacier (North Italy) over the last three decades. In fact, remote sensing allows analysing the complete studied area using repeated measures over long time span. Accordingly, we built a time-series of circular sections centred at the glacier of Landsat imageries (TM, ETM+). We excluded from the analysis due to the topographic shade, clouds and their shadows. Furthermore, we converted original imageries using normalized difference indices, and thus, increasing the dissimilarity between land-cover types, and in particular, vegetation types. In order to do so, we used the normalized difference indices for vegetation (NDVI), soil (NDSI), water (NDWI) and the modified version for water (MNDWI). A fuzzy approach was used to distinguish different land-cover types. The fuzzy clustering calculates for each pixel the probability of belonging to different land-cover types, i.e. the membership value. The membership values can be assumed as a surface estimate for the land-cover types composing the pixel.

We found a decrease of 23% in the extension of the glacier during the last three decades. Additionally, the forest and grassland have occupied areas at higher altitude, with the former increasing its surface by 24% and the latter remaining stable in terms of surface. However, we found a time-lag between the retreat of the glacier and the vegetation expansion of about 5 years. Our results contribute to the multi-disciplinary project “Calibrating Plant Biodiversity in Glacier Ice (CALICE)” funded by the Euregio (Tyrol Südtirol Trentino) initiative. The project aims to understand plant biodiversity in recent pollen deposition and to reconstruct plant biodiversity changes by means of pollen and eDNA sedimentation in the Adamello glacier.

## How the vegetation sampling plot can support the remote and proximal sensing analysis?

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Data from Earth Observation (EO) by remote and/or proximal sensing (i.e. Unmanned Aerial Vehicle - UAV), are among the most important goals achieved by the technological and methodological developments of the last decades. Such developments, especially satellite missions for land monitoring (e.g. Landsat and Sentinel), helped us to improve the knowledge of the natural dynamics.

The calibration of EO is usually assessed by using appropriate field observations. However, recent researches on remote and proximal sensing analyses, tend to focus on images processing techniques and neglect an effective in situ samplings schemes. An inappropriate and faulty sampling strategy can influence the reliability of the final product as much as errors in image processing. Therefore, it is important to develop a reliable sampling strategy for a remote sensing analysis process, based on what the satellite is observing and that environmental information could be obtain.

In the EO processes, the field data sampling aims at gathering data in a relatively small proportion of the whole area of satellite views. The obtained data from the field survey are used to train classification models and to assess the accuracy of the final product. Furthermore, the field survey can be useful for the interpretation and analysis of what is being sensed, e.g. plant species or plant communities. Indeed, the processed tile view from remote and proximal data shows a different perspective of landscapes.

The aim of this study is to test an appropriate field survey method considering the cover of both plant species or communities and abiotic components (e.g. bare soil, shadows). A combination of this survey method with the remote and proximal images analyses could be appropriate for vegetation/habitat mapping and monitoring given the high time and spatial resolution of the approach.

## Comparison of forests dominated by alien *Quercus rubra* and native trees in Central Europe

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*Quercus rubra* L. (northern red oak) is a deciduous tree native to North America which was first introduced as an ornamental plant to Europe in the 17th century. Over the centuries it has become one of the most common and commercially-important broadleaved woody species of alien origin. *Q. rubra* is an important source of hardwood timber, it is excellent firewood, it has been used in wasteland afforestation programmes due to its broad tolerance to habitat conditions, and it has been often planted due to the very decorative red autumn leaves as well. It grows faster and produces more wood than native oaks. In some countries it is considered as naturalized alien species (e.g. Slovakia) but in others as invasive (e.g. Czech Republic, Poland, Germany).

In this work, we studied influence of *Quercus rubra* on the diversity and structure of undergrowth vegetation. We sampled 76 relevés (38 pairs) in *Q. rubra* stands (with more than 50% frequency in tree layer) and adjacent forests dominated by the native trees with abiotic conditions (elevation, exposure and slope) remaining the same. Phytosociological relevés were made by standard methods of Zürich-Montpellier school in Slovakia, Czech Republic and Poland in 2016–2017. We compared the characteristics of the plots (number of all taxa, number and cover of native and alien taxa, cover and height of the individual vegetation layers, the cover and thickness of litter layer, light conditions measured by GLAMA) using Wilcoxon paired tests.

Preliminary results show that vegetation structure of alien *Q. rubra* stands and natural tree forests differed. The number of all species in *Q. rubra* stands was significantly lower, but the number of neophytes was higher than in native forests. Representation of archaeophytes does not differ. Cover of tree layer, GLAMA and thickness of litter layer were higher in *Q. rubra* stands.

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## *Quercus cerris* thermophilous woods in Molise: phytosociological characterization and phytogeographical relationships.

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A phytosociological study of the *Carpinion orientalis* and *Crataego laevigatae-Quercion cerridis* thermophilous hilly woodland in Molise is herein presented. Two matrix containing 99 relevés (published and unpublished) collected in Molise and 31 synoptic tables obtained from the consultation of 22 works published on the thermophilic *Quercus cerris* woods of the Italian peninsula were statistically analysed.

The results of the first classification showed 8 clusters grouped in three associations. The first one refers to the *Lonicero xylostei-Quercetum cerridis* association (subass. *typicum*, subass. *festucetosum exaltatae*, var. with *Euphorbia amygdaloides*, var. with *Quercus ilex*) distributed in the Mediterranean areas of the region. The second one refers to the *Daphno laureolae-Quercetum cerridis* association (subass. *rosetosum arvense*, var. with *Brachypodium rupestre*, var. with *Festuca exaltata*) distributed in the central part of the region on sandy-clayey soils with temperate climate. The third association (*Echinopo siculi-Quercetum frainetto*) finds the north-eastern limit of its distribution in Molise. It occurs in temperate areas and is connected with level ground or gentle slopes with substrates mainly represented by sandy soils, showing a clear edaphic determinism. For more conservative sites the new subassociation *maletosum florentinae* is proposed. The *Lonicero xylostei-Quercetum cerridis* and *Daphno laureolae-Quercetum cerridis* associations are included in the *Carpinion orientalis* alliance; the *Echinopo siculi-Quercetum frainetto* association refers to the *Crataego laevigatae-Quercion cerridis* alliance.

Through the results obtained from the elaboration of the synoptic tables, we tried to relate the thermophilic Turkey-oak associations from Molise with the similar ones described for the Italian peninsula. The resulting relationships are complex. First, we confirm the hypothesis that sets Southern Molise as a phytogeographical limit for several woodland associations (e.g. *Tilio-Acerion* forests). Therefore, and despite its small surface area, Molise represents a focal point for the *Quercus cerris* forests where the corotypes of SE European, Euroasiatic and European-Caucasian have a significant presence.

Moreover, 17 different associations have been used to describe the thermophilous oak woods of the Italian peninsula. Through the centuries, the thermophilic oak forests have been very much altered by human activity. Therefore, they have been floristically simplified. This may be one the reason why several existing associations are redundant despite many *Quercus cerris* woods are similar.

## Main forest-forming tree species habitats distribution over Asian Russia under climate change in current century

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Our goals were to evaluate consequences of climate warming on vegetation in Asian Russia. We used our Siberian bioclimatic models: SiBCliM that simulates the zonobiome distribution and SiBCliMTree that simulates major forest-forming tree species distribution. Both models are of static envelope-type that predict zonobiomes and tree species from three bioclimatic indices characterizing warmth, cold, and moisture conditions: growing degree days, GDD5, negative degree days, NDD0, and annual moisture index, AMI. Additionally to climatic indices, both models included permafrost, a critical ecosystem determinant in Asian Russia occurring on 80% of territory. The permafrost border was substituted by the active layer depth (ALD) 2 m ( $R_2 = 0.7$ ):  $ALD > 2m$  explicitly allows all conifers to thrive, and  $ALD < 2$  m allows only one conifer *Larix dahurica* that can withstand  $ALD < 2$  m to grow.

Coupling our bioclimatic models with the climatic indices and the permafrost distributions we predicted potential distribution of vegetation zones and forest-forming tree species in current and the 2080s climates. Climatic anomalies by 2080s were derived from the two climate change ensemble scenarios of CMIP5: the rep 2.6 and rep 8.5 reflecting the smallest and the largest temperature increase correspondingly.

Zonobiomes and tree species of Asian Russia were simulated severely shifted northwards and forest-steppe and steppe would dominate 50% of central Siberia in the 2080s dryer climate. Light conifers (*Larix* spp. and *Pinus sylvestris*) may get an advantage before dark conifers (*Pinus sibirica*, *Abies sibirica*, and *Picea obovata*) in a predicted dry climate due to their resistance to water stress and wildfire. Fire and the thawing of permafrost are considered to be the principal mechanisms that will shape new vegetation physiognomies. These model predicted distributions of zonobiomes, major forest-forming tree species and permafrost need to be verified by current remote sensing observations.

## Difference of soil temperature regimes under the forest vegetation of main high syntaxons in northern boreal subzone of Middle Siberia

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Soil climate is one of the most important factors for forest vegetation geography and productivity. In the northern latitudes, trees and plants of living ground cover are strongly influenced by permafrost, which regulates hydrothermal conditions in the soil.

The objective of this research was recognition of thermal regimes in soils under the forests vegetation of high syntaxons growing in northern boreal subzone of Middle Siberia (Krasnoyarsk Region).

Our study was conducted in Central Evenkia (64°N, 100°E). The relief of the territory is erosive and middle mountainous. The territory is underlain by continuous permafrost. Soils are Cryosols. Climate is continental, cold. Mean annual temperature is -8.9°C. The annual amplitude of temperature is 52°C. Sum of the active temperatures above 10°C is equal to 1000 °C. The frost-free period is 70 – 80 days. Mean annual precipitation is 369 mm.

Annual dynamics of temperature was measured beneath forest litter on the mineral soil surface (0-5 cm depth) and on the depth 20 cm (the depth of main root layer). For the measurement, we used temperature data loggers Thermochron DS1921G.

It was found that climatic specificity of different relief positions on Central-Siberian plateau determines forest vegetation's type.

All of the studied phytocoenoses belongs to the order *Ledo palustris-Laricetalia* Ermakov in Ermakov et Alsynbayev 2004 of the class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939. Temperature dynamics at different depth on the same sample plot showed the similar trends in the annual cycle. In the northern boreal forests soil temperature significantly depended on the location in the relief. The highest temperatures and the widest daily amplitude of temperatures was observed on the top positions (500-600 m a.s.l.) occupied by *Betulo tortuosi-Laricetum gmelinii* ass. nova prov. These forests have low stock of forest litter ( $2407 \pm 225$  g m<sup>-2</sup>) and deep permafrost level (more than 70 cm). Besides that on these positions, the temperature inversion was observed. This temperature inversion was connected with redistribution of air masses under the middle mountain relief and its influence was the most evident in the cold season of the year. The lowest temperatures observed in the bottom parts (150-250 m a.s.l.) of northern slopes where *Pleurozio schreberi-Laricetum gmelinii* ass. nova prov. forests grow. Litter stock in these forests was more than twice higher ( $5709 \pm 595$  g m<sup>-2</sup>) than in the *Betulo tortuosi-Laricetum gmelinii* forests and permafrost was on the depth 20-30 cm. Bottom parts of southern slopes showed middle values of soil temperature in



both summer and winter despite they have litter stock similar to the warmest top position forests ( $2986 \pm 256 \text{ g m}^{-2}$ ). Forests on these positions were identified as *Valeriano capitatae-Laricetum gmelinii* ass. nova prov.

