FRITSCHIANA

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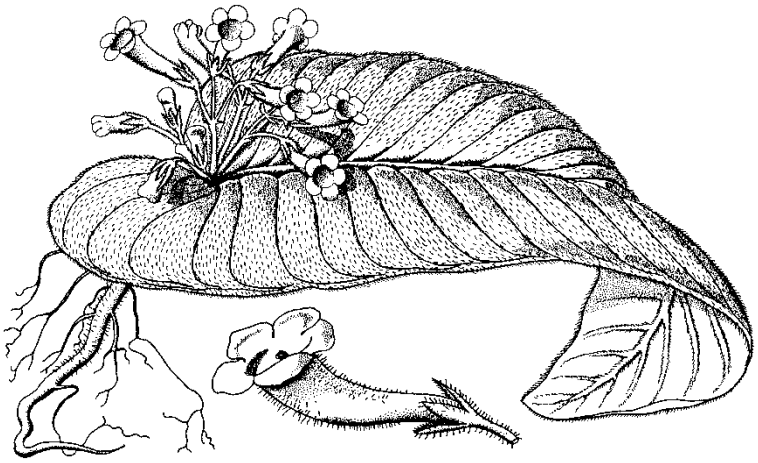

Veröffentlichungen aus dem
Institut für Biologie, Bereich Pflanzenwissenschaften
der Karl-Franzens-Universität Graz

Martin MAGNES (editor)

16th Eurasian Grassland Conference (EGC)
(29 May – 5 June 2019)

Species-rich grasslands in the Palaearctic – a treasure without economic value?

(Program and Abstracts)

Graz, 23. Mai 2019

Hofrat Prof. Dr. Karl FRITSCH

(∗ 24.2.1864 in Wien, † 17.1.1934 in Graz)

Karl FRITSCH studierte nach einem Jahr in Innsbruck an der Universität Wien Botanik und wurde dort 1886 zum Dr.phil. promoviert; 1890 habilitierte er sich. Nach Anstellungen in Wien wurde FRITSCH 1900 als Professor für Systematische Botanik an die Universität Graz berufen, wo er aus bescheidenen Anfängen ein Institut aufbaute. 1910 wurde er Direktor des Botanischen Gartens, 1916 wurde das neu errichtete Institutsgebäude bezogen. Aus der sehr breiten wissenschaftlichen Tätigkeit sind vor allem drei Schwerpunkte hervorzuheben: Floristisch-systematische Studien, besonders zur Flora von Österreich, monographische Arbeiten (besonders über *Gesneriaceae*) und Arbeiten zur systematischen Stellung und Gliederung der Monocotylen. An Kryptogamen interessierten ihn besonders Pilze und Myxomyceten.

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Graz, November 1997 Herwig TEPPNER

Die Serie FRITSCHIANA wurde als Publikationsorgan für die zahlreichen Aktivitäten im Zusammenhang mit der botanischen Sammlung des Institutes für Biologie (vormals Institut für Pflanzenwissenschaften bzw. Institut für Botanik) der Karl-Franzens-Universität Graz (GZU) gegründet. Vor allem Schedae-Hefte der von den Mitarbeitern herausgegebenen Exsiccatenwerke sollten hier erscheinen, aber auch Exkursionsberichte sowie Listen und Indices besonders wertvoller Bestände in GZU. Das Spektrum wurde mittlerweile auf floristische und kleinere taxonomische Arbeiten (zwischenzeitlich auch auf das Samentauschverzeichnis des Botanischen Gartens) ausgeweitet. Die Schedae-Hefte des von Prof. Dr. Josef POELT begründeten, inzwischen abgeschlossenen Exsiccatenwerkes Plantae Graecenses sind die Vorläufer dieser Schriftenreihe.

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Graz, 23. Mai 2019

University of Graz, Institute of Biology, Department of Plant Sciences and
University of Maribor, Department of Biology

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Scientific Committee

Coordinators of the 'Eurasian Grassland Conference' (EGC) / 'Eurasian Dry Grassland Group' (EDGG) Executive Committee

Local Organizing Committee

Conference venue

Institute of Biology, Department of Plant Sciences, University of Graz, Holteigasse 6, 8063 Graz, Austria

Editor

Martin Magnes, Institute of Biology, Department of Plant Sciences, University of Graz, martin.magnes@uni-graz.at

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17:00–21:00 Registration, welcome reception in the foyer of the greenhouses of the Botanical Garden, Schubertstraße 59

Thursday (30 May 2019): Botanical Garden of the University of Graz

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09:15–09:45 Opening ceremony (HS 31.11, Schubertstraße 51, 2nd floor)

09:45–10:45 Keynote lecture (**Zsolt Molnár**)

10:45–11:05 *Coffee break, foyer of the greenhouses*

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05.06.2019 (12:30) Arrival at the Botanical Garden UNI-Graz

16th Eurasian Grassland Conference in Austria and Slovenia, program

YIP: Nominated for the Young Investigator Price

Wednesday, 29. May 2019: Botanical Garden UNI-Graz

12:00–17:00. Natura 2000 network, UR 31.02 ('seminar room'), Schubertstraße 51, 1st floor.

17:00–21:00. Registration, welcome reception in the foyer of the greenhouses of the Botanical Garden, Schubertstraße 59, also possibility to mount the posters in the foyer of the building Schubertstraße 51, 1st floor.

Thursday, 30. May 2019: Botanical Garden UNI-Graz

08:00–09:00. Registration (foyer of the greenhouses of the Botanical Garden, Schuberstraße 59), possibility to mount the posters in the foyer of the building Schubertstraße 51, 1st floor.

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[chair: Gerhard Karrer]
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11:30–11:50. **(YIP) Magdalena Witzmann**, Maik Pressnitz, Monika Janišová & Martin Magnes: Biodiversity in pastures of the "Haymilk" region Neumarkt in der Steiermark.

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[chair: Bela Tóthmérész]

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16:40–17:00. Coffee break

17:00–17:55. Poster session 1, 3, 4: Foyer of the building Schubertstraße 51, 1st floor (authors can present and comment their posters for five minutes each)

18:00–21:00. Scientific writing workshop led by Jürgen DENGLER (HS 31.11, Schubertstraße 51, 2nd floor)

Friday, 31 May 2019: Botanical Garden UNI-Graz

08:00–09:00. KEYNOTE LECTURE. **Matej Vidrih:** Sustainable pasture management in Slovenia: balancing productivity and biodiversity (HS 31.11, Schubertstraße 51, 2nd floor).

09:15–18:30. Mid-conference excursion to Neumarkt in der Steiermark. Departure: Holteigasse (north-border of the Botanical Garden)

09:15–15:15. Bryophytes in Central European Grasslands. Excursion course led by Christian Berg to different places around the village Semriach. Departure: Holteigasse (north-border of the Botanical Garden)

19:00–22:30. Grassland party in the greenhouses of the Botanical Garden

Saturday, 1. June 2019: Botanical Garden UNI-Graz
HS 31.11, Schubertraße 51, 2nd floor

09:00–10:00. KEYNOTE LECTURE. **Wolfgang Willner:** Semi-dry grasslands of Central and Eastern Europe - syntaxonomic and biogeographical aspects.

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[chair: **Didem Ambarlı**]

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12:00–12:20. Philipp Sengl, Oliver Gebhardt & **Patrick Schwager**: Habitat suitability models help in pre-selecting the most promising sites for compensation and restoration measures.

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[chair: **Monika Janišová**]

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14:00–14:20: **Balázs Deák**, Orsolya Valkó, Dávid Nagy D., Péter Török, Attila Torma, Gábor Lőrinczi, András Kelemen, Szabolcs Mizse, Antal Nagy, Ádám Bede, András István Csathó & Béla Tóthmérész: Kurgans as refuges for grassland species: large-scale multi-taxon study on Eurasian burial mounds.

14:20–14:40. **(YIP) Laura Godó**, Orsolya Valkó, Béla Tóthmérész, Katalin Tóth, Réka Kiss, Szilvia Radócz, András Kelemen, Péter Török, Eva Švamberková & Balázs Deák: The red fox as an ecosystem engineer: Effect of fox burrows on the grassland vegetation of kurgans.

14:40–15:00. **(YIP) Natalija Špur**, Andrej Šorgo & Sonja Škornik: Insight into Public Attitudes towards Preserving Species-rich Grasslands

15:00–15:20. **(YIP) Peter Kozel**, Tone Novak, Natalija Turičnik Kleč, Franc Janžekovič, Sonja Škornik & Nataša Pipenbaher: Niche partitioning among morphotypes of *Phalangium opilio* (Opiliones, Phalangiidae) during the day rest in a montane pasture.

15:20–15:40. **(YIP) Orsolya Valkó,** Katalin Lukács, Balázs Deák, Réka Kiss, Katalin Tóth, Laura Godó, Tamás Miglécz, Judit Sonkoly, Szilvia Radócz, András Kelemen & Béla Tóthmérész: A new aspect of the dispersal of alien plants in grasslands - Human-dispersed seeds can survive and disperse after the laundry cycle.

15:40–16:00. Coffee break

16:00–17:10. Poster session 2: Foyer of the building Schubertstraße 51, 1st floor (authors can present and comment their posters for five minutes each)

17:10–17:30. Coffee break

17:30–19:00. EDGG General Assembly, closing ceremony of the conference part

19:00–22:00. Evening mixer in the foyer of the greenhouses of the Botanical Garden

Sunday, 2nd June to Wednesday, 5th June 2019
Post-Conference Excursion to Slovenia

Sunday, 2nd June, 08:00. Bus departure from Holteigasse, Graz (northern border of the Botanical Garden UNI-Graz)

Wednesday, 5th June, 12:00. Bus arrival at Graz airport

Wednesday, 5th June, 12:30. Bus arrival at the Botanical Garden UNI-Graz, Holteigasse 6

Climatic and land-use drivers of multiple animal-mediated ecosystem processes in grasslands

*Didem Ambarlı[1,2], Nadja K. Simons[1,3], Katja Wehner[3], Wiebke Kämper[3,4], Thomas Nauss[5], Sebastian Seibold[1,6], Wolfgang Weisser[1] & Nico Blüthgen[3]

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session 4, **talk**

Question: Global change impacts on biodiversity are likely to translate into reduced ecosystem functioning. However, we have limited information about the effects of global change drivers on the rates of animal-mediated processes human-modified habitats. Therefore we questioned the effects of climatic conditions and land-use intensity on dung removal, seed removal, predation and herbivory in semi-natural grasslands.

Methods: We measured process rates in 134 plots in three regions of Germany: the UNESCO Biosphere Reserve Schorfheide-Chorin (SCH), the National Park Hainich and UNESCO Biosphere Reserve Schwäbische Alb. To measure dung removal, seed removal and predation, we set up five regularly placed circular subplots in June 2017 (2 m in diameter) and placed baits: fresh cattle dung, non-viable sunflower seeds and dummy caterpillars, respectively. After 48 h, we re-collected the baits and measured amount of removal for dung and seed but attack marks on caterpillars. We measured herbivory as percent damage of the leaf area from biomass samples taken in May 2017. We tested the effects of short- and medium-term climate and land-use intensity, which are two major actors of global change, by using generalized linear mixed models.