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## Boreal pine (*Pinus sylvestris* var. *hamata*) forests in the Caucasus

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Pine (*Pinus sylvestris* var. *hamata*) forests occur as isolated plant communities in the Northern and Western Caucasus within upper part of forests belt at altitudes of 1200-2500 m and demonstrate a high phytocoenotic diversity there. Of particular interest for syntaxonomy and plant geography are forests types dominated by boreal dwarf-shrubs, grasses and bryophytes (*Vaccinium vitis-idaea*, *V. myrtillus*, *Pyrola rotundifolia*, *P. minor*, *Orthilia secunda*, *Goodyera repens*, *Pleurozium schreberi*, *Hylocomium splendens*, *Dicranum scoparium*) in the ground layer which occur here in isolation from the main range in the boreal zone of northern Eurasia. 72 releves of these pine forests were classified using the Braun-Blanquet approach and cluster analysis (Ward method, Euclidian distance). Four associations and two non-rank “communities” were included in the alliance *Daphno glomeratae-Pinion sylvestris* all. nova, order *Pinetalia sylvestris* Oberd. 1957, class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939. The association *Sedo oppositifolii-Pinetum sylvestris* and community *Pleurozium schreberi-Pinus sylvestris* var. *hamata* are characterised by absolute predominance of boreal dwarf-shrubs and bryophytes in the ground layer and they represent typical communities of the *Vaccinio-Piceetea* in the Caucasus. Association *Calamagrostio caucasicae-Pinetum sylvestris* is characterised by well-developed herb layer dominated by Euxinean and endemic Caucasian subalpine species *Astrantia major*, *Pyrethrum coccineum*, *Bromopsis variegata*, *Gentiana septemfida*, *Calamagrostis caucasica*, *Polygala caucasica*, *Vicia grossheimii*, *Campanula stevenii*, *Alchemilla rigida*. Association *Carici albae-Pinetum sylvestris* and community *Centaurea dahestanica-Pinus sylvestris* contain the plant species of various ecological and geographical groups. Together with a group of boreal species forming the moss layer here, the high constancy values are demonstrated by steppe Eurasian species (*Rosa pimpinellifolia*, *Filipendula vulgaris*, *Koeleria cristata*, *Pimpinella saxifraga*, *Thalictrum foetidum*), European-Siberian hemiboreal species (*Calamagrostis arundinacea*, *Rubus saxatilis*, *Fragaria vesca*, *Primula macrocalyx*, *Thalictrum minus*) and Central European-Mediterranean species (*Helianthemum nummularium*, *Teucrium chamaedrys*, *Berberis vulgaris*, *Cotoneaster integerrimus*, *Platanthera chlorantha*, *Carex humilis*). The group of widespread European and Eurasian mesic nemoral and hemiboreal species (*Euonymus verrucosa*, *Taxus baccata*, *Viburnum lantana*, *Galium odoratum*, *Geranium robertianum*, *Viola mirabilis*, *Fragaria vesca*, *Oxalis acetosella*) characterizes the association *Viburno lanatae-Pinetum sylvestris*. The high diversity of geographical and ecological groups of plants in Caucasian boreal forests of the *Vaccinio-Piceetea* indicates their complex floro-genesis after the Pleistocene period and plant-geographical

relations with the pine forests of the Mediterranean (*Erico-Pinetea*) and European-Siberian (*Brachypodio-Betuletea*) zonal types. The study was supported by RFBR (grants 19-54-40005 and 18-04-00633).

## Observing the health status of coniferous trees in the eastern Alps

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Mountain ecosystems are projected to experience a higher rate of climate warming than most other regions of the world. Elevation shifts of distribution towards mountain summits, spread of thermophilous species, colonisation by new species from warmer areas and phenological shifts are already evidens for all considered taxonomical groups, including higher plants. Warmer conditions induce an upward shift of the tree line and in species distribution. The aim of the study was to determine the state of health of two dominant conifers from the montane to the subalpine belt along an elevation transect in the Alps. Another goal was the compare the health status of the selected taxa in the light of the possible elevation shift. We hypothesized that the most severely deteriorated plants occur in their lowest elevation in both taxa. The examinations were carried out in the Eastern Alps, along a vertical transect from 800 m to 1750 m amsl. Among the dominant species of the given vegetation belt 3-3 individuals were measured in 50 meters. In the montane and supermontane belts (800-1500 m) the Norway spruce (*Picea abies*), while in the subalpine belt (1550-1750 m) the dwarf mountain pine (*Pinus mugo*) were investigated with an acoustic tomograph. Measurements were made using the FAKOPP 3D acoustic tomography, which is able to detect the size and location of decayed or hollow regions in the trunk non-destructively. The highest rate of deterioration (56%) and the highest average deterioration considering all examined layers were detected in the lowest altitude (800 m) of the *Picea abies*. This could refer to significant stress which indicates the changes' rapidity in the montane and supermontane belt. According to the lower rate of decay and the standard deviation, the altitudinal optimum of the species is presently around 1000 m and above 1400 m. The lowest average deterioration was recorded in the highest stands dominated by *Picea abies* at 1500 m amsl. In the case of *Pinus mugo*, the degree of decay was the lowest in the upper limit of the subalpin belt. The measured decay of *Pinus mugo* was varied in a very tight scale and only in the highest parts, in the upper limit of the species habitat showed changes. Our results showed that the individuals of *Picea abies* had the worst health status in the lower limits and the best health status in the higher limits of the species habitat, which predicts the spreading of the species and its dominated stands to the higher levels.

## Recruitment of forest plant species specialists (*Fagetalia*) in managed beech forests

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The impact of forest management on biodiversity of beech forest is crucial for the conservation of the European Union forest habitats of 9110 and 9130. In the present study we investigate species diversity of beech forests and recruitment of *Fagetalia* specialists in relation to environmental conditions and management practices.

We posed the following questions: 1) Does species diversity differ along environmental and stand age gradients? 2) How are forest species distributed after stand removal and during tree stand regeneration? 2) Is recruitment of forest specialists related to the type of neighboring stands and environmental conditions? By answering these questions we intend to work out recommendations for the future management planning enhancing recruitment of beech forest specialists.

We studied managed beech forests (acidophilic, mesophilic) which represented ancient woodlands existed continuously in Bardzkie Mountains, Sudety, Poland. We examined forest vegetation in four tree stand age classes: class I <20 years, class II 20-60, class III 60-100, and class IV >100 years. From plots of a size 10m<sup>2</sup> we collected species data. All species and their cover were recorded in all layers within each plot. Moreover, environmental variables were noted: height of a tree layer, canopy cover, tree regeneration type (natural or artificial), humus depth, slope and exposition. Soil samples were also collected. All data was collected during 3 vegetation seasons.

The preliminary results revealed the frequent occurrence of the mesophilous beech forest: *Hordelymo-Fagetum* and, in the lower elevation, also the *Asperulo-Fagetum*. In the acidophilous sites *Luzulo luzuloidis-Fagetum* was recorded. The highest species richness was found in class III (61-100 years). Forest species of *Fagetalia* order were distributed in all age classes.

Keywords: age class forest, ancient woodland, biodiversity, species composition, forest management.

## Higher aquatic vegetation of Ukraine

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The higher aquatic vegetation of Ukraine is characterized by richness due to natural-historical and geographical factors. According to the results of materials processing (almost 2500 vegetation plots) from the phytosociological database of aquatic and wetland vegetation, it has been established that in general, the higher aquatic vegetation in Ukraine has 72 associations from 12 alliances and 5 orders and 3 classes (*Potamogetonetea*, *Lementea*, *Littorelletea uniflorae*). The largest syntaxonomical diversity is characterized for the *Potamogetonetea* class. In Ukraine it has 42 associations belonging to 7 alliances (*Batrachion fluitantis*, *Ranunculion aquatilis*, *Ceratophyllion demersi*, *Nymphaeion albae*, *Potamogetonion*, *Potamogetonion graminei*, *Zannichellion pedicellatae*) and 3 orders (*Callitricho hamulatae-Ranunculetalia aquatilis*, *Potamogetonetalia*, *Zannichellietalia pedicellatae*). The plant communities are common in mesotrophic, mesoeutrophic water bodies, streams or saline ponds with sandy, muddy and peaty bottom sediments. Typically, the plant communities of the class are confined to the reservoirs of the plain part of the country, but they also occur in the highlands and mountain regions of Ukraine. The ecological differentiation of the *Potamogetonetea* syntaxa is most influenced by the variability of the damping, in particular the fluctuation of the water level and its eutrophication. The *Lementea* class in Ukraine is represented by 23 associations belonging to alliances *Lemnion minoris*, *Stratiotion*, *Utricularion vulgaris* from *Lemnetalia minoris* order. Phytocoenosis are commonly growing in mesotrophic and eutrophic standing ponds and slightly running waters with sandy, muddy, peaty bottom sediments in the plain part of Ukraine, as well as in the Crimea and the Carpathian Mountains. The main factors of the territorial distribution of plant communities are the type of water bodies and their flow rates. The ecological differentiation of syntaxa occurs along the gradient of the habitat's light regime, the fluctuations of the water level, as well as the degree of its mineralization. The *Littorelletea uniflorae* class represents unique plant communities that have a distinctive physiognomic and taxonomy structure and are characterized by a high degree of dynamism. In Ukraine, these phytocoenoses are distributed mainly in the north, in particular north-west, regions, primarily in shallow waters of lakes, channels, and rivers. Significantly less frequently occur on eroded microdecreases, which are constantly flooded in spring-summer with water, bottoms of lowered dams. In Ukraine, the *Littorelletea uniflorae* class is represented by seven associations belonging to the order *Littorelletalia uniflorae* and two alliances (*Littorellion uniflorae*, *Sphagno-Utricularion*). The main factors of territorial and ecological differentiation of plant communities are, first of all, eutrophication of water bodies, their flow mode, the constancy of water level, as well as the structure of alluvial sediments. The species

composition of the higher aquatic vegetation in Ukraine reflects its regional specificity, as well as the degree of anthropogenic transformation. In general, groups of diagnostic species on the different classification levels are similar for Ukraine and the countries of Southern, Eastern and Central Europe. A distinctive feature of the higher aquatic vegetation of Ukraine is the combination of the plant communities with the eastern and western distribution areas, as well as the northern and southern ones.

## Syntaxonomical diversity of riparian forest vegetation in Bulgaria – existing knowledge and future perspectives

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Riparian forest vegetation is widely distributed on the territory of Bulgaria but still its syntaxonomical diversity is poorly studied. We gathered all available relevés published in literature as well as during 2017-2018 we sampled new data from different parts of the country. Totally we collected 374 relevés following the Braun-Blanquet approach.

All relevés are contributed to the Balkan Vegetation Database (EU-00-013). The nomenclature of species was standardized according to the Euro+Med PlantBase. Vegetation classes were determined by EuroVegChecklist Expert System. PC-ORD hierarchical clustering was used for classification below class level - from order to association and community levels. Diagnostic, constant and dominant species were determined for all syntaxa established.

We classified riparian forest data to *Salicetea purpurea* and *Alno glutinosae-Populetea albae* classes, 6 associations (*Smilaco excelsae-Fraxinetum oxycarpae*, *Scutellario altissimae-Quercetum roboris*, *Stellario nemorum-Alnetum glutinosae*, *Amorpho fruticosae-Salicetum albae*, *Salicetum fragilis* and *Castaneto sativae-Platanetum*) and *Alnus incana* community. Woodlands dominated by *Fraxinus oxycarpa* and *Quercus robur* are found in eastern part of the country at lower altitude and strong Mediterranean influence. *Platanus orientalis* woodlands are distributed in south Bulgaria and still their syntaxonomical diversity is poorly studied. *Stellario nemorum-Alnetum glutinosae* and *Salicetum fragilis* floodplain forests occurs from lowlands up to 1000-1300 m a.s.l. On the other hand, data of *Alnus incana* communities is still limited. Its phytocoenoses are distributed in mountainous region in beech, coniferous and subalpine belts.

During 2019-2020 we will collect new data from riparian forest vegetation from 35-40% from the territory of the country, which will be supported by the National Science Fund (Contract ДКОСТ 01/7/19.10.2018) as a part of “COST Action CA16208 Knowledge conversion for enhancing management of European riparian ecosystems and services“.

## Macrophytes as ecological quality indicators of streams in Latvia

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Latvian rivers are classified into six types using Water Framework Directive system B typology which uses catchment size and slope. Most of rivers, included into State surface monitoring programme belongs to types R3 - medium-sized fast flowing (slope > 1 m/km, catchment area 100-1000 km<sup>2</sup>) and R4 – medium-sized slow flowing (slope < 1 m/km, catchment area 100-1000 km<sup>2</sup>) lowland rivers. In this study, we tested also possible use of MIR index (Macrophyte index for rivers) in other national river types - R1 (slope > 1 m/km, catchment area < 100 km<sup>2</sup>), R2 (slope < 1 m/km, catchment area < 100 km<sup>2</sup>), R5 (slope > 1 m/km, catchment area > 1000 km<sup>2</sup>) and R6 (slope < 1 m/km, catchment area > 1000 km<sup>2</sup>). Macrophyte survey data were obtained from Latvian Environment, Geology and Meteorology Centre. Surveys were carried out in Latvian rivers between 2006 and 2016. Data from 356 macrophyte surveys in 186 rivers were used.

Mean MIR index value in all data set was 38.9 and it ranged from 24 to 50.8. We did not find any significant differences between MIR index values within Daugava, Gauja and Venta river basin districts (RBD), but in Lielupe RBD, which can be characterized with high agricultural intensity, index value was on average four points lower. Pressure-response analysis between nutrients and different river types revealed that relationships in slow flowing rivers are significantly stronger than in fast flowing rivers. Strongest links were observed between P<sub>tot</sub> (also P-PO<sub>4</sub><sup>3-</sup>) and MIR index. Relationships between MIR index and nitrogen compounds were not observed or were insignificant. Mean MIR index value in natural rivers was 39.3 but in straightened rivers 38.9 indicating that this index is not suitable tool to assess habitat degradation degree. Macrophyte composition is affected by other factors such as substrate composition and shading which affects their relationship strength with pressures. Mann-Whitney nonparametrical test did not reveal any significant differences between macrophyte index values between national river types R3 and R4. Differences were found between middle-sized and large rivers, indicating that LV MIR index needs score modifications to be used to assess ecological quality of larger rivers with catchment area > 1000 km<sup>2</sup>. For small rivers with catchment area < 100 km<sup>2</sup> number of used samples were too small to make plausible conclusions but in general number of species were lower than in larger streams, but index value tends to be higher. Another possible problem in smaller streams is lack of species to calculate macrophyte index. For index calculation we set threshold to at least 6 species to calculate index. Only 47% of samples were valid to calculate MIR index in R1 type rivers, in middle-sized and large rivers 81-88% of samples were enough species rich to calculate MIR index.

## The changes of water-peat vegetation in the Lower Silesian Forests (Western Poland)

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In the Lower Silesian Forests (Western Poland) complex, near the locality Węgliniec (51°17'18"N, 15°13'32"E), swamps and peatlands extend, some of which belong to the "Peatbog under Węgliniec" Nature Reserve. In this area, phytosociological and hydrochemical studies were carried out. Using the Braun-Blanquet method, 63 phytosociological relevés were realized in swamps areas. On the basis of the numerical classification, three syntaxonomic units in the rank of associations were distinguished: *Cicuto-Caricetum pseudocyperi* Boer et Siss. in Boer 1942, *Typhetum latifoliae* (Allorge 1922) Soó 1927, *Phragmitetum australis* (Gams 1927) Schmale 1939 and one community of peat-moss with *Sphagnum girgensohnii* Russow. The species composition in the distinguished associations, mainly *Cicuto-Caricetum pseudocyperi* and *Phragmitetum australis*, indicates progressive processes of drying and disturbances of water management, resulting the succession towards the wet meadows. The hydrochemical research carried out, i.a. High Performance Liquid Chromatography (HPLC), indicates a high trophic level of the habitat, at a slightly acidic pH (pH=5.18 – 6.79 from 14 samples). Concentrations of mineral substances dissolved in water do not exceed limit values for I class of water quality. Occasional changes in the local and seasonal content of nitrates and sulphates (VI) suggest the inflow of these anions from the outside. Regular monitoring would make it possible to check if anthropogenic sources contribute to the described amplitudes of the elements content on the analysed area. These changes have impact on the species composition of local, rare swamps phytocoenoses.

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## Spring vegetation and water chemistry in eastern Finland

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Springs and spring fen habitats with continuous groundwater flow and many specialized and highly adapted species are increasingly threatened by drainage, forestry practices, and groundwater uptake. We inventoried 118 springs located in groundwater areas in North Karelia, eastern Finland in 2017 and 2018. The studied springs comprise of all known springs marked on topographic maps and some additional springs found during the field inventories. We recorded the abundances of all plant species from phytosociological relevés using Braun-Blanquet approach, and obtained water samples that were analyzed for pH, electrical conductivity, and concentration of 22 mineral elements, including Al, Ca, Fe, K, Mg, and Na. We used DCA for determining the main compositional gradients, and cluster analysis and indicator species analysis for vegetation classification.

Among the studied springs, 53 % were found in pristine state. We did not find general significant differences in plant communities or water chemistry between pristine and disturbed springs. In DCA ordination, the main gradients reflected the degree of groundwater influence and trophic state (i.e. the poor-rich gradient). Springs with rich-fen vegetation formed a separate group in ordinations. Four clusters were obtained and interpreted as representing springs with 1) high abundance of spring-specialists and strong groundwater influence, 2) high abundance of rich-fen vegetation, 3) dominance of mesic spruce swamp forest vegetation, and 4) vegetation common in flooded swamp habitats. Sites with spring fen specialist communities comprised 38% of all inventoried springs. Within the spring-specialist cluster, distinction could be made between *Marchantia polymorpha-Filipendula ulmaria* and *Crepis paludosa-Brachythecium rivulare* vegetation types.

Our results provide reliable information of natural state and vegetation of spring habitats in eastern Finland. Only part of map-marked springs have representative spring vegetation characterized by habitat specialists, while most sites bear limited indication of spring influence. While all springs are important to structural diversity in boreal forest landscapes, detailed and uniform classification of spring vegetation is needed to recognize most valuable sites and aid conservation planning.

## Links between biodiversity and water quality in Latvian surface waters

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The Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive, BHD) and the Water Framework Directive 2000/60/EC (WFD) focus on quality assessment protection and proper management of rivers and lakes. Although both directives have different objectives and measures, the main goal of both is ensuring good quality of aquatic ecosystems. According to the WFD, all rivers and lakes are divided into surface water bodies. All habitats, in accordance with the BHD, are a part of these water bodies. The WFD assesses surface waters using chemical, biological and hydromorphological parameters while the BHD focuses more on habitat quality which also involves aquatic species. Based on these similarities, both approaches theoretically must deliver similar results. This study analyses the newest surface monitoring data (2016-2017) from the Latvian Environment, Geology and Meteorology Centre and the freshwater habitat inventory data (2017) from the Latvian Nature Conservation Agency. The paper tries to compare the both quality assessments and to harmonise the biodiversity/ habitat and ecological freshwater quality monitoring results. There are several problems regarding assessment harmonisation. To compare results, one must be sure that water bodies belong to the same type. The authors of this paper compared 170 river stretches and only about 60% of them were of the same type. The main cause of this mismatch is due to biodiversity experts assessing river in one 500 m stretch while ecological type is calculated as a theoretical type for all river. Therefore, it is especially important that both surveyors choose a representative site. According to the results, about 20% of Latvian surface water bodies belong to good and high ecological quality class and about 23% of water bodies have good and high habitat quality. However, more than half or 51% of Latvia's surface water bodies is not recognised as a European Union habitat; most of this percentage is formed by anthropogenically modified rivers. Overall, the ecological quality of lakes is better than that of rivers: at least 25% of lakes and only 13% of rivers are of good quality. 12% of lakes and 24% of rivers are of bad and very poor quality. Habitat quality is similar, and lakes are of better quality than rivers. Ecological quality classification did not show any differences between river types, but habitat quality for fast flowing rivers was better than that for slow flowing rivers with soft substrate. Although the WFD focuses more on water quality but the BHD – on habitat quality, both assessments are comparable. First and most important step to fully harmonise results is to make a comparable water typology. Also, it is possible to make joint monitoring and exchange data about macrophytes and physico – chemical parameters which are important to define some of lake types.

## Ten-year restoration effect of mulching and mowing on semidry *Bromion* grassland

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The Biele Karpaty Mts are a part of Protected Landscape Area located at the border between the Slovak and the Czech Republic. This territory is famous especially for unique species-rich grasslands, but during the 20th century a lot of grasslands especially on the remote sites were abandoned. In order to avoid successional changes, regular or at least irregular management should be ensured. The field experiment was founded in 2009 in the Bošácka dolina valley with the aim to find answers to three main questions: i) Is mulching appropriate management for restoration of the abandoned grassland? ii) Are there any differences in the effect of mulching in different seasons – summer and autumn? iii) What are the differences in the effect of mulching and mowing on species composition and cover of species? Permanent plots were established in the semidry grassland community of *Bromion erecti* alliance, which was unmanaged for several years. The effect of the four management treatments was tested: mowing in June, mulching in June, mulching in September, and no management. The plots were sampled during ten vegetation seasons (2009–2018). The experiment was designed in four completely randomized blocks. The list of species with percentage cover and presence and absence data on smaller subplots were recorded. Multi-way ANOVA was performed on data on species richness of vascular plants in two scales (1x1 m and 10x10 cm). Frequency and cover data on species composition were analysed by Principal Component Analysis and by Redundancy Analysis when interactions of all four treatments with time were tested. Results of multi-way ANOVA show significant interaction of Treatment and Time factors in relation to species richness in the scale 10x10 cm (P=0.05), the results were close to significance level in the scale 1x1 m (P=0.08). It is evident, that during the first three years any type of applied management had a positive effect on the species richness increasing both in plots 1x1 m and 10x10 cm comparing to no treatment control. Later, in the fourth year, both mulching treatments led to a decrease of species number in comparison with mowing. In the following years, the impact of various treatments on the number of species varied in different scales. Finally, after 10 years of experiment, the highest species richness in the scale 1x1 m was recorded in plots managed by mowing, while both mulching treatments had a similar effect like no management. But in the scale 10x10 cm, late mulching after 10 years surprisingly supported the highest species richness. After ten years of the experiment it is obvious, that species composition of studied grassland is very dynamic and applied management seems to interact with other factors e. g. weather fluctuations. This work was supported by grant VEGA 2/0040/17.