Results: We found significant regional differences: higher dung removal, seed removal and herbivory but lower predation rates in SCH. Within-plot variation of rates were high (40-180%) and were correlated with the land-use intensity. Climatic factors had stronger effects on the rates compared to land use intensity except predation. Temperature during the survey period had negative effects on herbivory. Minimum temperatures of the pervious winter had positive effects on other processes. Intensities of grazing and mowing activities weeks before the surveys had negative effects on predation but fertilization and grazing intensity in previous two years had positive effects.

Conclusions: Two drivers of global change had significant impacts on the rates of animal-mediated ecosystem processes. None of the short- or medium-term climatic or land-use drivers had consistent positive or negative effects across processes; hence responses of processes were highly idiosyncratic. This also brings the difficulty that there is no single optimal management that promotes all processes, and no single process can be used as an indicator for other processes.

The work has been funded by the Deutsche Forschungsgemeinschaft (DFG) Priority Program 1374 "Infrastructure-Biodiversity-Exploratories" (DFG-WE 3081/21-1.)

Gradual Utilization of managed semi-natural grassland to preserve biodiversity – a case study from Upper Styria

Wolfgang Angeringer

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session 1, talk

Question: Is gradual utilization of managed grasslands appropriate for both preserving biodiversity as well as providing an adequate economic value on a farm scale level?

Methods: The case study was established on a pilot farm in the Upper Styrian Pöls valley. Site conditions: 950 m a.s.l.; 230° SW/25 % inclination; 5,8 °C annual mean temperature; 1000 mm mean annual precipitation, Cambisol on crystalline bedrock, sandy loam; pH 5,3 to 5,8.

Two associations from traditional managed hay meadows, Cardaminopsido-Trisetetum and Alchemillo-Arrhenatheretum, set up as initial point for an intensification experiment. The triannual study tested the influence of cutting regime and type of organic fertilizer on composition of higher plants. Experimental design: incomplete block, six treatments with 10 replicates á 4m² plots, treatment combination of cutting regime (2, 3, 4 cuts/y.) and slurry/solid manure.

Results: The meadows of the pilot farm is managed by gradual utilization: appropriate sites are utilized more intensively, whereas others are managed in the traditional way, depending on inclination and soil conditions. This means an increased time and financial effort for the farmer, both limiting factors in agriculture today. On the other hand, as the results from the case study experiment shows, the plant communities react immediately to management intensification. Especially the quality of the plant composition in terms of valuable fodder species declines rapidly. The main fodder grass *Trisetum flavescens*, declines in abundance even after one year of intensification in cutting regime. On the other side, less valuable species as *Poa trivialis* gained abundance. Therefore, intensively managed meadows has to be sown regularly with suitable cultivars that fit to the higher utilization intensity, replacing the autochthonous species. Overall, 71 taxa of higher plants are found at the experiment site, on average 22 taxa/4 m². This contributes to about 30% of the species pool at the pilot farms grassland (223 taxa/10 ha).

Conclusions: Management intensification in terms of cutting regime and fertilization lead to a short-term degradation of species composition of traditional semi-natural hay-meadows. Grassland farmers can maintain their traditionally used species rich hay meadows with the method of gradual utilization. Therefore, they need an incentive for managing different stages of usage at the farm, to keep the economic as well as the ecological value of this stands.

(YIP) Citizen science as a tool for conserving grasslands on sacred natural sites – the main goals of the Eurasian Kurgan Database

Balázs Deák[1], Csaba Albert Tóth[2], Ádám Bede[3], Iva Apostolova[4], Miklós Bán[5] & ***Ferenc Báthori[6]**

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[2] Department of Physical Geography and Geoinformation Systems - University of Debrecen
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session 2, poster

Question: Eurasian steppes have an essential role in conserving biodiversity confined to open habitats. However, due to the huge worldwide habitat loss, they are preserved only in small refuges. Such refuges are the ancient steppic burial mounds (‘kurgans’) which have a high cultural and historical importance and are also essential sites of nature conservation. Kurgans often harbor grassland islands in transformed landscapes and contribute to landscape-scale biodiversity even in the pristine steppes. The Eurasian Kurgan Database aims to fill an existing information gap by collecting information and providing a public repository of basic kurgan data that can be used by a wide range of end-users. To fill the huge knowledge gap regarding the kurgans involvement of local communities also seems to be a vital option.

Methods: Considering the need for a long-term sustainable database, we have chosen a dynamically developed open source database framework. OpenBioMaps provides interfaces for uploading and accessing data. Our database has been placed on a freely usable, long-term database repository that is shared by several institutions as an OpenBioMaps partner.

Results: We built a public database which allows to record and query basic information on their cultural values and factors that might serve as a basis for effective conservation of the kurgans (such as land cover type, threatening factors, cover of woody species). The database (http://openbiomaps.org/ projects/kurgan) provides possibility to collect two types (*basic data form* and *complex data form*) of data regarding the kurgans. The two levels differ in the complexity of the data provided. The attributes to collect were selected considering that data providers are not necessarily professional biologists or geographers; thus only such data is collected which can be recognized or estimated without any previous professional training.

Conclusion: The database provides a transparent, public and easy-to-use source for conservation managers and landscape planners focussed on grassland conservation. In addition, it also provides background information for other associate disciplines and public agencies dealing with the protection of cultural heritage.

(YIP) Germination properties affect colonization success of semi-dry grassland species

***Lisa Bernhard**[1], Christian Berg[1] & Philipp Sengl[2]

[1] Institute of Biology, Division of Plant Science, University of Graz, Austria
[2] Engineering Office for Biology Dr. Philipp Sengl, Marktstraße 21, 8354 Sankt Anna am Aigen, Austria

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session 2, poster

Question: To extend the amount of species-rich semi-dry grasslands in the region South-East Styria, spontaneous colonization was applied as a passive restoration method in St. Anna am Aigen (Styria, Austria). Since studies on the relationship between germination behavior and colonization success are still rare, we investigated the germination behavior of semi-dry grassland species and examined linkages between colonization success and germination properties (i.e. germination percentage and rate) of the tested species. Further, we studied if germination activity and colonization success are controlled by the 1000-seed weight of semi-dry grassland species.

Methods: We collected diaspores of several semi-dry grassland species and performed germination tests under controlled conditions. In order to determine the colonization success for each tested species, we collected vegetation data in the study area. For the statistical analysis of the data, we used MannWhitney-U and correlation tests.

Results: We found out, that colonization success of species during passive restoration is controlled by germination behavior. Species with high germination activities were more successful in colonizing the restoration site than species with low germination activities. Indeed, we found no relationship between germination activity or colonization success and the 1000-seed weight of the tested species.

Conclusions: In summary, germination behavior of semi-dry grassland species can be seen as a part of a network of impact factors, which altogether determine the outcome of the passive restoration process in the study area.

Long-term changes of Natura 2000 grasslands and effects of nature protection

***Marianna Biró**, János Bölöni & Zsolt Molnár

MTA Centre for Ecological Research, GINOP Sustainable Ecosystems Group, 8237 Tihany, Klebelsberg Kuno u. 3., Hungary

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session 2, talk

Question: An increasing number of studies document long-term changes of land-cover types but only few time-series are available for changes of finer-level habitat types. Habitat specific data could help to increase effectiveness of conservation of grasslands and communicate endangerement to policy makers and the public.

Methods: For identification of past habitat types a point-based method was developed using iterative habitat identification and information transfer between historical and recent sources. We used different sources as historical maps, archival and recent aerial photos and satellite imagery, botanical descriptions, recent thematic layers and field data. ArcGIS10.1.ESRI software was used for managing the database. We analysed changes of grassland types since the 18th century (7 time periods, 5000 randomly selected localities in Hungary) and the impact of protected areas on habitat loss.

Results: Almost all Natura 2000 grassland types decreased in extent during the studied 230-year period meanwhile secondary habitats were increasing. Semi-natural grasslands like alluvial meadows of river valleys (6440), *Molinia* meadows (6410) and also zonal Pannonian loess and sand steppe grasslands (6250*, 6260*) lost more than 90% of their area since 1783. According to the IUCN Red List threshold values, these grasslands were classified as critically endangered when calculated with long-term data (the IUCN threshold for critically endangered status since approximately 1750 is loss of habitats >90% in this period). In case of Lowland hay meadows (6510) and semi-natural dry grasslands (6210) trends in area loss are also around 89-90% in the studied period thus they almost reached the IUCN threshold for endangered status (the IUCN Red List threshold value for Endangered Status for 250 years is 70% loss). However, our analysis also showed that nature conservation had a measurable effect on habitat loss in the end of the 20th century: habitat loss ceased, but only in areas under national protection.

Conclusions: The method we developed could help to understand recent changes and processes related to grasslands and to interpret and recognize targets in habitat conservation and management especially in case of priority habitats of the European Union (Natura 2000). The research was supported by the project “Sustainable Conservation on Hungarian Natura 2000 Sites” within the framework of the Swiss Contribution Program (SH/4/8) and the GINOP-2.3.2-15-2016-00019 project.

Vegetation as bioindicator of waste-filled dolines in karst landscape

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session: 4, talk

Introduction: Mismanagement practices, such as unsustainable waste disposal, caused many misused sites. In karst landscapes, old uncontrolled landfills are often located in dolines (sinkholes). Buried waste material in dolines represents degradation of landform, habitats and a potential danger of groundwater pollution. Buried waste provides heterogeneous ecological conditions on the surface, thus plant communities or individual plant species that developed on the surface of landfills can be used as a bioindicators of waste-filled doline sites and therefore indicator of land degradation.

Question: We aimed to discover the potential of vegetation to detect unknown locations of old dump-sites in suffusion dolines in Logaško polje (Dinaric Karst, Slovenia), either by plant communities or by plant species. We aimed to ascertain whether vegetation can indicate the dumping period by afiliating actual plant communities to types along the potential successional trajectory.

Methods: Locations and the age of waste-filled dolines (doline-dumps) were preliminary identified by a historical landscape study. Thus, we used time series of aerial photographs and digital photogrammetry tools for 3D modelling of historical terrain. Ecological evaluation was based on sampling the floristic composition of plots (5x5 m). We estimated actual ecological conditions by Ellenberg indicator values and analysed vegetation structure by life history traits as well as naturalness by hemerobic levels of plants. We studied in detail 30 waste-filled dolines that differ in age up to 50 years and are interspersed by dry and mesic grasslands.

Results: Ecological evaluation demonstrated that the main driver of ecological diversity at doline-dumps is the starting date of succession after the dolines were backfilled. Communities formed by annuals and nitrophytes dominate the youngest doline-dumps, middle aged doline-dumps are covered by nitrophilous perennial forbs and, finally, oldest communities developed towards mesic grassland.

Conclusion: We conclude that plant communities in combination with diagnostic plant species can be used as a bioindicators of doline-dumps in agricultural landscape of karst polje and can therefore indicate the sites of potential groundwater pollution sources but not the type of long-time buried waste.