## Preliminary study of post-fire natural regeneration: A five-year study of the affected area in Valdemaqueda (Madrid, Spain)

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Over five years, we evaluated the restoration capacity of the natural vegetation following the 2012 fires in Valdemaqueda (Madrid, Spain). The latter was carried out through the characterization of the post-fire and residual vegetation, added to the analysis of physical-chemical characteristics of the soil. In turn, six pilot-plots were established through the affected site based on fire incidence, altitude and vegetation type. In addition, forest species representative of the natural potential vegetation of the area (*Juniperus oxycedrus* and *Quercus rotundifolia*) and broom shrubs (*Cytisus scoparius* and *Retama sphaerocarpa*), were planted in the pilot-plots to assess the relationship among the stages of ecological succession, competition and soil restoration processes following devastating fire events.

Our results showed the affection of the soil physical-chemical properties by the fire, reflecting an increased pH and reduced C/N ratio. In addition, we observed a reduction in the clay fraction of the soil, coupled to increased sand and silt fractions. The soil enrichment resembles to that of other habitats affected by fires around the globe. This aforementioned soil enrichment, though transient, can be accompanied by the propagation of herbaceous species, supporting our seedbank findings, showing a clear difference in the sprouting rate between burnt and control plots (80% vs 20%, respectively). Furthermore, we observed a clear conversion of the vegetation in burnt areas due to the establishment of strong, pyrophyte shrub species (*Cistus ladanifer*, *Cistus laurifolius* and *Rosmarinus officinalis*) rather than natural succession.

The high vulnerability of the natural vegetation to the settling of these pyrophytes was evident in the pilot-plots, given their low survival rate under the strong competitive pressure of these pyrophytic species. Moreover, the establishment of these shrub species will contribute to soil acidification in the long-term, given the high quantities of leaf litter they produce. The proliferation of these pyrophytes could translate into changes in soil macro- and microbiota, nutrient dynamics, species diversity and interaction, added to the alteration of fire regimes in the area. These results highlight the risk for soil impoverishment and plausible erosion of the fire-affected sites, underlining the importance of the establishment and regeneration of *Genisteae* species to outcompete invasive pyrophytic species and favor the reintroduction of the natural potential vegetation of the area.

## How affects a replacement of original hardwood floodplain forest by black locust plantation habitat conditions and species diversity of understory vegetation, gastropods, and Carabid beetles – case study from Borská nížina Lowland (SW Slovakia)

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We hypothesize, that replacement of native tree edificators in original hardwood forest by black locust plantation hardly affects fundamental habitat conditions and consequently species diversity of biocoenosis. To verify the hypothesis we selected plain area along small stream with homogeneous habitat conditions originally covered by native hardwood floodplain forest. Right side of the stream was secondary reforested by *Robinia* plantation. We used twins plot method (7 twins – 14 samples) for gathering the data on species composition of understory vegetation (phytocoenological relevés), terrestrial gastropod and Carabid beetle communities, light (density of tree canopy by GLAMA app.), and air temperature and relative humidity under tree canopy (by dataloggers). The distance between paired relevés/samples was 30 – 100 m. Twins were compared using Wilcoxon pair test. We found apparent differences in all measured ecological parameters. Black locust plantations were lighter, drier and warmer. Temperature extremes and daily intervals in plantations were bigger. Studied groups of organisms reacted differently on replacement of native forest by *Robinia* plantation. The most significant was shift in plant species composition, followed by carabid beetles and terrestrial gastropods. In the understory vegetation among the most frequent species more than 15 typical hardwood forest species retreated (e.g. *Circaea lutetiana*, *Galeobdolon luteum*, *Pulmonaria officinalis*). About 15 new species appeared. They consist of neophytes (*Aster novi-belgii*, *Solidago gigantea*, *Erigeron annuus*), archaeophytes (*Anthriscus \*trichospermus*, *Chelidonium majus*) and more heliophilous grasses (*Arrhenatherum elatius*, *Bromus sterilis*). Only 10 common native mostly nitrophilous herbs occurred in both types of forests nearly equally (e.g. *Galium aparine*, *Geum urbanum*, *Lamium maculatum*, *Urtica dioica*). Gastropod and Carabid beetle communities were less changed. Both surveyed twin plots are characterised by a similarly low number of eurytopic land snail species (*Robinia* plantation: median = 12.0 spp., native forest: median = 13.0 spp.). The most frequent species (100% of samples) in *Robinia* plantation were forest mesohygrophilous species (*Cochlodina laminata*, *Monachoides incarnatus*) and shrub or sparse grove species (*Euomphalia strigella*, *Aegopinella minor*). The most frequent species (100% of samples) in the native forest were forest mesohygrophilous species *Cochlodina laminata* and *Petasina unidentata*, two shrub species (*Euomphalia strigella*, *Helix pomatia*) and invasive slug *Arion*

*vulgaris*. The Carabids in the native forest were represented mostly by species combination characteristic for the driest floodplain forests (*Abax parallelopedus*, *Platynus assimile*, *Nebria brevicollis*). In more humid parts of the *Robinia* plantation mesohygrophilous *Carabus ullrichi* predominated, whereas heliophilous *Amara* spp. and *Harpalus* spp. in the driest part.

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## Functional traits of leaves at abandoned and managed sites in Central Forest Reserve, NW Russia

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**Aims.** Along with other functional traits, specific leaf area (SLA) is a crucial tool to assess the response of meadow plants to the type of management. However, the variability of leaf traits across habitats is poorly studied. Meadows of Central Forest Reserve represent a long-term experiment as their management was ceased under protection regime. Our study was aimed to reveal the difference between SLA of herbaceous plants at abandoned and managed sites.

**Location.** NW Russia, Tver' Oblast' (Lat.: 56°26'–56°39'N. Long.: 32°29'–33°01'E).

**Methods.** We measured leaf area and SLA of 24 herbaceous plant species on abandoned and managed upland meadows with similar floristic composition. Fully water-saturated leaves were scanned at 300 dpi, then dried in the oven and weighed to the nearest of 0,1 mg. Leaf area was measured in ImageJ software. Specific leaf area was calculated as a ratio between leaf area and leaf dry mass. The statistical analysis was conducted in R environment. Based on the data for each species at managed sites the coefficients of the regression equation were determined and further used to calculate expected SLA at abandoned sites. To compare the observed and the expected SLA at abandoned sites the Mann-Whitney U-test was applied.

**Results.** We identified four groups of species with different SLA variability. The first group included 12 species whose leaf area and SLA did not differ at abandoned and managed sites. The second group consisted of two species with SLA changes at abandoned sites depending solely on the leaf area which was not connected with the site management. Five species whose leaf size did not differ at abandoned and managed sites while their SLA depended on management belonged to the third group. In this group the observed SLA either increased or decreased compared with the expected one. The fourth group comprised five species whose leaf size differed at abandoned and managed sites with SLA depending on management. Difference was detected neither between forb and grass species nor between tall and short ones. The revealed differences in SLA may be connected not only with management, but also with other ecological factors.

**Keywords:** biodiversity, meadows, functional traits, SLA.

## Habitats recovery after invasive plant removal: the case of *Carpobrotus* eradication from the Pontine islands (Lazio, central Italy)

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The spread of invasive species is a major environmental threat on the Pontine Archipelago, a group of islands located off the western coast of Italy that are used as major stop-over by migratory birds and that host protected habitats and species of conservation interest.

The EU LIFE PonDerat project (LIFE NAT/IT/000544) aims at restoring the natural ecosystems of the Pontine islands and protecting the nesting colonies of Scopoli's shearwater and Yelkouan shearwater. To this purpose, the project foresees a set of conservation actions that include the eradication of black rats (*Rattus rattus*), feral goats (*Capra hircus*), and invasive plants of the genus *Carpobrotus*.

On the Pontine Archipelago *Carpobrotus* often spread on the rocky coasts, where we mainly recorded habitats of Community interest (1240, 5320, 5330) and rare and endemic plants (*Limonium pontium*, *L. pandatariae* and *Matthiola tricuspidata*). Here *Carpobrotus* generally grows in natural and seminatural habitats with native plant species rather than in dense and monospecific mats.

Since 2017 *Carpobrotus* has been eliminated by all public areas on the Pontine islands except for sheer cliffs and slopes, where specialized personnel working with ropes will eradicate this autumn. To minimize the impact on native vegetation and important plant species, removal is in all cases by manual eradication. In the following years, we did not observe any *Carpobrotus* regeneration or significant spreading of populations still present on steep slopes, but rapid and significant recovery of natural vegetation within eradicated areas.

To monitor vegetation recovery, we are regularly surveyed 10 permanent plots in natural and seminatural areas with *Carpobrotus* and 5 control plots once per year since 2017. Here we present some results, which suggests improvement of conservation status and representativeness of coastal habitats.

## Enhancing Agricultural Productivity: A Case of Potato Cultivation in Western Guatemala

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Guatemala agricultural sector plays a significant role in producing food and providing employment opportunities. Potato is one of the major export crops as well as a food crop in Western Guatemala. 88% of rural households engage in potato farming however potato cultivation records low productivity compared with the world average. Existing data reveals that there is a high correlation among potato productivity, rural poverty, income inequality and food insecurity in rural Guatemala. However, little is known about the causes of low productivity in potato farming. This paper aims to fill such a knowledge and provides policy implications for formulating a rural development strategy which integrates productivity enhancing factors in potato farming. This paper estimates a stochastic frontier production function for 98 households in four rural municipalities in Western Guatemala and attempts to identify the factors that lead to inefficiency in potato farming system. Our estimates show that technical inefficiency contributes to 58% of production variability among potato farmers. With each individual technical efficiency value, we will map them to enable us to see if some areas are most affected due to topography and soil types and recommend any remedial measure such as using different cropping patterns or practices would enhance production. This finding has vital policy implications for formulating an innovative development strategy which integrates sustainable crop management and human capacity building.