Preserving plant biodiversity by implementing the economic sustainability of mountain farming in sub-Mediterranean dry grasslands

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session 1, talk

Question: Sub-Mediterranean dry grasslands are threatened by multiple socio-economic and environmental constraints, not least the global warming. The research is part of the CLIMAPP project, funded by the University Research funds (FAR 2014/2015), whose main aim was to deepen our knowledge on how to counter such threats using a multidisciplinary approach. The specific aims were to understand the drivers and mechanisms behind the species assemblage modification and to test adaptive management techniques to ensure a high level of animal welfare and food quality.

Methods: We analysed the dry grasslands functional variation under different stressors, disturbance intensities and environmental gradients, to build predictive models of grasslands modifications. In an experimental farming system, we analysed the interplay between sheep welfare and forage, and compared milk/cheese chemical composition under different management conditions. Produced cheeses were submitted to sensory and consumer tests; a hypothetical choice experiment was performed to evaluate the consumer willingness to pay.

Results: We found that increasing summer aridity leads to a shift from acquisitive to retentive traits and to regeneration strategies enabling plants to cope with the unpredictability of climate variability. Productive grasslands were the most negatively influenced by increasing summer drought. Reduction of disturbance fosters the spread of dominant tall grasses leading to decreased nutrient value of pastures and a loss of plant diversity. Worsening of forage features caused the increase of rumen keratinization degree and a decline of sheep welfare. The experimented adaptive management techniques proved to foster the production quality. Milk and cheese showed an increase of poly-unsaturated fatty acids and Vitamin A and E. These features reflected in the cheese taste and consumer appreciation, which in turn led to the theoretical availability of the 56% of consumers to pay the 47% more than the current market price for the cheese.

Conclusions: Proper management practices proved to be a key tool in maintaining grasslands ecosystem services and to increase the quality of productions and satisfy customers' demand, respecting the animal welfare and reducing the risks of mountain farming abandonment by increasing the farm incomes.

Ecosystem services assessment in the Slovak Republic

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session 2, poster

Question: Evaluation of selected ecosystem services (ES) at national level using complex data on nature protection, forestry, agriculture. The evaluation include the identification of habitat types (EUNIS classification), their spatial representation, estimation of the extent of ES provided by habitat type and their identification in the field, followed by the monetary expression of the value of ecosystem services provided.

Methods:

1. Preparing a detailed map of habitat types in EUNIS classification
2. Assign ecosystem services to individual ecosystem types and determine the quality of ES provided by ecosystem types based on size and borders of habitat types (realworld unit)
3. Partial evaluation of conservation status of habitat types in relation to the quality of provided ES
4. Valuation of l ES based on the prepared map of the ecosystems and assessment of conservation status of habitats

Results: The authors have prepared a pilot nationwide assessment of ES in Slovakia using detailed data from different areas, including a detailed map, monetary assessment for ES as well as summaries and statistics for those areas at national level. The basis was the preparation of a detailed map of ecosystems - more than 1,000,000 polygons associated with habitat types with an average area of 4.9 hectares. The assessment also included the assessment of the conservation status of ecosystems at national level. In Slovakia, 114 ecosystems were identified (all categories present in Slovakia included) in 7 different levels of EUNIS categorization and 23 ES valued.

Conclusion: In summary, identification of ecosystems of Slovakia based on habitat types, their spatial allocation and the subsequent assignment of ecosystem services to individual ecosystems were prepared. First national assessment of ES in Slovakia delivered significant progress towards fulfillment of CBD targets, provide the pool and background for future detailed analysis regarding the mapping of habitat types, its quality, mapping of ES and communicating the value of the nature to the important national and local stakeholders.

Kurgans as refuges for grassland species: large-scale multi-taxon study on Eurasian burial mounds

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session 2, talk

Question: In transformed landscapes the last remnants of grassland habitats have been preserved in the few large protected sites and in small grassland islands inadequate for agriculture. In our study we aimed to reveal the conservation potential of the kurgans harbouring grassland vegetation but located outside the protected areas. For this we compared the applied management regimes, the species composition and threatening factors present on kurgans inside and outside protected areas.

Methods: We compared the species richness and abundance of grassland specialist taxa (vascular plants, ants, orthopterans, true bugs and rove beetles), the applied management and the presence of anthropogenic threatening factors (roads, buildings, garbage deposition) on 78 kurgans located outside and 60 kurgans located inside protected areas (East-Hungary).

Results: We found that due to their long-term persistence, special topographic attributes and relatively undisturbed status kurgans can provide refuge and key resources for grassland specialist plants and insects even outside the protected areas. For sessile species (plants, ants, orthopterans) kurgans can function as habitat islands providing feasible habitat conditions, whilst mobile species (true bugs, rove beetles) most likely use kurgans as stepping stones in landscapes with fragmented habitat structure. We found that the proportion of unmanaged kurgans was higher outside protected areas, which is predominantly due to the unfeasibility of grazing in transformed landscapes. Even protection could effectively suppress the level of garbage deposition, it did not have a significant effect on the proportion of the permanent buildings and roads which on the long run support weedy and woody encroachment.

Conclusions: Our study revealed that kurgans can effectively foster grassland biodiversity even outside protected areas. Together with road verges, field margins, rocky outcrops and riverbanks kurgans can be functional elements of a semi-natural grassland network in transformed landscapes and can increase the total area available for grassland species. Even though biodiversity were not significantly affected by the protection status of the surrounding landscapes, based on our results there is a considerable future threat for the long-term maintenance of benefits provided by the kurgans. For their effective conservation a new conservational approach is needed, which can provide more focused management actions.

Ancient burial mounds serve as refugee islands for semi-natural grasslands in Bulgaria

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session 2, poster

Question: Ancient burial mounds are the most widespread sacred sites of Eurasia. In Bulgaria the number of the burial mounds exceed 50000, which rates the country at the forefront position in Europe. Thus, burial mounds represent landscape features that have been preserved for millennia due to their spiritual significance. The vegetation of the kurgans is generally also well preserved because the hill shape of the kurgans hindered ploughing. Yet, little is known about the plant diversity of burial mounds in Bulgaria. Data from Central- and Eastern Europe suggest that, even though nowadays burial mounds are surrounded mostly by agricultural fields, they host diaspores of autochthonous flora. Therefore, the main objective of the project titled “Thracian mounds – biodiversity hotspots and refugee islets for conservation of flora and vegetation”, which started in the beginning of 2019, is to analyse the importance of the burial mounds for biodiversity conservation.

Methods: We selected 100 burial mounds all over Bulgaria, based on the National Archaeological map. To analyse the role of mound’s degree of isolation for the floristic diversity, we created 200 m buffer around each mound and based on the land cover content assigned the kurgans to two groups: (1) high degree of isolation (agricultural fields >80%) and (2) low degree of isolation (semi-natural areas >80%). Methods applied for exploring plant and lichen diversity include 100m^2 plots and transects.

We suggested the following hypotheses for testing:

- Burial mounds act as refugia for natural vegetation and increase landscape-scale biodiversity.
- Biodiversity of burial mounds depends on the diversity of microhabitats on the kurgan and biogeographical region.
- The human influence affects the floristic composition of the mounds.
- The biodiversity of burial mounds highly depends on species traits.

Conclusion: Burial mounds could act as a unique experimental field for studying the role of fragmentation and isolation in shaping plant diversity patterns. Bulgarian historical monuments are protected by the Cultural heritage law. We expect that the importance of burial mounds in Bulgaria as biodiversity refugia will be re-evaluated as a result of our study.

Patterns of structure of petrophytic steppes of the Urals and adjacent territories on a moisture gradient

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session 4, poster

Question: How does floristic composition of petrophytic steppes of the Urals and adjacent territories change along a moisture gradient?

Methods: The elaborated dataset consists of 3,614 relevés from the Urals and adjacent territories included in the vegetation databases (GIVD ID 00-RU-006, AS-RU-002). Data preparation and analysis were carried out using IBIS 7.2. (Zverev, 2007), JUICE 7.0 (Tichy, 2002) and PAST 3.0 (Hammer et al., 2001) software. Differential species (Dengler et all, 2005; Michl et al, 2010) were determined. The assessment of communities moisture status was carried out using Korolyuk ecological scales (Korolyuk, 2006).

Results: The whole dataset was divided into six parts according to moisture status assessment. Using TWINSPAN modified algorithm and cluster analysis (UPGMA, Bray-Curtis) a synoptic table with 13 columns was compiled. Each column revealed zonal and petrophytic types of steppe communities in every step of gradient. Comparison of types was carried out and differential species were determined. Changing the number of species and species constancy on the steps of moisture gradient was analysed. Indicator species groups, which differ in ecological amplitude, were determined.

Conclusions: Significant heterogeneity of petrophytic steppe vegetation along a moisture gradient was revealed. It is closely related with landscape position of open stony habitats. It changes on the South - North direction and moistening regime changes at the same time. So, three main groups of communities could be distinguished. The first group presents desert-steppe type. There are species of chalk habitats and dry steppes in indicator species group (*Anabasis cretacea, Anthemis trotzkiana, Echinops meyeri, Hedysarum razoumovianum etc.)* The second group combines dry and true steppes (i.s.: *Allium globosum, Echinops ritro, Elytrigia pruinifera, Linaria uralensis, Thymus guberlinensis* etc.). The Third group – petrophytic variants of the forb and meadow steppes (i.s.: *Cerastium arvense, Echinops crispus, Thalictrum foetidum, Silene klokovii,* etc.).

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Systematic plan for management measures in non-forest habitats in Slovakia

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session 2, poster

Question: In Slovakia actually doesn´t exist a plan for systematic management measures for protected areas. So far, management measures have been realised locally on small areas by staff of State Nature Conservancy of Slovak Republic, volunteers and local stakeholders, especially by small national projects. However, in order to conserve and improve conservation status of non-forest habitats in Slovakia, it´s necessary to prepare a systematic plan for the practical implementation of management measures. The main groups of management measures are mowing, grazing, removal of secondary succession and elimination of invasive plant species.

Methodology: The concept of the proposed areas for the practical management has been prepared in GIS on the following basis: preselection of non-forest areas in protected areas (national parks, protected landscape areas, SCIs, SPAs), on permanent monitoring plots for habitats/plants/animal and proposed unique areas by experts in nature conservation.

Results: The plan of areas for systematic management measures implementation includes 415 SCIs, 2.690 permanent monitoring plots in total area of 41.341 hectares. At the same time an aggregate price list of basic management measures in non-forest habitats has been prepared.

Conclusion: The plan for management measures is the first step for realization management measures on large scale and systematically. Practical management measures implementation have lot of difficulties, such as very complicated land owner/land user relationships (many land owners per one parcel), inappropriate management measures applied in areas donated by Rural development program, bureaucratic processes, missing tools for systematic support to small farmers, agricultural intensification etc. The main obstacle remains the lack of systematic financial support from government for realization of measures.

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

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session 4, poster

Questions: 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. No significant differences were found between forb and grass species or between tall and short ones. The revealed differences in SLA may be influenced not only by management, but also by other ecological factors.

(YIP) The red fox as an ecosystem engineer: Effect of fox burrows on the grassland vegetation of kurgans

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session 2, talk

Question: Kurgans often harbour species-rich remnants of loess grasslands. Due to their hill-like shape these habitats are especially favoured by burrowing animals. We aimed to reveal the changes in the habitat properties caused by the foxes and their effect on the vegetation composition of loess grasslands on kurgans. Our study questions were the following: (1) How do fox burrows and landscape context affect the habitat properties of grasslands situated on kurgans? (2) Do the fox burrows support the establishment of grassland species or are rather hotspots for weed infestation? (3) Is the effect of fox burrows mediated by the landscape context?

Methods: We surveyed the vegetation of fox burrows and that of the surrounding grassland on five kurgans situated in cleared landscapes surrounded by arable lands, and five kurgans in complex landscapes surrounded by grazed grasslands. We recorded the percentage cover of vascular plants, the amount of litter and soil moisture content in twelve 0.5m×0.5m plots per kurgan, in a total of 120 plots.

Results: Red foxes can change the vegetation composition and the structure of the community through transforming the habitat conditions and creating microhabitats for plant establishment. Foxes increased the soil nutrient content and reduced the accumulated litter on their burrows. These sites predominantly were characterised by weeds, but patches also provided opportunity for the recruitment of specialist species. Landscape context has significantly influenced the vegetation composition on fox burrows.

Conclusion: Kurgans play a crucial role in preserving grassland vegetation, thus are the object of special concern and their conservation take priority. For their effective protection, it is important to know the processes which shape their vegetation composition. Ecosystem engineering by animals has long been studied but we provide data about this complex process in a different context. We proved that the transformed environment and a stochastic event can heavily alter the vegetation dynamics of kurgans.

Conservation of regional plant genetics from semi-natural grassland (G-Zert)

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session 1, talk

Aims: Trends in land use towards intensification, but also complete abandonment, lead to a decline in species richness. The Convention on Biological Diversity aims at promoting biodiversity conservation and stopping the loss of biodiversity. In order to achieve these aims seed and plant material of regional propagation and provenance from semi-natural grassland (low intensity farming) is needed.

Methods: Recent work and research at AREC is done at two levels: In cooperation with farmers or nature protection, spots of still intact semi-natural, extensive grasslands are searched and registered. After a species inventory on-site, seed material from the most characteristic species is collected. This material is evaluated, described and stored in the gene bank at AREC. The other important work was the development and implementation of an Austrian-wide certification system for regional seed material, the “Gumpenstein Certificate of Origin”. The full value of site specific, regional seed material can only be effectively used, if these properties are transparent, guaranteed and reproducible for all, as a protection for potential customers. Regional seed material awarded with the “Gumpenstein Certificate of Origin” has to originate directly from a collection at a site in one of the Austrian bio-geographical zones of origin, or directly propagated from a collection on a certified field. Extensively managed semi-natural grassland can be used as donor sites for restoring new areas of high nature value. The certificate is obligatory for the seed producers, companies and farms, which are dealing with the material.

Conclusions: Both efforts presented contribute to the conservation of wild, regional seed material from endangered semi-natural grassland in Austria. They prove that firstly not only the ecological side of conservation and restoration needs to be considered. Secondly, also the importance of a framework for practitioners and end users guaranteeing the quality of the material used in order to create the premise for successful restoration projects is confirmed.

(YIP) Effect of different measures on seeds germination of typical plants from Festuco-Brometea erecti and Trifolio-geranietea sanguinei classes

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session 1, talk

Question: Species-rich grasses meadows can be successfully reproduced or artificially formed in anthropogenic territories, willing to neutralize biodiversity degradation in urban areas. The regional plants seed often are used to be the most suitable seed source, reproducing flowering meadows, because they are adapted to the local environmental conditions. But sprouting of wild meadows plants' seed is very different. Seeking to answer the question, what measures would help synchronize the seeds' germinating process in mixtures of typical for Festuco-Brometea erecti and Trifolio-Geranietea sanguinei classes plants seeds.

Methods: On the basis of wild plant germination data we categorized the seeds into two groups: 43 easily-germinating and 40 requiring germination stimulation. The seeds from the first group were kept in optimal 22°C temperature and which showed less than 40 % germination additionally affected with 0.2, 0.5, 1% potassium hydroxide (KOH) solution. As control, the seeds were imbibed in distilled water during the same time. Tree replicates of each treatment and control were made with 50 seeds each one. In parallel, 60 plant species were stratified in 0°C temperature for 50 days. Then seeds from both experiments were kept in darkness for 25 days, 22°C temperature during the day, and 5°C during the night for 25 days.

Results and Conclusions: The germination percent for 30 plant species out of 43 easily-germinating group was less than 40%. 1% KOH solution positively stimulated germination of *Centaurea scabiosa* and *Centaurea jacea*; 0.2% was particularly effective for *Silene nutans, Trifolium rubens, Geum rivale*. Stratifying positively stimulated the germination of many plants, such as *Gentiana cruciata, Galium verum, Hypericum hirsutum, Salvia pratensis*, and it was especially effective for *Pimpinella saxifraga, Campanula bononiensis*. However, comparing experimental group with control group revealed negative effects of KOH solution for the germination process of many other plants.

Top 15 authentic Carpathian recipes for sustainable management of species-rich grasslands

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session 3, talk

Question: Carpathian farmers are renowned contributors to the world „grassland cuisine“. Through the past centuries, they have invented numerous recipes for one of the species-richest meadows and pastures in the world thanks to the multiple traditional outdoor activities thriving and applied regularly even nowadays. We examined on the proven procedures leading to establishment and maintenance of species-rich grassland ecosystems.

Methods: Taking the opportunity of farmers' willingness to share their traditional knowledge on grassland management, we studied traditional farming systems and traditional ecological knowledge in 15 settlements within the Western and Eastern Carpathian Mts in six countries (Austria, Slovakia, Hungary, Poland, Ukraine and Romania). We conducted semi-structured interviews with local farmers asking questions about 1) the history of settlements and local grasslands; 2) the continuity of grassland management; 3) the developmental trends in local land use; 4) the details on mowing and grazing practices; 5) the quality of agricultural products in relation to grassland quality; and 6) the settings of optimal conditions to satisfy diverse needs of local communities. In each of the 15 sites we also sampled plots in selected patches of grasslands, collecting data on species composition and diversity of vascular plants, bryophytes and lichens. For each plot, we further gathered information on grassland management, in most cases directly from the landowners. The information on historical land use we obtained from historical maps from the first, second and third military surveys of Habsburg Monarchy for the 18th and 19th centuries, and from historical orthophoto maps for the 20th century.

Results and Conclusions: In our contribution we summarize the information on grassland management practices that contribute to the maintenance of high plant diversity and discuss the role of regional peculiarities in grassland conservation at the national and European levels.

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(YIP) *Crambe koktebelica* (Junge) N. Busch s.str. populations of dry grasslands in Crimea

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session 4, talk

Crambe koktebelica (Junge) N. Busch s.str. is a rare endemic species from *Brassicaceae* family in the flora of Ukraine (Crimea). It is protected at the state level (in Red Data Book of Ukraine as a rare species), and International level (in The IUCN Red List and The European Red List it has categories DD (EU) and NE (EU 27). *Crambe koktebelica* s.str. grows only in talus sea coast dry grasslands in the Crimean mountains on the territory of the Karadag array and near the village Koktebel.

Question: There are not enough data to make an assessment of risk of extinction or it has not yet been evaluated against the criteria for this protected species in natural habitats.

Methods: Investigation on ontomorphogenesis, demographic and space structures of *Crambe koktebelica* s. str. populations were conducted in two local populations in Karadag array and near the village Koktebel (locus classicus) according to common methods.

Results: *Crambe koktebelica* s.str. is a summer-wintergreen semirosette mostly conode (basal stem zone with approximate nodes of perennial monocarpic plants according to NUKHIMOVSKIY 1969) monocarpic or occasionaly caudex perennial polycarpic. Its ontomorphogenesis includes three periods and five age classes: latent (seeds), pregenerative (seedlings, juvenile, immature, virgin plants) and generative (generative plants). Acceleration of ontomorphogenesis is possible due to the loss of immature phase, and slowing down due to prolongation of immature or virgin plants phases.

The base age spectrum of two investigated *Crambe koktebelica* s.str. populations is left-sided, which indicates the potential for increasing the number of populations. The sharp decline in the percentage of immature and virginal individuals compared to seedlings amount is due to the increased competition of individuals in clusters, as well as covering of significant part of them by substrate during landslide soil processes.

Conclusions: Thus, it was figured out that monocentricity of ontobiomorphs of *Crambe koktebelica* s.str., low competitivity (especially in the early stages of ontomorphogenesis), only the seed method of reproduction of populations, the lack of adaptations to the active distribution of seeds determine the heterogeneous nature of the population field and contagious or compact-diffuse types of spatial distribution of individuals in more or less isolated clusters.

Unintended effects on meadows in a nature reserve caused by management following advices by nature conservancy bodies

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session: 2, talk

Question: The management of species-rich meadows in the nature conservation area Lainzer Tiergarten (Vienna) is regulated by a management plan since 1998. In the context of this project, floristic changes of these meadows were studied over 18 years aiming to detect species changes of the meadows and to assign the latter to either the management regime or to environmental changes like nitrogen deposition or climate change.

Methods: 64 vegetation relevés from 1997/1998 were selected and re-surveyed in 2014/2015. Compositional changes between the two survey periods were examined by use of multivariate methods (DCA).

Results: The DCA of the combined dataset shows homogenization of the species composition between 1996/97 and 2014/15. The total variation in the two datasets decreased from 4.7 to 4.2 SD-Units. Group centroids of vegetation units shifted towards the overall Centroid. The mean indicator value for nutrient supply increased on average from 3.8 to 4.0. Obviously, the cessation of nitrogen inputs in 2000 did not lead to an impoverishment of the system. In contrast, the ongoing nitrogen deposition lead to cumulatively better nutrient supply favoring species characterized by high Ellenberg N-values. Besides the harmonizing effect by the overall aerial nitrogen deposition, this development can be attributed also to the fact that the majority of the meadows were cut since 1999 +/- at the same date.

Conclusions: Although there was available a very detailed management plan with specific mowing regimes optimized for the various types of meadows, including a vegetation map for operationalization the conservation authorities voted for a less sophisticated management style with one single “earliest allowed” cutting date for whole field complexes. The mean indicator values for temperature indicate that climate change (I.e., higher annual mean temperatures) in the investigated period (1996/97 to 2014/15) did not lead to an increase of species favored by higher temperature. Conservancy authorities intended to keep the biodiversity of this NATURA2000 area at its high level by applying management practices in the framework of EU-subsidy program ÖPUL. A parallel monitoring program could have made apparent the mistakes to adjust the management adequately.

(YIP) Establishment gaps: new and successful tool to overcome propagule- and microsite-limitations in grasslands

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session 2, talk

Question: Can establishment gaps increase species diversity in species poor grasslands? How does grazing affect the establishment and colonization success of sown species? What is the spatial and temporal dynamics of species colonization?