## Phytocoenological studies in open sandy grasslands in the Hungarian Northern Great Plain (*Festuca* species and species composition of plant communities)

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In this study we examined the vegetation of sandy areas along the Danube. Our goal is to study the open sandy *in the Hungarian Northern Great Plain*. In Hungary sample areas were examined in May-June and September 2018, then in May 2019. Beside coenological studies, biomass and soil data were also recorded and valued. Older literature regarded *Festuca vaginata* as the only dominating grass species of open sandy grasslands. During the studies the vegetation type dominated by *Festuca pseudovaginata* was also recorded and analysed. This species was recorded in 2003. Detailed comparison was conducted between the vegetation types of *F. vaginata* and *F. pseudovaginata*. Both were examined as natural, degraded, even pastured populations. On pastured areas *F. pseudovagina* appeared as a dominant, disturbance tolerant species. *F. pseudovaginata* vegetations were more significant considering species count and diversity; they can be found mainly in forest-grassland patches, even under *Populus alba* populations. We also examined degraded patches of this type, where weed and natural pioneer species became dominant in the autumn records. These patches formed secondarily on cut or disturbed areas. The vegetation type of *Festuca vaginata* had fewer species, but weed did not appear in them. According to nature conservational valuing, *F. vaginata* patches were more valuable; populations of *F. pseudovaginata* showed natural and disturbed conditions, but they appeared along a larger oecological spectrum as patches with individual species combinations, showing that this newly recorded species is more adaptive to changing environmental conditions.

This survey was supported by OTKA K-125423.

## Psammophilous vegetation in the Iberian South Plateau: a preliminary overview

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A detailed phytosociological study of the vegetation growing on rare eolic sand deposits in central La Mancha region are presented. The studied territories cover from Daimiel city (Ciudad Real), in the west, to Albacete city, in the east, including La Manchuela (Cuenca). These psammophilous vegetation types (therophytic and chamaephytic plant communities) are poorly studied and they are really threatened by the actual strong agricultural development and by forestry pine plantations.

The diversity of the recognized plant communities are determined by edaphic and biogeographic factors. Unfortunately, this interesting vegetation are strongly altered since historic times.

## The taxonomic problems of the *Festuca vaginata* agg. and their coenosystematic aspects in the sandy areas along the Danube

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We studied the vegetation of the sandy areas along the Danube. The most important dominant species of these grasslands is *Festuca vaginata*. Besides *Festuca vaginata*, there is another taxon, *Festuca pseudovaginata*. *F. dominii* is a dominant species on acidic grasslands. Taxonomical judgement of *Festuca dominii* Krajina changed remarkably, therefore today the accepted name is *F. psammophila* subsp. *dominii* (Krajina) P. Šmarda. We examined individuals belonging to *F. vaginata*. On the basis of the results, we found the *F. vaginata* taxon were the typical without awn. In addition, we have collected taxa with shorter or longer awn from the tip of the lemma, which have short fibers under the tip of the lemma. Clarification of taxa also means clarifying the name and dominant species of sandy vegetation, and overriding along with correction of the associations and coenotaxa described above is also necessary.

Pawlus has distinguished several new series within the genus *Festuca*. The *F. trahyphylla* series includes 3 species: *F. trahyphylla* (Hack.) Krajina, *F. macutrensis* Zapalowicz, *F. duvalii* (St-Yves) Storh. We checked in the Carpathian Basin and in the natural grasslands which of these 3 taxa occur. In addition to these, hybrid taxa have been detected during our investigations, and the expulsion of *Festuca wagneri* and *F. javorkae* has also been widened. and their vegetation types has been clarified.

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## Changes in functional structure of riparian tall herb fringe communities caused by alien plant invasion

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Riparian tall herb fringe communities of the order *Convolvuletalia sepium* are listed in Annex 1 of the EU Habitat Directive (6430). Due to their specific conditions they are very prone to invasion. Author's previous studies showed that the invasion of alien plants does not cause a decline in diversity and total species richness of these communities, but it does reduce native species cover and native species number in the patches. Here we apply a trait-based approach in order to address the following question: does alien plant invasion alter the functional structure of riparian tall herb fringe communities? The impact of invasion on the functional structure was assessed using the community-weighted mean of trait (CWM), i.e. the mean value of every single trait across species weighted by their abundance. Changes in CWMs due to the invasion of alien plants are expected to alter ecosystem functioning.

The total of 44 samples (relevés) with *Solidago gigantea* and 41 samples with *Echinocystis lobata* were used to compare the CWMs of traits (calculated including and excluding the invader) between the groups of relevés with increasing coverage of both invasive species. The set of traits was chosen from the LEDA traitbase and other sources: plant growth form, maximum plant height, specific leaf area (SLA), leaf dry matter content (LDMC), seed mass, flowering onset, flowering duration, dispersal type, life strategy. One-way analysis of variance (ANOVA), followed by post-hoc Duncan's test for multiple comparisons were used after Box-Cox transformation of the data. Significant differences were found between patches invaded by different species (most of studied traits), and also between patches invaded by the same species but with various abundances (e.g. maximum plant height, seed mass, flowering onset), although only in case of CWMs calculated with the invader. In contrast, when *S. gigantea* and *E. lobata* were excluded from CWM calculations the differences were insignificant, except for the SLA. The dominance of both invasive species in the patches shifted the overall mean traits of the communities, but did not alter significantly the mean traits of the persisting resident species in invaded patches.

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## Can we really predict the course of plant invasion?

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Models of IAS expansion, based on species biology, climatic factors and rarely on the human activity, assume the species's striving for complete settlement of convenient habitats. However observations of real distribution and the course of invasion in many cases contradict the results of modeling. Species do not fill the habitat or occur in a much larger area than predicted. During the IAS expansion, we can observe periods of dormancy and a sudden increase in occupied area.

In this study, we would like to show how unpredictable the process of invasive species expansion is. The examples are two of Invasive Alien Plant Species found in Poland. *Erechtites hieracifolia*, occurs in the present Polish borders since 1902, mainly on the fresh forest clearcuts and until the 1970s grew only in the south-western part of the country. Since the 1990s, it has been rapidly spreading in central and northern Poland – appears simultaneously at localities several dozen kilometers apart. *Elodea nuttallii*, which spread widely in Europe transmitted by birds and along rivers, reached the north-eastern part of Germany, close to the Polish border around 1953. However, the first occurrence in Poland was noticed only in 2007 (in 2004 it was found further to the east, on the territory of Ukraine).

In the case of the *Erechtites hieracifolia*, the factor that allowed to infect new areas was probably human action – a change in the way logging works associated with the transport of foresters machinery over long distances. The factors, which first stopped the expansion of *Elodea nuttallii* for 50 years and then allowed for a rapidly increase of the occupied area - beyond the boundaries predicted in the models, is unknown.

Numerous factors influence the course of the invasive species' expansion, whose full diagnosis is difficult. Therefore, it is not feasible to draw up an accurate invasion model.

## Impacts of long-term fertilization on biodiversity of dry grasslands in Sub-Mediterranean Slovenia

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Dry species rich grasslands are (beside wetlands) one of the most threatened ecosystems in Europe due to changes of traditional management reflected in land-use intensification (eutrophication, etc.), abandonment and re-growth.

The plant biodiversity, forage yields and its feed value were studied during the long-term fertilization experiment, which was designed in 1983 on the karst dry grassland near Rožice village in Sub-Mediterranean Slovenia. We set-up 4 x 4 m plots according to 9 treatments in 4 replicates. The treatments were as follows: fertilization with P only (50 kg P ha<sup>-1</sup> year<sup>-1</sup>), fertilization with P and K (50 kg P + 100 kg K ha<sup>-1</sup> year<sup>-1</sup>), four fertilization treatments with combinations of N, P and K (60 or 80 or 120 or 160 kg N + 50 kg P + 100 kg K ha<sup>-1</sup> year<sup>-1</sup>), fertilization with N only (120 kg N ha<sup>-1</sup> year<sup>-1</sup>) and two non-fertilized plots (control). On each plot (16 m<sup>2</sup>), soil samples were collected and forage / biomass yield and its feed value were determined. In the period of 2002–2018, we performed vegetation relevés on randomly selected plots to monitor changes in floristic composition and abundance of species according to different fertilizing treatments.

The results show that the species diversity was affected by the use of different combinations and amounts of fertilizers. The highest species richness (average: 42; min: 35; max: 46) was found on non-fertilized plots. They differed significantly from all other treatments except from the treatment with N, which was the most variable treatment in number of species, and from PK treatment with high number of species (average: 39). The lowest species richness (average: 29; min: 22; max: 36) was found on NPK plots with the large quantity of N (160 kg N ha<sup>-1</sup> year<sup>-1</sup>). This treatment significantly differed from all others except from two NPK treatments (with 60 and 80 kg N ha<sup>-1</sup> year<sup>-1</sup>), both with low average number of species (33).

Regarding the number of nationally protected plant species, the difference between treatments was not detected. Three protected species (*Helleborus multifidus* ssp. *istriacus*, *Orchis tridentata* and *O. morio*) were mostly present individually on non-fertilized plots. Only one invasive alien species (*Erigeron annuus*) was observed, mostly on NPK fertilized plots.

During the period of 1983–2018, the vegetation type and structure (density and height) on NPK plots compared with non-fertilized ones were changed, too. The vegetation became denser and higher on fertilized plots than on the non-fertilized ones. The vegetation type of *Danthonio-Scorzoneretum villosae* (still present on non-fertilized plots and on surrounding grasslands) was transformed to *Arrhenatheretum* s.lat. (present on fertilized plots).

Considering both, agricultural and nature conservation interests, the treatment with PK fertilization shows the smallest change in composition and structure of vegetation, and also the lowest loss in plant biodiversity.

## **Vegetation succession, soil seed bank and seed rain on shallow eroded areas in the South Tyrolian Dolomites**

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Shallow erosion on steep grasslands results in the removal of vegetation cover and degradation of soil with a consequent loss of related ecosystem services. During the last decades, this phenomenon increased in frequency on pastures and meadows in the Alps. With this study, we aim to investigate the potential for unassisted recovery of shallow eroded areas occurring within the Puez-Geisler Nature Park (South Tyrol, N Italy). Particularly, we will test the similarity between the seed bank and the standing vegetation along a successional gradient, investigating eroded areas that formed in different periods. Furthermore, we will quantify the seed rain on the same areas.

Based on multi-temporal orthophotos available for the period 1992 to 2018 we classified the eroded areas into three age classes, i.e. 0-4 years, 5-7 years and > 27 years. During the vegetation season of 2019 we will determine the aboveground vegetation for each eroded area according to the Braun-Blanquet methodology. The same methodology will be applied to produce a list of the species of the surrounding undisturbed grassland where the eroded areas are located. For the seed bank analysis, soil cores will be randomly taken from each eroded area and subsequently germinated and determined in the greenhouse. A seed trap will be finally placed within each eroded area to quantify the seed rain.

Thus, we will obtain information about the restoration potential determined by seed bank composition and seed rain input. Furthermore, based on the different ages of the investigated eroded areas, we will be able to determine the vegetation succession that characterize the process of recolonization. This research is conducted within the international project “Shallow erosion dynamics in mountain grasslands of South Tyrol: Monitoring, process analysis and mitigation measures (EroDyn)”.

## **Secondary succession in old fields: changes in plant functional markers in central Spain abandoned vineyards**

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One of the most important anthropogenic effects on Earth's ecosystems is the change on land use. In the Mediterranean region, the abandonment of agriculture lands during the course of the twentieth century has induced changes in vegetation type and cover due to successional dynamics since the structure and composition of plant communities greatly influence the functioning of ecosystems. The aim of the present study was to understand how changes in the environment during succession affect the distribution of species and consequently the composition of plant communities. To do that we have studied a chronosequence of vineyard abandonment in the Mediterranean region.