Methods: Landscape scale grassland restoration with low-diversity seed mixture in Hortobágy National Park, Hungary, resulted in a species-poor grasslands. To increase the diversity of the restored grasslands we installed in total 24 establishment gaps with various size (1m^2, 4m^2, 16m^2) and management (grazing, fencing) eight years after the landscape-scale restoration. We opened the dense grass sward by tilling and sowed high-diversity seed mixture of 35 species. We monitored the establishment success of sown species by recording their percentage cover in gaps. We also monitored the colonization dynamics of sown species outside the establishment gaps. We placed 20 plots of 1 m^2 in the four main directions of establishment gaps in a transect and counted the individual number of sown species in every plot.

Results: We found that every species established in at last one of establishment gaps. Larger gaps had more stable development than smaller ones, sown species reached higher coverage. Grazing did not hamper the establishment of sown species but maintained a higher species diversity than fencing. Weedy species development was hampered by sown species. We recorded most sown species outside of establishment gaps but only with low individual number. The most successful species had good vegetative dispersal ability and/or good competitive ability. From larger windows more species were able to spread with a higher individual number. Grazing maintained a higher species number in colonization plots. In the five years of observation most species were able to colonize only the close proximity of establishment gaps.

Conclusions: In total we conclude that establishment gaps are appropriate tools to increase grasslands diversity, functioning as hotspots for species colonization. Colonization is a slow process and in five years species were able to establish permanently only in the close proximity of establishment gaps. Disturbance by grazing is able to maintain a higher species diversity and also helps species colonization.

(YIP) Grassland communities within abandoned settlements in NW Russia: syntaxa and land use status

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Session 4, talk

Question: Herbaceous communities are widespread in the European part of Russia and connected with human activity. The restorative succession of abandoned croplands and settlements was investigated before, but the syntaxonomy of those communities and the drivers of their spatial structure remained beyond the scope of previous studies. Our research aimed to test the hypothesis that the syntaxa correspond to land use.

Methods: To classify the vegetation according to Braun-Blanquet approach 98 relevés collected in 2014 and 2018 were used. The data were processed by means of the modified TWINSPAN algorithm provided by the JUICE software. Remnants of former land use may be traced back in the landscape for a long time by analyzing satellite images. The structure of microsites and the type of management (mowing+grazing, gardens+yards and other areas) were reconstructed based of Landsat 5 image (19 May 1985, ESA archive) and high-resolution PlanetScope images.

Results: A preliminary classification scheme of herbaceous vegetation was suggested for the studied area. We identified four classes (***Molinio-Arrhenatheretea, Phragmito-Magnocaricetea, Epilobietea angustifolii, Artemisietea vulgaris***) and seven alliances. The chi-square correspondence analysis showed the uncontingency for sites and alliances on p-level = $7{,}17*10^{-6}$ and for sites and classes on p-level = $4{,}26*10^{-7}$. Thus, the localization of syntaxa corresponded to the land use history. After about 30 years of abandonment on the place of houses, yards and gardens the plant communities of ***Artemisietea vulgaris*** and ***Epilobietea angustifolii*** have formed. Within mowed and grazed sites, the communities of ***Molinio-Arrhenatheretea*** have developed.

Conclusion: The question concerning the drivers of spatial structure of the communities on the alliance level was not investigated before. Our research has proved the hypothesis that the syntaxa basically correlate with former land use. Semi-ruderal and semi-natural syntaxa have retained in abandoned sites despite the long period without any agricultural use and their spatial distribution resulted from the previous type of land use.

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The use of remote sensing techniques to identify vegetation units in North Russia

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Session 4, poster

Question: 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 helps 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 looked like impossible before 2016. Nowadays the improvement of data and techniques availability probably opens the new era for using RS for grassland researchers. Our objective is the remote-sensed characterization of meadows and semi-ruderal herbaceous vegetation.

Methods: We used the data of 233 grassland releves (collected in 2014 and 2018; marked by GPS) from the surroundings of Polistovsky state natural reserve, Pskov region, Russia. The syntaxonomy of the grassland plots was analysed with Juice 7.0 (TWINSPAN). We used Sentinel-2 images (bands 02-08A, 11, 12 of 09 Aug 2017 and 03 Jun 2018 and vegetation indices: NDVI, Moisture, Tasseled Cup, Red Edge and Chlorophyll indices based on raw bands data) and drones data for RS analysis. Using ArcGIS 10.5.1, we extracted the remote sensing data (including indices values) for each point of relevé, then analysed the differences between syntaxa of classes and alliances using R 3.4.4 (Mann-Whitney test). The last phase was the classification of plots using Random Forest predictive algorithm aimed to a) measure the accuracy of classification (we splatted the releves' database into model and control samples randomly) and b) select the most significant bands/indices to understand which of them are the most important for grasslands classification.

Results: Communities related to 4 classes: ***Phragmito-Magnocaricetea, Epilobietea angustifolii, Artemisietea vulgaris, Molinio-Arrhenatheretea***; the last one contains four 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.

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(YIP) Meat production and maintaining biodiversity: Grazing by traditional and crossbred beef cattle breeds in marshes and grasslands

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session 2, poster

Question: Grazing megaherbivores are important drivers of the ecosystem processes in open landscapes and traditional livestock grazing plays an important role in nature conservation worldwide. Thus, sustainable rangeland utilization considering traditions and economic reasons is compulsory for harmonising the needs of the agricultural and nature conservation sectors. For proper management it is crucial to compare the grazing effects of traditional and crossbred breeds of the same livestock species that might have different effect on the rangelands. To fill this knowledge gap, in a grazing experiment we investigated the effect of cattle breeds on the vegetation of marshes and grasslands in the Hortobágy National Park, Hungary.

Methods: We sampled 60 plots in 12 areas grazed by traditional (Hungarian Grey Cattle) and large-sized crossbred (Charolais × Limousine) beef cattle. Vegetation was sampled in May 2015, 2016 and 2017. Within each sample area, we designated five 2 m × 2 m-sized permanent plots, where we recorded the percentage cover of all vascular plant species. We analysed a total of 60 plots.

Results: The traditional breed kept higher species richness and diversity compared to the crossbred cattle in both habitat types. In marshes, grazing of crossbred cattle favoured species preferring drier habitat conditions, which confirmed the second hypothesis.

Conclusions: We demonstrated that there are crossbred cattle breeds which are proper substitutes when traditional breeds are not available for the management of grasslands; our finding, however, suggests that traditional breeds should be prioritized for maintaining marsh ecosystems.

(YIP) Niche partitioning among morphotypes of *Phalangium opilio* (Opiliones, Phalangiidae) during the day rest in a montane pasture

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session 4, talk

Question: Selective grazing leaves some plants tufts giving shelter to many invertebrates, like the harvestman *Phalangium opilio*. In this species, male dimorphism occur, resulting in three adult morphotypes: the long-horned males, short-horned males and females. Due to more prosperous long-horned in comparison to short-horned males in intrasexual competition, we hypothesized that long-horned males would occupy more favorable resting places on turfs. Consequently, the spatial niches of both male morphotypes would be partitioned, while the female spatial niche would overlap with both.

Methods: We measured selected environmental parameters in resting places of all the three morphotypes on the tufts of *Lupinus polyphyllus*, *Rubus idaeus*, *Agrostis tenuis* and *Urtica dioica* in a montane pasture on the Mt. Košenjak, Slovenia. In each resting place, we measured the height of the individual placement, the height of the plant, temperature, humidity and insolation. Additionally, we measured the specific leaf area and the leaf dry matter content of each plant species.

Results: Altogether, we considered 370 individuals: 118 long-horned, 105 short-horned males and 147 females. We found significant differences in the spatial niches of all the three morphotypes. Analyses revealed that different environmental parameters influence the presence of morphotypes in the resting places. The probability of the presence of long-horned males was greatest in resting places with lower air humidity closer to the soil surface. In short-horned males, lower the air temperature increases the probability of the presence, and vice versa in females. The specific leaf area and leaf dry matter content, despite being collinear with some environmental parameters, contributed additional information on selection of resting places.

Conclusions: We found that the spatial niches during the day-rest differ significantly not only between the two male morphotypes, but among all the three morphotypes. *Phalangium opilio* individuals prefer broadleafed plants above the grasslayer. This is probably due to the plant physiognomical features including specific leaf area and leaf dry matter content.

Predictive distribution modeling of the dry grasslands in the Republic of Tatarstan

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session 4, poster

Question: The Braun-Blanquet method has been widely used by Russian researchers during the recent years for the purposes of vegetation classification. In this context, some regions, such as the Republic of Bashkortostan, have been investigated in detail and their complete prodromes are available. However, for plant communities of other territories, including the Republic of Tatarstan, this work has just begun. The following two major questions are commonly faced by researchers when studying the syntaxonomic diversity of the territory: "which of the already identified syntaxa are present in the study area?" and "how are they distributed?"

Methods: Our research was focused on dry grasslands of Festuco-Brometea Br.-Bl. that occupy an area within the steppe and forest-steppe zones of Cis-Urals. We based our model for potential distribution of dry grasslands on the following strategy: "predict first, assemble later".

We used georeferenced data from Vegetation Database of Tatarstan (GIVD ID EU-RU-011) and Database Meadows and Steppes of Southern Ural (GIVD ID 00-RU-006). The data of the WorldClim 2.0 and SoilGrids models were used as the abiotic predictors. The spatial data were compiled with the QGIS 2.14 package. The Maxent method was applied as a modeling algorithm. We developed species distribution models for each of diagnostic species of Festuco-Brometea. The resulting models were stacked to produce a final model of the potential distribution of communities of this class.

The relevés assigned to Festuco-Brometea by the EuroVegChecklist expert system were used as presence data to verify the final model.

Results: The model was used to assess the suitable habitats of Festuco-Brometea communities in Tatarstan. At the stage of visualization it demonstrated that dry grasslands belonging to the class Festuco-Brometea are most likely to be found to the south from Kama river.

Conclusions: We plan to investigate the localities where the probability of presence of the modeled communities in the territory of Tatarstan is highest during the next field season. The obtained data will be used to develop the syntaxonomy of dry grasslands of Tatarstan.

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Depressions (pody) of the Steppe zone – a new habitat type of European importance

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session 2, talk

Question: Thanks to the implementation of the EU Habitat Directive, according to the Association Agreement Ukraine - EU, the process of habitat inventory in Ukraine was significantly intensified. At the same time, the generally accepted habitat classification (EUNIS, Annex I of Habitat Directive, Resolution 4 of Bern Convention) does not fully cover the diversity of Ukraine's habitats. One of these habitats is the depressions (local name – "pody") of the Steppe zone, which were absent in existing lists, and only at the end of 2018, were included in the Resolution 4 of the Bern Convention by the proposal from Ukraine. Our work is devoted to the comprehensive characterization of this habitat type.

Methods: The factual basis of the work is the dataset of a complex survey and monitoring of the flora and vegetation of depressions of the Steppe zone, carried out during 2002-2018.