Twelve old fields located in central Spain (El Tiemblo, Avila) were selected for study. They were previously vineyards abandoned 2-42 years before our study. Age since abandonment was determined from chronological series of aerial photographs (scale:1:25 000). The similarities in soil type, climate, and plant species pool make these 12 old fields a good model of chronosequence to study successional patterns. In any field we collected the two or three more dominant plants, a sample of soil (from three or four subsamples), the biomass at the start and end of the season and the cover of four subplots. We have sampled during years 2017-2019.

With the collected plants, we measure functional traits such as the specific leaf area (SLA), leaf dry matter content (LDMC), and nitrogen and carbon concentration (NC, NC). We have also determined the proline and chlorophyll content, as functional traits to detect drought and photosynthetic efficiency, respectively. The soils were also analyzed to obtain data from texture, organic matter and total soil carbon, nitrogen and sulphur. They are parameters that varied significantly with field age, and correlated with community-aggregated (i.e., weighed according to the relative abundance of species) functional leaf traits. Biomass serve to know the ecosystem-specific net primary productivity.

Those measurable traits (functional markers) can provide a simple means to scale up from organ to ecosystem functioning in plant communities. They can be used to assess the impacts of community changes on ecosystem properties induced by global change drivers particularly. In this sense, abandonment vineyards are a good example to study secondary succession and their impact on ecosystems.

## Vegetation dynamics and succession in semiarid series of *Maytenus senegalensis* subsp. *europaea*

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Thermomediterranean western Almeriense semiarid series of *Maytenus senegalensis* subsp. *europaea* (*Zizipho loti-Mayteno europaei* S.) is an endemic model of succession (set of plant communities, which can substitute each other over time in an ecologically homogeneous space or “tessella”) in western Almeriense district (Almeriense sector, Muciano-Almeriense province, Mediterranean region). This territory lies in the southeast of the Iberian Peninsula and undergoes a desertic oceanic bioclimate.

This area was severely affected by the phenomenon of the rural abandonment and consequently, sheepherding and traditional agriculture were drastically reduced during the second half of the 20th century. Natural ecosystems experienced a strong recovery for a long time, but recently, groundwater use for irrigation has allowed a new agricultural revolution that threatens these ecosystems: greenhouse crops.

In order to assess the establishment rate of different stages of this series, a study area (around 3400 ha) has been delimited from rambla de la Sepultura to rambla de las Amoladeras (E-W limits), and shoreline to A7 motorway (S-N limits); a part of it belongs to the Cabo de Gata Natural Park. By means of aerial photography, the sometime cultivated areas were delimited from those never ploughed, dating the last crops event. The oldest available aerial photographs correspond to the American flight (1956-1957). All recognizable types of communities and the ground percentage covered by each one were recorded for each age type of plot. By means of the statistical comparison of samples, the establishment time of each community (habitat), could be known.

The associations detected now are the following:

1. Prickly scrubland communities (climax): *Zizipho loti-Maytenetum europaei* (Habitat 5220\*, Spanish code 422011\*)
2. Bunchy tall grassland communities: *Lapiedro martinezii-Stipetum tenacissimae* (Not included)
3. Heliophilus dwarf scrubs: *Helianthemo almeriensis-Sideritidetum pusillae* (Habitat 5334, Spanish code: 433421)
4. Halo-nitrophilous dwarf scrub communities on well-drained soils: *Artemisio barrelieri-Salsoletum genistoidis* (Habitat 1430, Spanish code: 143032)
5. Halo-nitrophilous dwarf scrubs communities on deep soils occasionally with high water table: *Suaedo verae-Salsoletum opossitifoliae* (Not included)
6. Pioneer early spring ephemeral plant communities: *Eryngio ilicifolii-Plantaginetum ovatae* (Habitat 6220\*, Spanish code: 522031\*).

## Vegetation dynamics in the high mountain ecosystems (Central Apennine, Italy)

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Since the end of the Second World War, European mountain areas have been increasingly abandoned, resulting in grazing declines and often in shrub encroachment of the sub-alpine belt. In this context, the Apennine chain in Italy harbors a unique vegetation as it is characterized by relatively low altitudes compared to other mountain chains such as the Alps or the Pyrenees. This factor, together with the strong influence of the Mediterranean climate, makes Apennines's alpine and subalpine vegetation particularly vulnerable to climate change. According to the IPCC reports of 2013, drier summers are expected to occur in the Apennine area, with 30-40% less summer precipitation by 2100. In these water-limited environments, the soil capability to store water and avoid drought is likely to be especially important for vegetation, particularly under future climate scenarios. However, how soil characteristics influence ongoing vegetation dynamics in Mediterranean mountain areas is still largely unexplored. The main objective of this work is thus to describe and understand vegetation dynamics of these alpine and subalpine landscapes in the context of ongoing changes. Specifically, we aim to test: 1) the main factors underlying shrub encroachment, 2) the specific importance of soil water capacity, and 3) whether certain alpine grasslands are more vulnerable to encroachment.

The study focuses on Central Apennines: Reatini, Duchessa and Ernici mountains. These areas were selected because of their importance as southern limit for alpine vegetation, because they share the same lithotype, harbor both grazed and ungrazed areas and have suitable climate data. In this context, *Juniperus communis* subsp. *nana* is interesting to study because of its known tolerance to severe drought and freezing (“embolism resistance” super trait). First, to test what explains past shrub encroachment we will compare 1954 and 2012 aerial photographs, recording dwarf-shrub cover change, and relate this with grazing trends in the areas and other factors. Second, we will test if different capabilities of soil to store water, and therefore to avoid drought, determine alpine vegetation distributions. We will do so by performing 100 surveys of 4m<sup>2</sup> where we will collect floristic, pedological, grazing and topological data. Third, to investigate the suitability of different alpine grasslands to *Juniperus communis* subsp. *nana* encroachment (as defined from 1954 and 2012 aerial photographs), we will compare areas where common juniper has spread and areas where it didn't.

Preliminary results confirm that there has been significant shrub encroachment in the area, mainly by *J. communis* subsp. *nana*, and that grazing abandonment, next to climate change, is an important driver of this trend. Against this background, future

results will help shed light on the role of soil characteristics for potentially mitigating or exacerbating these patterns. Results will also allow us to potentially identify plant communities that might better cope under future drier scenarios and with encroachment.

## Dynamics of regenerative succession of Azorean pastured peatlands

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The Azores are located at about 1400 km W from Europa in the middle of Atlantic Ocean. The archipelago has nine islands, distributed in three groups. The study was implemented in Terceira Island (central group). There is, in Azores, a potential distribution of 350 Km<sup>2</sup> of peatlands. Less than 30% of the original area persists nowadays and of these, more than 50% are under pressure. The main threat of Azorean peatlands is their use as pasture for livestock, leading to an increase of degradation. The study area (15 ha) is integrated in an important ecological corridor, connecting the two major natural spaces of the island. This study focused on regenerative succession dynamics, on pastured degraded peatlands, after the removal of cattle. The natural distribution of *Sphagnum*, in the degraded peatland, was evaluated through mapping. Simultaneously, permanent plots (68) were established in the degraded, as well as in a natural and semi natural peatland, to analyse dynamics of regeneration, namely identifying flora/vegetation changes. These plots were surveyed three/year between 2012 and 2015 and data analyzed with PCA and RDA. Mapping, using remote sensing with Rapideye, PlanetScope and drone images, showed that *Sphagnum* still persist even in pastured situations (in 7% of the area), pointing to the resilience of peatlands. The distribution of this moss increased to 17% after two years without disturbance, and to 39%, four years after the removal of pasture uses. This study shows, in the degraded peatland, a clear increase of *Sphagnum* cover, after pasture cessation. There was a significant change of vegetation, confirmed with Monte Carlo permutation test. Some species cover increase was quite relevant, namely *Calluna vulgaris* and *Holcus azoricus*, typical wetland species. Yet, regenerative dynamics varied within the 15 ha, depending of landscape factors, as the existence of natural or semi-natural patches in adjacent areas. Other conditioning factors, with local expression, affected regeneration, namely biotic features, as the *Holcus lanatus* constrain for *Sphagnum* development (in covers of 60% or more of *H. lanatus*) and abiotic features, as water entrance and accumulation in the substrate.

This study allowed the identification of restraint and promoting features, important instruments to evaluate the recovering potential of degraded peatlands. Results show that regenerative succession is, under some conditions, a possible (passive) restoration tool in post-pastured peatland in Azores.



## Factors affecting the distribution and abundance of Balkan endemic species in grasslands

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We have investigated ecological preferences of 77 endemic plant species in 1244 relevés of dry grasslands in Serbia. The fidelity of Balkan endemic species to specific vegetation types was analysed by indicator species analysis and influence of environmental factors on distribution of endemic species by outlying mean index. The results showed that 34 Balkan endemic species presented high fidelity to specific vegetation types, whereas 8 species were statistically correlated with specific geological bedrock types. The species *Achillea clypeolata*, *Cephalaria pastricensis*, *Genista subcapitata*, *Sesleria latifolia* and *Hypericum rochelii* show fidelity to rocky grasslands of *Saturejion montanae*. In steppe therophytic communities grow species *Allium melantherum*, *Armeria rumelica*, *Centaurea rhenana* ssp. *tartarea*, *Gentianella bulgarica*, *Pastinaca hirsuta*, *Peucedanum olygophyllum*. The local endemic species *Nepeta rtanjensis* shows fidelity to the steppe grassland of *Festucion valesiaca*. On serpentinite grasslands of alliance *Centaureo-Bromion fibrosi* occur *Centaurea kosanini*, *Aster albanicus*, *Convovulus boissieri* ssp. *compactus*, *Genista hassertiana*, *Linum tauricum* ssp. *serbicum*, *Polygala doerfleri*, *Sanguisorba albanica*, *Saponaria sicula* ssp. *intermedia* and *Scabiosa fumarioides*. The species *Armeria rumelica* shows fidelity to silicate, and *Stipa mayeri* to serpentinite geological bedrock, while *Centaurea chrysolepis*, *Silene roemerii* and *Viola dacica* to fine-grained sediment and sedimentary rocks. In order to conserve endemic Balkan species special attention should be paid to protection of specific and rare grassland vegetation types.

## Germination and growth processes of radish seeds under influence of *nipplewort* aqueous extracts

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Plants during growth are subjected to the influence of various stress factors, and one of them is the positive or negative impact of other plants growing in their closeness. Substances that arise during the decomposition of plants or are part of their natural metabolic pathways, become mobile in soil aqueous solutions and can cause stress in other species. This is particularly important in the case of environmental relations of crop plants and weeds growing in their immediate environment. The effect of allelopathic compounds depends so from their concentration in the plant and soil, as well as from environmental and ecological conditions of the locality where they growth. There is a close interdependence between the occurrence of environmental stresses that affect plant growth and stimulation of phytotoxic production. In natural ecosystems, allelopathic interactions begin already during germination of seeds with subsequent impact on the growth and development of surrounding plants. Many allelopathic compounds that on the one hand inhibit the growth of certain plants at higher concentrations can to the other hand stimulate the growth of the same or different plants at lower concentrations. However, these phenomena still require detailed research that will allow to draw general conclusions about their mechanisms.