Results: Pody represent a heterogeneous group of closed depressions, some of them are relics of the ancient hollows of the former Dnipro valley, and others are formed as a result of deposition or deflation phenomena. Characterized by specific soils – "gleysolod", formed as a result of prolonged flooding. Vegetation of the pody is represented by communities that syntaxonomically belong to endemic alliances - Myosuro-Beckmannion eruciformis and Lythro virgati-Elytrigion pseudocaesiae, also, depending on the level of flooding, communities of alliances Eleocharition soloniensis, Festucion valesiacae etc. can be formed here. Such vegetation (ephemeretum) is confined to a short-term period of flooding, observed with different periodicity (7-20 years). These habitats are the only source of local endemics (*Allium scythicum, Phlomis scythica, Tulipa scythica* etc.) of the Left-Bank Lower Dnipro River. The main threats to these habitats are the plowing of the virgin land of the catchment basin, the regulation of drain, phytoinvasions, pollution by chemicals from adjacent farmland, silting of bottoms, overgrazing.

Conclusions: Taking into account pan-European significance of pody, now officially approved, an important task is inventory all these habitats in Ukraine, and to provide an adequate level of protection in the protected areas as well within the Emerald Network of Ukraine.

(YIP) Kurgans as refuges of rare dry grassland species

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session 2, poster

Question: In heavily transformed open landscapes of Europe dry grasslands have suffered a considerable decline during the past centuries; most of them have been transformed into arable lands and urban areas. In such transformed landscapes small remnant grassland islands have a considerable role in preserving grassland biodiversity and maintaining functional connections between the remaining populations of grassland specialist species. In the steppe and forest steppe region of Eurasia the ancient burial mounds, the so-called kurgans have an important role in preserving grassland habitats and grassland specialist species. In this presentation we represent the results of a landscape-level survey from Hungary, which aimed to reveal the role of kurgans in the maintenance of grassland specialist plant species in heavily transformed agricultural landscapes.

Methods: We surveyed the vegetation of 83 kurgans by recording all vascular plant species. All of the surveyed kurgans harboured Pannonian loess grasslands. The surveyed kurgans were in the area of the Hortobágy National Park Directorate (East-Hungary), and the studied region covered approximately 13,000 km^2.

Results: We found altogether 43 taxa that are protected (*Anchusa barrelieri, Aster sedifolius, Carduus hamulosus, Centaurea solstitialis, Chamaecytisus rochelii, Inula germanica, Phlomis tuberosa* and *Ranunculus illyricus*) or regionally rare (*Aegilops cylindrica, Asplenium ruta-muraria, Astragalus austriacus, Lychnis viscaria, Rosa gallica, Rosa rubiginosa* and *Stipa capillata*). Most species belonged to the phytosociological classes Festuco-Brometea (loess grasslands) and Festuco-Puccinellietea (alkali grasslands). The studied kurgans also harboured several rare weedy species typical to extensively used agricultural fields, which are also important from the nature conservation point (*Ajuga chamaepytis, Glaucinum corniculatum* and *Nigella arvensis*).

Conclusions. Our findings demonstrated that kurgans have a vital role in maintaining the populations of rare and endangered grassland species even in transformed landscapes. Floristic surveys focusing on kurgans can contribute to the exploration of landscape scale grassland biodiversity. These data can also be essential elements of nature conservation plans focusing on the maintenance and restoration of grassland networks in agricultural landscapes.

Variability and plant communities' diversity of acidophilous dwarf-heath mountain tundra (the class Loiseleurio-Vaccinietea Eggler ex Schubert 1960) in Romanian Carpathians

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session 4, poster

Introduction: The class *Loiseleurio-Vaccinietea* Eggler ex Schubert 1960 includes both the chionophobous cryophilous dwarf-shrub heathlands on windswept slopes and edges together with acidophilous mesophilous dwarf-shrub communities in subalpine and alpine belt of Eurasia mountain systems. These communities are dominated mainly by ericaceous species (genera *Empetrum*, *Loiseleuria*, *Rhododendron*, *Vaccinium* etc). The classification of dwarf-shrub communities to higher syntaxa was problematic from the very beginning. Probably this happened due to the poor species composition and the monotony of their stands. During the time, their syntaxonomic classification changed, as they have been classified within the Vaccinio-Piceetea, Juncetea trifidi or Calluno-Ulicetea. In the 60s, this unit (Loiseleurio-Vaccinietea) was proposed, trying to reflect not only unified floristic composition but also specific the structure and ecosystem functions.

Questions: In our contribution we focus on following questions: (i) what is the variability of dwarf-shrub heathlands in Romanian Carpathians and what diagnostic species differ individual communities from each other? (ii) What are the main environmental characteristics of each communities? and, (iii) what are the main ecological factors shaping their floristic composition?

Methods: We used 1470 relevés dominated by dwarf-shrub species stored in the Romanian Grasslands Database (EU-RO-008). All relevés were analysed using hierarchical agglomerative clustering methods in order to identify the main vegetation groups.

Results: Numerical analysis revealed well-defined communities dominated by *Empetrum nigrum* subsp. *hermaphroditum*, *Juniperus sibirica*. *Loiseleuria procumbens*, *Rhododendron myrtifolium*, *Vaccinium gaultherioides*, *V. myrtillus* and *V. vitis-idaea*. New syntaxa were identified at lower hierarchical levels (sub-associations). Direct and indirect ordination methods were used to identify the main gradients affecting floristic composition of individual vegetation types. In all cases, the floristic composition of target species-poor communities was mainly modelled by soil characteristics (pH and nutrient content) and altitudinal range.

Ground beetles (Coleoptera: Carabidae) of Egyek-Pusztakócs Reserve, Hortobágy National Park, Hungary

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session 4, poster

Question: Natural and semi-natural grasslands support species-rich ground beetle assemblages. Ground beetles are excellent environmental indicators. The aim of our study was to explore the ground beetle fauna of the Egyek-Pusztakócs Reserve Area (Hortobágy National Park, Hungary).

Methods: Egyek-Pusztakócs Reserve Area is a lowland region, characterised by a mean elevation of 88–92 m a.s.l.; the climate is continental. The natural vegetation of the most elevated plateau is loess grassland; the region harbours alkali dry grasslands at higher elevations, alkali marshes and alkali meadows at the lowest elevations. Ground beetles were collected by unbaited pitfall traps with ethylene-glycol as a killing-preserving solution. Study sites were in Egyek-Pusztakócs Reserve, Hortobágy National Park, Hungary. Trapped beetles were collected monthly from June to October in 2010; collected beetles were identified at species level using standard keys.

Results: Altogether 2302 ground beetle individuals belonging to 64 species were trapped during the study period. Most frequent species were *Pterostichus macer* (16,98% of total), *Poecilus cupreus* (8,29%) and *Brachinus nigricornis* (7,43%). The number of species was the highest in September (48 species), while the number of individuals was the highest in August (828 specimens).

Conclusions: The following species were rare and/or notable from faunistic point of view to the loess grasslands, alkali meadows, and alkali marshes. The *Ophonus cribicollis* was characteristic to loess grasslands. The following species were found in alkali marshes: *Agonum atratum*, *Amara tibialis*, *Brachinus psophia*, *Carabus clathratus*, *Dinodes decipiens ambiguus*, and these were found in alkali meadows: *Brachinus bipustulatus*, *Polistichus connexus*, *Pterostichus chameleon.*

(YIP) Introducing spectral remote sensing into grassland restoration: can we track down soil phosphorus availability?

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session 2, poster

Question: The elevated nutrient levels resulting from past fertilization generally form a major bottleneck for the restoration of species-rich semi-natural grasslands. Soil phosphorus (P) is particularly problematic in this context because of its persistence in the soil and strong impact on plant communities. Assessing soil P availability is therefore key in determining the restoration trajectory of a target site. However, current techniques, i.e. soil sampling, are often labor intensive, expensive and provide low spatial coverage. In this project, we will investigate how vegetation spectra can be used to track down soil P availability by resolving the plant ecological basis underlying the linkages between soil P, the vegetation chemical and spectral signature.

Methods: We established a common garden experiment where we grow typical grassland species along a soil phosphorus gradient. Species were selected along the leaf economics spectrum, reflecting a trade-off between investing in further resource acquisition versus the conservation of captured resources. Plant responses in terms of the plant biochemical and spectral signature are measured and quantitatively linked to soil P availability.

Results: Current research shows that soil nutrients influence the nutrient concentrations in the plant tissue, determining the biochemical signature of the vegetation which on its turn influences the reflectance features of the vegetation, that is, the spectral signature. In this study, we want to further explore the variation in biochemical and spectral responses between different functional plant groups and the upscaling of individual species responses to the vegetation. Based on the spectral proxies for soil and vegetation phosphorus from our experiment, we will then scale up and test our findings in the field.

Conclusion: The ultimate aim of our research is to provide managers and practitioners a concrete framework to assess soil P levels in the most cost-effective way. We hope this facilitates the prioritizing process for ecological restoration and simplifies the decision making process for restoration strategies. This way managers can spend limited resources more effectively and grasslands can be restored on a larger scale.

Key words: ecological restoration, soil phosphorus availability, spectral remote sensing

Maintenance of species-rich grasslands by traditional farmers: diversity, practice, knowledge, subsidies and future

[KEYNOTE LECTURE]

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Species-rich semi-natural grasslands are precious components of the European cultural landscapes, however, their conservation is a great challenge. In a few marginalised corners of Europe, these grasslands are still managed by extensive land-use systems that are maintained by traditional ecological knowledge. We carried out research in the Gyimes region of the Eastern Carpathians, Romania, in a heterogeneous cultural landscape. We studied the traditional ecological knowledge and the well-developed grassland management system of the local Hungarian Csángó community by participatory observations and semi-structured interviews.

We found that the Csángó traditional land-use system is based on deep ecological knowledge of more than 200 wild plant species and more than 140 habitat types as well as a deep understanding of vegetation and landscape dynamics and their drivers. Csángós influence vegetation dynamics of their species-rich hay meadows by 1) mowing; 2) optimizing seed and biomass production (rotating the hay-cut of meadow parcels from year to year); 3) removing ant hills, mouse hills, stones and branches; 4) cutting the trees, bushes, i.e. clearing; 5) overseeding with *Onobrychis viciifolia* or 6) application of hayseed from the barn; 7) manuring on certain parcels; 8) manual thinning of meadow weeds; 9) suppression of mosses; and 10) small-scale drainage. Their goal is not the management of protected species or to maintain biodiversity but to keep grasslands in good condition for a long run, and thus ascertain the availability of hay in the needed quantity and quality. We argue that a better understanding of existing traditional low-input grassland management systems could greatly help improve our ability to maintain biodiversity in these traditionally managed farmlands.

We will also discuss the role of increasing the spatial scale of agricultural regulations, the need to consider the whole socio-ecological system and the need for region-specific regulations in the European Union. We argue that in those landscapes where traditional small-scale farming is still actively practiced, decision-makers should understand local management practices and concepts first, instead of imposing requirements on farmers that are alien to the local landscape and society.

Traditional herders modify both livestock and researcher behaviour: knowledge co-production for better management of species-rich grasslands

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session 3, talk

Traditional landscape stewards often manage and use biodiversity to produce food for the wider society. Traditional herders (one of the most common types of landscape stewards of species-rich grasslands in our region) possess a deep understanding of the livestock, its behaviour, the forages of their pastures, and the relations of livestock and plant species. Herders who keep their animals on species-rich pastures in protected areas also learn a lot from nature conservation, often through conflicts but also ever more often through cooperation and knowledge co-production with conservation rangers and scientists. Thus, traditional herding in a nature protected area is a precious opportunity as two knowledge systems meet here: Western Science (including vegetation ecology and conservation biology) and traditional/indigenous knowledge.

We made knowledge co-production with herders (see them as co-authors of this presentation) at Kunpeszér, Kiskunság, Hungary in 2015-2016. We documented the grazing desire of beef cattle towards 117 plant species in various species-rich grasslands by visual observation of livestock behaviour. We found 10 different types of behaviour and learnt that herders consciously use and modify the diverse desire of the livestock towards the different species by herding. Modifications of herd movement and grazing locations aim at increasing grazing intensity in less desired patches and decreasing grazing selectivity in heterogenous swards.

Many elements of these practices have potential conservation benefits, e.g. through avoiding under- and overgrazing, and targeted removal of pasture weeds, bushes, invasive species and litter. We argue that knowledge co-production could help develop innovative conservation management practices of species-rich grasslands.

(YIP) Unburned microhabitats and their surroundings support epigeic arthropods after prescribed burning of dry grasslands

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session 2, poster

Question: Fire supports landscape openness; thus, prescribed burning could be an effective management in open landscapes. In this study we tested the response of arthropods (spider, ground beetle, rove beetle and woodlouse) to dormant-season prescribed burning in dry grassland patches. We hypothesized that the unburned patches support the arthropods recolonizing the burned patches; thus, fire causes no serious damage to the arthropod assemblages.

Methods: Epigeic arthropods (spider, ground beetle, rove beetle and woodlouse) were collected by unbaited pitfall traps containing ethylene glycol as a killing-preserving solution. Altogether 60 traps worked in 3 burnt and 3 control plots (10 traps/plot). Traps were emptied monthly from May to October in the year after burning. Collected arthropods were identified at species level using standard keys.

Results: We found no significant difference between the burned and control plots for the abundance, species richness, and Shannon diversity of spiders, ground beetles, rove beetles and woodlice. Differences in total abundance, species richness and diversity of arthropods were also not significant between the burned and control plots. Among from 12 most abundant species, ten species were not affected by burning, while the abundance of *Titanoteca veteranica* spider species increased and the abundance of *Trochosa robusta* spider species decreased in the burnt plots.

Conclusions: Microcaves and other unburned microhabitats in and around the burned patches serve as refuge for epigeic arthropods supporting the fast recolonization after prescribed burning, although the abundance of some epigeic spider species (*Titanoteca veteranica*, *Trochosa robusta*) was affected by burning. Our findings revealed that prescribed burning is a potentially promising conservation method. We also highlighted that preservation of unburned microhabitats and surroundings of the managed patches is essential during the prescribed burning.

Combined effects of shrub encroachment and wildfire on species richness in semiarid sand forest-steppe vegetation

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session 2, poster

Question: Does invasion of native common juniper (*Juniperus communis*) change the species richness in calcareous open sand grassland? Does wildfire affect species richness in grassland plots and in plots previously occupied by common juniper? Does species composition in grassland plots recover after juniper invasion and subsequent wildfire?

Methods: The study was conducted in Kéleshalom (Hungary), in a partially burnt forest-steppe landscape. Vegetation sampling (visual cover estimation of vascular plant species) started in 2008, one year after a large wildfire event. We analysed an eleven-year dataset containing 18 burnt and 18 unburnt blocks. Each block includes two 5 x 5 m plots, one grassland and one juniper plot, and four 1 x 1 m plots, one grassland, one juniper, one northern juniper edge and one southern juniper edge.

Results: The cover of junipers increased significantly during our study period in northern and southern edge quadrats. In these quadrats, we found decreasing species richness of both native and alien species. In contrast, we did not find negative effect of junipers on species richness at larger scale (5 x 5 m plots), where plots were big enough to represent also grassland community. Wildfire increased species richness compared to control grasslands at both spatial scales, and the effect was stronger on patches formerly invaded by junipers. The recovery of species composition in burnt plots did not complete during our study.

Conclusions: Common juniper has contrasting effects regarding conservation aspects. While it contributes to diversity by forming different microhabitats in the invaded grasslands, it is a threat for species richness at fine scale, as it converts grassland patches to a woodland state. In burnt plots, the richness of alien species increased in parallel with fast regeneration of native species. Therefore, while fire increases richness, it is not a desired conservation management tool against shrub encroachment in the studied grasslands.

Local climate and latitude affect flower form of *Ophrys fuciflora* (Orchidaceae): evidence for clinal variation

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session 4, poster

Question: The present study was undertaken to study bioclimatic variables in relation to floral morphological character values in order to evaluate if the morphology- the floral form (size and shape) is also environmentally driven. We addressed two specific questions: a) Could morpho-species (morphological entities) *sensu* Delforge (*Ophrys fuciflora* s.str., *O. medea*, *O. untchjii*, *O. tetraloniae* and *O. serotina*) be objectively separated based on floral morphology alone? b) Do these morphological entities represent clinal morphological variation as a response to the changing bioclimatic variables and altitudinal/latitudinal gradients?

Methods: We selected 18 *Ophrys fuciflora* s.lat. populations covering almost the entire distribution range in Istria (north-south gradient) and two populations from the Quarnero islands of Krk and Cres. Specimens from each location are represented in a set of 24 measured macro-morphological character (continuous variables only) values obtained from a single flower, quantified with traditional morphometric methods. Altogether 221 flowers were measured. Univariate and multivariate statistics of morphological data (continuous characters) obtained from flowers were performed. For hierarchical clustering, Ward's hierarchical clustering method was used. Correlation tests and regression analyses were performed based on 19 bioclimatic variables and with means of floral character values for each population.

Results: Nine bioclimatic variables (precipitation and temperature regime) and latitude show statistically significant, strong correlation with the flower form (size and shape). Results indicate that the observed floral continuous quantitative characters, traditionally utilized to differentiate taxa in the *Ophrys fuciflora* complex are affected by the local climatic conditions and latitude, and exhibit clinal variability.

Conclusions: Species ecology should be considered in the first place in any attempt to morphologically evaluate and delimitate any closely related *Ophrys* taxa. With a strong evidence for clinal variability of flowers and flowering time overlapping, the current taxonomic status of the analysed sympatric *Ophrys* taxa proves as questionable.

Important Dark Sky Areas as key territories for grassland conservation in Europe and the Caucasus region

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session 2, poster

Question: Human society benefits a lot from ALAN (artificial lighting at night), but it also led to a significant increase in light pollution of the night sky during the past decades. This has negative effects, e.g. on reproduction, navigation, foraging, habitat selection, communication, trophic and social interactions of the biota. Therefore, the conservation of refugia where natural habitats are not influenced by ALAN is very important. Especially, it concerns grasslands which are under the strongest anthropogenic pressures during the last centuries in whole Europe.

Methods: There has been selected promising territories without, or with a low impact of ALAN for the development of an IDSA (Important Dark Sky Area) Network in Europe and the Caucasus region using the New World Atlas of Artificial Sky Brightness. The next, these territories have been recognized as IDSA, if they have area size of at least 700 km², and protected areas (Biosphere and Natural Reserves, National Parks as well as sites of NATURA2000 and Emerald Networks etc.) are located there.

Results: 54 IDSAs within the borders of 30 countries were chosen, located in different biogeographic regions, at different altitudes. Most likely, different types of grasslands are represented in majority of them, though it does not establish exactly during the research. Special attention has been paid to sea and ocean islands, non-polluted by ALAN, as well as to large parts of European Russia and Kazakhstan where there is still a low level of light pollution.

Conclusions: The IDSA Network drafted for Europe and the Caucasus region might be a basis for the biodiversity protection from the consequences of ALAN, and they can also serve as key education centers for increasing the awareness of the problem of light pollution of the sky at night. It might also contribute to the development of different types of tourism in allocated IDSAs. As well they will prove an additional tool for carrying out of further researches on light pollution and artificial light effects on living organisms.

(YIP) Biodiversity in meadows of the “Haymilk” region Neumarkt in der Steiermark

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session 1, poster

Question: What is the mean species richness in associations of traditionally managed hay meadows in Styria, that are currently used for an economical milk production? Is there an influence of manuring and utilisation intensities on species richness even in areas without silage production? Which factors are the most important drivers for species richness?

Methods: We sampled the meadows of farmyards in the mountain region Neumarkt in der Steiermark that take part in a “Haymilk” program. Hay production (no silage allowed) and at least 120 days of pasturing are obligatory. At least 75% of the fodder has to be produced on the own farmyard with a maximum of 15 % concentrated feed (like cereals, no soya). We analysed 61 nested-plot series (0.0001 – 10 m^2 plot size) along three different manuring and utilisation intensities and tested their influence on species richness by a GLM analysis. For classification we implemented data from an earlier work (2005) from the surrounding area. We classified the plant communities using TWINSPAN analysis, DCA ordination and semi-supervised classification with K-means.

Results: In the hay meadows we found the associations *Pastinaco-Arrhenatheretum, Poo-Trisetetum flavescentis and Angelico-Cirsietum palustris* with species numbers between 16 and 59 species per plot (10 m^2). With the exception of the noticeable nutrient poor, wet or dry sites, most of the relevés belong to the *Poo-Trisetetum flavescentis*. The DCA ordination shows that nutrients and moisture are the strongest environmental gradients. Manuring and utilisation intensities are significantly negatively correlated with species richness of vascular plants.

Conclusions: With the documented high species richness we can prove that even meadows that are currently used for an economic milk production can achieve at least some basal biodiversity goals. Nevertheless, the ban of silage as a single measure is not enough to maintain species rich meadows. At this altitude (900 - 1300 m a.s.l.), a maximum of two cuts per year as well as the use of solid manure should be supported.

Do species rich grasslands still have economic value? Examples from Lower Austria.

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session 1, talk

Lower Austria is the northernmost and with an area of 19,186 km² the largest of the nine federal states of Austria. Especially concerning grasslands, Lower Austria is an area with high diversity. The author is working on the implementation of the agro-environmental scheme in Lower Austria since 1995 and will try to give some insight in the biodiversity of its grasslands as well as in the economic situation of their management with four examples.

Blockheide is a reserve and nature park in the Hercynian region. It covers an area of 106 ha and is characterized by very small grassland plots, mixed with also small arable fields and pieces of woodlands. It was utilized by small-scale subsistence farmers up to the 1990ies. Since then, the agricultural structure was changing rapidly.