The aim of the study was to determine the effect of aqueous extracts from dry shoots of nipplewort (*Lapsana communis* L. subsp. *communis*) on the germination and early growth of radishes (*Raphanus sativus* L. var. *sativus*) in cultivars: 'Carmen', 'Frida F1', 'Rowa', 'Saxa Polana', 'Krakowianka'. The changes in germination indexes: germination percentage (GP), germination index (GI), speed of emergence (SE), coefficient of the rate of germination (CRG), seedling vigour index (SVI) and required for 50% germination (T<sub>50</sub>) were observed. There were also differences in the length of seedlings, changes of relative water content (RWC) and fresh and dry mass. The electrolyte leakage was different compared to the control, and depend on the radish cultivars.

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**Mineralogy and seasonal variation of elemental composition of the endemic halophyte *Sarcocornia carinata* (Chenopodiaceae) in relation with the environmental variables.**

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Halophytic vegetation is considered a prioritized EU habitat due to its high vulnerability. Vegetation communities of the saline lagoons from the center of the Iberian Peninsula are subjected to different threads as waste spills, agricultural and livestock activities among others. In addition to the special adapted flora that grow in these habitats, there are endemic species with a very restricted distribution area. That is the case of the perennial succulent chamaephyte *Sarcocornia carinata* Fuente, Rufo and Sánchez-Mata.

In an attempt to acquire a better understanding of the life cycle of this species, we carried out this study, since there are no reports regarding their chemical composition and its seasonal variation. Specimens from two lagoons (Laguna Larga de Villacañas and Laguna de Peña Hueca, Toledo, Spain) together with their soils have been collected during 2016-2017 (April, July, October and February). Elemental composition (ICP-MS) has been analyzed in the photosynthetic succulent stems. Soil pH, electric conductivity and ionic concentration have been analyzed for each of the edaphic samples. Mineralogy of soil and plant samples was studied by X ray diffraction analysis (XRD).

The analysis showed a considerable intraspecific variation. As a succulent euhalophyte *S. carinata* showed high concentrations of saline elements, especially Na and Mg. Other elements found in high concentration were Fe and Sr. Seasonal variation was only observed for Na, Mg and Sr concentrations (highest values in July samples). A positive correlation has been observed between the concentration of Ca<sup>+2</sup> in the soil and Sr in the plants. Several biominerals were observed as halite, weddellite, glushinskite, or gypsum.

**Morphological and reproductive trait-variability of a food deceptive orchid, *Cephalanthera rubra* along different altitudes**

**Gilián LD<sup>1</sup>, Endrédi A<sup>2</sup>, Zsinka B<sup>3</sup>, Neményi A<sup>4</sup> & Nagy JGy<sup>1</sup>**

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Presenting author: lilla.gilian@gmail.com

As climate change is forcing plant species to migrate northward and upward, it is important to know how species' vegetative traits and reproductive success vary along different climatic conditions. We aimed to examine the impact of elevation on the morphological and reproductive characteristics of *Cephalanthera rubra* in four different altitudes in Hungary: in a lowland oak forest (103 m), and in the beech forests of the Bükk-mountains (361 m, 533 m, 657 m). We counted the number of leaves, flowers, and fruits, and measured the height of each plant with the length and width of all leaves. Linear, negative binomial, and quasipoisson regressions were used to compare the populations. Our study has shown that the lowland and mountain populations of *C. rubra* are sharply different regarding their life history strategy and reproductive success, and altitudinal effects can be found only in the mountain populations. The number of flowers depends strongly on the vegetative production (height and leaf area) of the plants, but at the same time, the area that facilitates greater vegetative production - possibly because it also facilitates species with better competitiveness, and it is less favorable to its mimicked partners - were less beneficial in terms of fruit production.

## Urban structure and environment impact plant species richness and flora in Ljubljana (Slovenia)

Jogan N<sup>1</sup>, Küzmič F<sup>2</sup> & Šilc U<sup>2</sup>

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We analysed a floristic mapping dataset on the scale of 1 km<sup>2</sup> of the city of Ljubljana (Slovenia) and compared plant species richness between different urbanization zones. Using Generalized Additive models (GAM) we tested the effects of three categories of predictors: i) urban structure, represented by the distance from the city centre, population density, soil sealing, and quality of life index, ii) habitat predictors, represented by habitat diversity and lithologic diversity, and iii) environmental conditions, represented by urban heat island (UHI). Spatial distribution was tested for different species categories: species according to residence time (natives, archaeophytes and neophytes) and endangered and thermophilic species.

Species richness decreases with the distance from the city centre and is highest in the cells with intermediate habitat diversity. Number of species is highest within city parts of highest life quality and lowest in parts with UHI effect.

Spatial distribution of neophytes is related to urbanization pattern. Most neophyte rich grid cells are located in the most built-up areas and in the city centre. It is positively associated with soil sealing and habitat diversity, while it is negatively associated with UHI. The portion of archeophytes is higher where habitats are more diverse and increases with distance from city centre. Relationships are reverse for native species. Thermophilic species are positively associated with soil sealing. Endangered species have uniform distribution pattern and their proportion is (negatively) associated with distance from the city centre and soil sealing. A grid cell with the highest proportion of endangered species that stands out includes two protected areas with wetland habitats. Ecological indicator values show correlation mostly with soil sealing and habitat diversity.

Specific characteristics of the city landscape, including three forested hills running through the middle of the city, heavily built-up northern part and agricultural and wet southern part, dictate most of the patterns explained.

## *Asphodelus microcarpus* dominated community in Montenegro

Stanišić Vujačić M<sup>1</sup>, Stešević D<sup>1</sup>, Hadžiablahović S<sup>2</sup>, Caković D<sup>1</sup> & Šilc U<sup>3</sup>

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Research of plant communities dominated by *Asphodelus* spp. became very intensive in recent years, as well as debates about its syntaxonomical classification. They are either classified within the grassland classes *Lygeo sparti-Stipetea tenacissimae*, *Helianthemetea guttati*, *Festuco-Brometea*, or into the edge vegetation classes *Trifolio-Geranietea* and *Charybdido-Asphodeletea*.

We researched *Asphodelus microcarpus* plant community on Čemovsko polje near Podgorica (Montenegro). It thrives on alluvial plain of Cijevna river on underused and abandoned surfaces of *Chrysopogon gryllus* grasslands. Soils are sandy with large pebbles. Climate is Mediterranean, with hot and humid summers, and mild winters. Tall-herb community is characterized by *Asphodelus microcarpus*, *Anemone hortensis*, *Carlina corymbosa*, *Cerastium trichogynum*, and *Galium parisiense*.

Our study expands knowledge on distribution area of *Asphodelus microcarpus* dominated communities which were up to date researched mainly in Western and Central Mediterranean. In Eastern Adriatic similar vegetation was described from neighbouring Albania and Croatia but found on limestone stony grasslands, ruderalized or even under influence of salt spray.

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## Programme

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**Monday, 2 September 2019**

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18:00-20:00 **Registration and Welcome drink**

**Facultad de Farmacia (New Pharmacy Building)**

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**Tuesday, 3 September 2019**

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8:00-9:00 **Registration**

9:00-9:15 **Opening Ceremony**

9:15-10:00 **Keynote Lecture: Adrián Escudero (Rey Juan Carlos University, Móstoles).**

*Linking above and below ground plant community responses: a melting pot of interactions and soil heterogeneity*

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**Session 1. Sand-Dune and Halophilous Vegetation**

*Chair: Iva Apostolova*

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10:00-10:15 **Through the lens of time: experiences from a resurveying study of coastal dune ecosystems in Central Italy**

*Sperandii MG, Barták V & Acosta ATR*

10:15-10:30 **Conservation status assessment of dune habitats in two contrasting Natura 2000 sites**

*Argagnon O, Sirvent L & Treil V*

10:30-10:45 **Synthetic overview of sandy vegetation of the Pannonian and western Pontic region**

*Ćuk M, Botta-Dukát Z, Csecserits A, Chytrý M, Franjić J, Igić R, Ilić M, Janišová M, Kuzemko A, Rédei T, Škvorec Ž, Tzonev R, Vukov D, Willner W, Čarni A*

10:45-11:00 **Syntaxonomical approach on the fruticose halophytic vegetation of Western European territories**

*Sánchez-Mata D, Ramírez E, Rufo L, Sánchez-Gavilán I & de la Fuente V*

11:00-11:30 **Coffee/Tea break**

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**Session 2. High-Mountain Vegetation**

*Chair: Milan Chytrý*

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11:30-11:45 **Disentangling observer error and climate change effects in long-term monitoring of alpine plant species composition and abundance**

*Winkler M, Futschik A, Steinbauer K, Lamprecht A, Rumpf S, Barančok P, Palaj A, Gottfried M & Pauli H*

11:45-12:00 **Biogeography of alpine plant communities in southern Europe**

*Jiménez-Alfaro B, Abdulhak S, Bergamini A, Carranza ML, Čušterevska R, Font X, Giusso del Galdo G, Kuzmanović N, Marcenò C, Milanović D, Ruprecht E, Šibík J, Stanisci A, Vassilev K, Willner W and EUROALP Consortium*

12:00-12:15 **Coenological and syntaxonomical features of relic populations of two *Salix* species in the high-altitude sector of the Apennines**

*Di Pietro R*

12:15-12:30 **Fine-scale patterns of mountain tundra vegetation**

*Czóbel Sz, Maglódi G, Baltazár T, Rusvai K & Szirmai O*

12:30-12:45 **Counteracting summer drought: Osmolyte accumulation in orophytes from Mediterranean high-mountain communities**

*Magaña Ugarte R, Escudero A & Gavilán RG*

12:45-13:00 **Analysis of global diversity patterns of alpine vegetation**

*Testolin R, Attorre F & Jiménez-Alfaro B*

13:00-13:15 **Ozone risk assessment for Mediterranean high mountain grasslands at the Guadarrama mountain range**

*Elvira S, González-Fernández I, Bermejo-Bermejo V, Sanz J, García-Gómez H, Rabago I, Alonso R*

13:15-14:30 **Lunch**

14:30-15:45 **Poster Session I**

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**Session 3. Assessment and Conservation of European Habitats I**

*Chair: Mirjana Ćuk*

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15:45-16:00 **Threatened and endemic species associated with habitat types in Europe - overview**

*Hobohm C, Beierkuhnlein C, Moro-Richter M*

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16:00-16:15 **First overview on the 4th Annex I Habitats Report in Italy: methods, criticality, results and future prospects**

*Gigante D, SBI-4RH & Angelini P*

16:15-16:30 **Monitoring and status of Natura 2000 habitats in Flanders, Belgium**

*Paelinckx D, Westra T, Oosterlynck P, Lommelen E & De Bie E*

16:30-17:00 **Coffee/Tea break**

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#### **Session 4. Assessment and Conservation of European Habitats II**

*Chair: Daniel Sánchez-Mata*

17:00-17:15 **Habitat identification by satellite images**

*Šibík J, Mikula K, Jarolímek I, Kollár M, Podroužková-Medvecká J, Škodová I, Urban J & Šibíková, M*

17:15-17:30 **Challenges in classification of mosaic vegetation and implications to ecosystem change studies in northern mires**

*Tahvanainen T & Kolari T*

17:30-17:45 **Establishing Natura 2000 in Albania: state of the art and future perspectives**

*Mahmutaj E, De Sanctis M, Fanelli G, Hoda P, Mullaj A, Mesiti A, Meço M, Kashta L, Gjeta E, Shuka L, Cambria V, Buffi F & Attorre F*

17:45-18:00 **Biotope as a syntaxa complex**

*Didukh Ya., Kuzemko A.*

18:00-18:15 **Discovering missing parts in an island ecosystem**

*García-Cervigón AI, Sangüesa-Barreda G, García-Hidalgo M, Rozas V, Martín-Esquivel JL & Olano JM*

18:15-18:30 **Syntaxonomical diversity of Strazhata hill in the central part of north Bulgaria**

*Nazarov M, Vassilev K, Gecheva G, Mardari C & Velev N*

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**Wednesday, 4 September 2019**

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9:00-9:45 **Keynote Lecture: Alessandro Chiarucci (University of Bologna)**

*A sampling approach for habitat monitoring at national scale*

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#### **Session 5. Vegetation Patterns in the Palearctic**

*Chair: Manuela Winkler*

9:45-10:00 **Phytosociological alliances of zonal boreal forests in Northern Europe**

*Jašková A, Chytrý M & Data Contributors*

10:00-10:15 **The temperate deciduous forests of Europe and western Asia: a survey on their biogeography and diversity**

*Loidi J, Marcenò C, Campos JA, Chytrý M, Gholizadeh H, Jiménez-Alfaro B, Knollová I, Naqinezhad A, Novák P, Nowak A, Petřík P & Data Contributors*

10:15-10:30 **Oak-hornbeam forests from the European perspective – Currently recognized alliances, a faithful mirror of their floristic variability?**

*Novák P & Data Contributors*

10:30-10:45 **Benchmarking plant diversity of Palearctic grasslands**

*Biurrun I, Dengler J, Burrascano S, Dembicz I, García-Mijangos I, Guarino R, Kapfer J, Pielech R, Soliveres S, Steinbauer MJ & GrassPlot Consortium*

10:45-11:00 **European annual weed vegetation: first results of numerical classifications**

*Küzmič F, Šilc U, Lososová Z, Mucina L & Data Contributors*

11:00-11:30 **Coffee/Tea break**

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#### **Session 6. Methods and Databases for Vegetation Studies**

*Chair: John Rodwell*

11:30-11:45 **Probabilistic key for identifying vegetation types in the field: a new method and Android application**

*Tichý L & Chytrý M*

11:45-12:00 **Using model-based classification in the phytosociology: possible solutions and examples of application**

*Botta-Dukát Z*

12:00-12:15 **Pladias.cz: an online database of the Czech flora and vegetation**

*Chytrý M, Danihelka J, Kaplan Z, Lepš J, Wild J, Holubová D, Novotný P, Řezníčková M, Rohn M, Grulich V, Klimešová J, Lososová Z, Pergl J, Sádlo J, Šmarda P, Bartušková A, Blažek P, Chrtek Jr. J, Dřevojan P, Fischer FM, Guo W-Y, Herben T, Konečná M, Kühn I, Moravcová L, Petřík P, Pierce S, Prokešová H, Štěpánková P, Štech M, Těšitel J, Těšitelová T, Tichý L, Večeřa M, Zelený D & Pyšek P*

12:15-12:30 **Using the beta distribution to analyse plant cover data**

*Damgaard C*

12:30-12:45 **Modelling vegetation composition and plant richness across spatial scales and environmental gradients in Central Apennines Mountains**

*Di Musciano M, Theurillat JP, Guisan A, Bronnimann O, Cutini M, Iocchi M, Frattaroli AR*

12:45-13:00 **VigLib, using Python in vegetation data analysis**

*Hatim MZ*

13:00-13:15 **An Expert System for Dutch plant communities**

*Janssen JAM, Schaminée JHJ, Hennekens SM, Tichý L, Chytrý M*

13:15-14.30 **Lunch**

14:30-15.45 **Poster session II**

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### Session 7. Mediterranean and Thermophilous Forests

*Chair: Idoia Biurrun*

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15:45-16:00 **Preliminary results from the classification of the thermophilous oak forests in Bulgaria**

*Tzonev R, Dimitrov M, Gushev Ch, Pachedjieva K, Gogushev G, Apostolova-Stoyanova N, Nikolov I, Aleksandrova A & Glogov, P*

16:00-16:15 **Native forest dominance patterns in the Iberian Peninsula**

*Monteiro-Henriques T, Cerdeira JO, Cabeza M, Aguiar C & Fernandes PM*

16:15-16:30 **Mediterranean and Submediterranean pine forests: Approaching the end of a classification tale**

*Bonari G, Coban S, Font Castell X, Agrillo E, Bergmeier E, Acosta ATR, Angiolini C, Didukh YP, Xystrakis F, Sağlam C & Chytrý M*

16:30-16:45 **Thermophilous forest fringe vegetation in Ukraine: a review of syntaxa and habitat types**

*Iakushenko D*

16:45-17:15 **Coffee/Tea break**

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### Session 8. Mediterranean, Temperate and Boreal Forests

*Chair: Rossen Tzonev*

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17:15-17:30 **Vegetation diversity of Mediterranean woodlands in Turkey**

*Kavgacı A, Balpınar N, Öner HH, Arslan M & Carni A*

17:30-17:45 **Are Italian laurophylls in equilibrium with climate? From their Quaternary refugia to the potential area of spread**

*Alessi N, Těšitel J, Zerbe S, Spada F, Agrillo E & Wellstein C*

17:45-18:00 **The forest vegetation of the middle boreal subzone high-rank syntaxonomic units review in Middle Siberia**

*Krivobokov L, Mukhortova L*

18:00-18:15 **Calcicolous rock-outcrop lime forests in the eastern part of Central Europe**

*Zukal D, Novák P, Duchoň M & Chytrý M*

18:15-18:30 **Floristic and coenotic diversity of Vyatka-Kama biome**

*Kadetov N*

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Thursday, 5 September 2019

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9:00-9:45 **Keynote Lecture: María Pilar Rodríguez-Rojo (Castilla-La Mancha University)**

*Singularity of Iberian Mediterranean grasslands in the European context*

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**Session 9. Wetlands, Riparian and Aquatic Vegetation**

*Chair: Daniela Gigante*

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9:45-10:00 **Reinforce of the network of riparian vegetation group and disseminate the current results done under COST CONVERGES**

*Mandžukovski D, Dufour, S, González del Tanago M, Čarni A, Douda J, Vassilev K, Sibikova M, Stupar V, Čušterevska R, Slezák M, Stešević D, Škvorc Ž, Kavgaci A, Šibik J, Jasprica N*

10:00-10:15 **The MedIsWet project in Sicily and Sardinia. An opportunity for improving wetland knowledge and conservation. Preliminary results**

*Marcenò C, Minissale P, Sciandrello S, Cuena-Lombraña A, Fois M & Bacchetta G*

10:15-10:30 **How to sample water-dependent protected plant species in a standardized way to be taken into account in the hydrological planning processes? Insights from Spain**

*Cortés FM, Magdaleno F, López-Piñeiro T, Viu M & Vallejo N*

10:30-10:45 **Calcareous fen succession in Engure Lake Nature Park in Latvia**

*Pakalne M, Priede A*

10:45-11:00 **Classification of *Schoenus ferrugineus* L. communities from eastern Baltic to the Southern Ural**

*Auniņa L, Ivchenko T, Rašomavičius V, Smagin V & Truus L*

11:00-11:30 **Coffee/Tea break**

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**Session 10. Vegetation Dynamics and Succession in Different Habitats I**

*Chair: Borja Jiménez-Alfaro*

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11:30-11:45 **Disturbance impacts in temperate forests are increasing: 10 years of monitoring understory vegetation in Slovenia**

*Kutnar L & Nagel TA*

11:45-12:00 **Aizjoms – ancient extensive agriculture land “behind beach” in old fishermen villages along SW coast in Latvia**

*Rove I*

12:00-12:15 **Study of vegetation on recent lava flows in the Güimar Valley, Tenerife, Canary Islands**

*Martín Osorio VE, González Negrín R, Wildpret de la Torre W & Wildpret Martín WH*

12:15-12:30 **Using conjointly species abundance in plots and phylogeny to approach vegetation classification. A case-study on Macaronesia’s woody vegetation**

*Capelo J*

12:30-12:45 **Facilitation by nurse plant *Juniperus communis* subsp. *hemisphaerica* and its role on natural regeneration of cedar forest on the southern slope of Djurdjura (Algeria)**

*Meddour R, Sahar O, Bitam L & Belhacene D*

12:45-13:00 **Investigation of the weed infection of baits in the Mátra Landscape Protection Area**

*Rusvai K, Baltazár T, Czóbel Sz*

13:00-13:15 **Vegetation succession within the last 16 years in a limestone quarry in central Spain.**

*Isabel J, Sardinero S & Fernández-González F*

13:15-14:30 **Lunch**

14:30-15:15 **Poster Session III**

15:15-15:45 **EVS Business Meeting**

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**Session 11. Vegetation Dynamics and Succession in Different Habitats II**

*Chair: Anna Kuzemko*

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15:45-16:00 **Remote sensing techniques for investigation of plant communities’ syntaxonomy: two cases from Russia**

*Komarova, A, Cherednichenko, O, Borodulina, V, Gavrilova, T, Zudkin, A*

16:00-16:15 **Phenological trends in plant communities dominated by grasses in Mediterranean areas**

*Rojo J, Romero-Morte J, Lara B, Fernández-González F & Pérez-Badía R*

16:15-16:30 **Hydrochemical and vegetation trends and dynamics across the poor-rich gradient in a boreal aapa mire over 20 years**

*Kolari T, Korpelainen P, Sallinen A, Kuzmin A, Kumpula T & Tahvanainen T*

16:30-17:00 **Coffee/Tea break**

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**Session 12. Vegetation Dynamics and Succession in Different Habitats III**

*Chair: Fabio Attorre*

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**17:00-17:15 Succession in soil and plant-community attributes along a chronosequence of abandonment vineyards**

*Diéguez A, Quintanar JR, Molina JA & Valverde I*

**17:15-17:30 Increased drought and high maximum temperatures alter recruitment patterns in Mediterranean forests: Linking climate, canopy cover and seedling survival in three co-occurring tree species**

*de-Dios-García J, Pardos M, Madrigal G, Garriga E, Conde M, Kobe R, Calama R*

**17:30-17:45 Biotic and abiotic conditions and vegetation diversity during spontaneous succession on postindustrial sites – the info-geographical approach**

*Woźniak G, Chmura D, Malicka M, Magurno F & Galka R*

**17:45-18:30 Closing Ceremony**

**20:00-23.30 Social Dinner**