Leiser Berge is a hill area reaching almost 500 m above sea-level in the Pannonian region in the north-east of Lower Austria. 45 km² have the status of a nature park. Since 2000, a newly established sheep farm uses formerly abandoned species-rich dry grasslands as pastures. This land-use is subsided from the agro-environmental scheme and produces high-quality lamb-meat.

Wienerwald is an area with 1,050 km² with predominating beach forests on the north-eastern edge of the Alps and reaching immediately to the outskirts of Austria's capital Vienna. A very traditional form of grassland use survived in this area until today. In the last decades, the production of hay for horses kept in growing number for recreation and sport became a crucial factor for low-input grassland farming in the region. In 2005 a biosphere reserve with a joint management for the parts in Lower Austria and Vienna was established. Afterwards mapping of the grasslands was implemented in the area.

The last example are mountain pastures around the **Schneeberg**, with 2,076 m above sea-level the highest mountain of Lower Austria, most of them situated in the montane zone. These grasslands are used by farms from the adjacent valleys. Within their farmland, they practice a system of graduated intensity, with the mountain pastures being used without fertilizing.

Habitat suitability models help in pre-selecting the most promising sites for compensation and restoration measures

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session 2, talk

Question: Semi-natural grassland types, such as wet meadows, species-rich mesic or semi-dry grasslands are known as highly valuable habitat types in cultural landscapes. In cases where larger infrastructure projects consume such habitats, the implementation of compensatory measures is required according to the act of Environmental Impact Assessment (EIA) and the nature conservation acts of the individual countries. Also, the EU habitat directive targets maintenance or achieving of a favourable conservation status of target habitats within Natura 2000 sites. Both compensatory and restoration measures are usually associated with the development of high-quality habitat types. However, the success of these measures primarily depends on proper site conditions. While suitable sites must be found in the course of project realization, nature conservationists are searching for relict habitats to improve a target habitat type. In the first case, tedious negotiations with a multitude of landowners are necessary, in the second case, a targeted search is often not possible, especially when the areas of conservation are extensive. In both cases, purchasing land turns out to be expensive and time consuming.

Methods: In a pilot study, we use habitat suitability models to identify priority sites that are highly suitable for the development of three grassland habitat types, which are in many cases relevant for compensation or restoration actions.

Results & Conclusion: We aim to create a transparent and flexible planning tool with strong potential to improve the success of future compensation and restoration measures and simultaneously being cost and time effective.

Linking above and belowground diversity patterns in grasslands under different management regimes: insights from indicator species analysis

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session 4, talk

Question: Within the framework of the BIOINVENT project (https://www.biodiversa.org/972), a Pan-European (Sweden, Germany, Switzerland and Portugal/Azores) survey of plant and microbial diversity in grasslands was undertaken, in a total of 370 grasslands, divided according to three levels of management intensity. We tested the hypothesis that there was a high correlation between plant and fungal indicator species, depending on the management regime.

Methods: In the summer of 2017, soil samples from grasslands under three management intensity levels were taken from all regions. An amplicon-based Illumina Miseq sequence analysis was conducted on the fungal internal transcribed spacer (ITS) region and an OTU table constructed. The differences in floristic composition were particularly sharp along the Azores management gradient (60 grasslands divided in semi-natural grassland – low management intensity; permanent grassland – medium management intensity, kept for 10 years; resown grassland – high management intensity, kept for 3 to 5 years). We used redundancy, co-correspondence, correlation and indicator species analyses to estimate the degree of association between plant and microbial communities. A characterization of climatic and soil parameters was undertaken.

Results: Some soil parameters, such as pH and bulk density, differed between management intensity levels, and climatic parameters showed a tendency for a decrease in temperature and an increase in precipitation from resown to semi-natural grassland. Plant and fungal indicator species were clearly found to be associated with the different management intensity levels, and high correlation values were found between the two types of indicators. That is, correlation was highest for plants and fungi that indicated the same type of grassland management. Similar results were obtained for bacteria.

Conclusions: A link between grassland management regime and indicator species definition was clearly revealed. Further, this was expressed as a high correlation between plant and microbial indicators, that is, between above and below-ground communities. Therefore, these type of indicators are clearly useful to evaluate plant and microbial community change, and alterations in biodiversity patterns, originated by different types of grassland management. Similar analyses are being undertaken for the remaining regions.

Grassland restoration – how can multiple potential natural vegetation (MPNV) estimations contribute?

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session 2, talk

Question: Multiple Potential Natural Vegetation (MPNV) is a model based fuzzy estimation of Potential Natural Vegetation (PNV), which consists of the probability distributions of potential vegetation types per locations. MPNV reflects that abiotic conditions do not necessarily lead to one vegetation type only, but rather allow the survival of several ones with differing probabilities. In the current study, we aimed at finding the implications of the MPNV for grassland conservations and restoration in particular based on the example of Hungary.

Methods: MPNV estimation has been built by Gradient Boosting Models based on the relationship of observed vegetation data (38 semi-natural and natural vegetation types) in the Hungarian Habitat Database (MÉTA) and explanatory variables describing the abiotic environment (hydrology, soil, terrain and climate). The probabilistic outcome of the models has been rescaled into a five-level ordinal scale to ensure comparability of vegetation types. The rescaled output was further analyzed by classification and ordination. The classification was used to map the self-similarity pattern of potential vegetation using a series of cuts providing 6 to 15 groups.

Results: The modelling resulted in probability surfaces, which can be directly used for grassland habitat suitability if only one vegetation type is in focus. Rescaled maps demonstrate the relative suitability of sites for multiple vegetation types including grasslands. The classification and ordination identified major self-similar landscape types with regard to the vegetation they host. Grasslands were dominantly, but not exclusively determining groupings in the lowlands, but their potential presence or absence was also important in separating vegetation-based landscape types in the medium mountains of Hungary.

Conclusions: We argue that MPNV can become a valuable tool in grassland restoration in two aspects: when selecting the optimal target and selecting the optimal neighbourhood for propagule transfer. MPNV estimation reflects actual environmental conditions and therefore can be particularly useful in case of the relatively quickly developing grasslands.

Besides the direct use of MPNV estimates, self-similar areas of the estimations can provide a guideline for determining the range of sufficiently similar environments from which propagules are collected. The multiple group sizes resulted from the series of classification cuts ensure flexibility to match propagule availability when determining such ranges.

(YIP) Insight into public attitudes towards preserving species-rich grasslands

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session 2, talk

Question: Goričko (Slovenia) forms part of the trilateral Nature 2000 protected landscape park (GLP) on the borders of Hungary and Austria. The park was established because of the well preserved natural and semi natural landscape, among other dry grasslands. However, the trend has been toward losing precious habitats, owing to intensification and abandonment. To prevent this trend, the aim of the research was to answer the question: “Which factors influence the willingness of residents in GLP to preserve grassland biodiversity?”

Methods: We will give a review of two studies carried out in GLP. The studies yielded important insight into general public attitudes toward grassland management and participation in conservation measures. Attitudes about and participation in measures were measured with a questionnaire from April 2015 to April 2016 and analysed via Principal Component and Regression Analysis.

Results: We received 228 completed questionnaires. The results revealed that the majority perceived unmown meadows as ugly. They agreed that a house with a carefully mown lawn shows the owner’s environmental awareness. The majority of respondents disagreed that grass (fodder) gives value to a meadow and that any other plants or animals have no value. Moreover, they disagreed with the claim that the presence of protected plants and animals on meadows produces only problems and no benefits. Following these positive attitudes, respondents agreed that meadows should be managed so as to preserve species biodiversity. Although reporting positive attitudes toward meadows, respondents were not prepared to participate in measures for preserving biodiversity, as volunteers without financial compensation. From 363 reported meadows, 302 were being used extensively and 61 intensively. Only 40 from the extensively and 9 from intensively used meadows were included in the Agricultural Environmental Climate Scheme (AECS) for encouraging the proper management of extensively used meadows.

Conclusions: From these results, we can recognize a conflict between conservation goals and owners’ perceptions of the groomed, well-kept meadow. These results highlight the importance of education for better understanding of the relation between grassland management and biodiversity. The majority of owners labelled their meadows as extensively used, which indicates that they are already acting toward biodiversity conservation, but not all through participation in AECS.

Functional vegetation recovery of sand grasslands: trait-neutrality and filtering effects

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session 4, talk

Question: In the study of succession changes in species composition are frequently analysed, but functional analyses focusing on temporal changes of respective traits and functional diversity are rather scarce. We analyzed vegetation changes in the first 12 years of succession after heavy goose grazing on acidic sand. With trait-based analyses using permanent plots we addressed the following hypotheses: (i) High fluctuations in the trait values are typical in the first years; later a temporally divergent change in the trait patterns of sites with different vertical position became characteristic. (ii) In the functional diversity of regenerative and vegetative traits we expected different temporal patterns.

Methods: Altogether 15 functional plant traits were considered in the analyses: seven traits related to growth, vegetative spread and competitive ability (leaf area, leaf dry weight, leaf dry matter content, specific leaf area, plant height, life form and clonal spreading ability) and eight traits related to generative reproduction, spatial dispersal and persistence (flowering start, flowering period, the rate of wind pollination, insect pollination and self-pollination, seed weight, terminal velocity and seed bank type). We calculated community-weighted means (CWMs) and single trait variance for each trait, and multi-trait functional richness, functional evenness, and functional divergence using all traits in exception of pollination. We also calculated the multi-trait indices separately for the vegetative and regenerative traits.

Results: We found that in the first few years most traits displayed high fluctuations. We found a marked increase in CWMs of clonal spreading, life span, and leaf dry matter contents during the succession. In parallel, we found a trend of decrease in the CWMs of plant height and SLA. While there were distinct patterns detected in the functional richness of traits, functional divergence and evenness displayed no clear distinctive patterns.

Conclusions: We can conclude that both trait neutrality and filtering effects can be tracked in the vegetation changes during the first period of secondary grassland succession. High fluctuations in some trait values, however, were typical during the whole study period, which underlines that the effect of stochastic processes was especially important also in later stages in vegetation development.

The effect of grazing on grassland biodiversity is strongly dependent on grassland type and grazing intensity

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session 2, talk

Question: Optimal selection of the grazing intensity levels is essential for grassland conservation and for sustainable management. However, according to our previous findings, the selection of livestock type masks the effects of intensity. In addition to these two factors, the type of grassland is also a crucial and rarely analyzed factor. We addressed three study hypotheses: 1. Habitat-dependent effects of intensity hypothesis: The effect of grazing intensity on species and functional diversity is strongly dependent on grassland type. 2. Intensity-dependent selectivity hypothesis: The magnitude of diet selectivity of grazers decreases with increasing grazing intensity. 3. Intensity-dependent evenness hypothesis: Increasing grazing intensity increases evenness and functional evenness of the subjected grasslands.

Methods: We analyzed vegetation patterns in four types of grasslands (dry alkali short-grass steppes, dry loess steppes, non-alkali wet and alkali wet grasslands) along an intensity gradient of beef cattle grazing in 73 sites in Hungary. We analyzed species richness, Shannon diversity and evenness and the changes of four quantitative leaf traits (LDW, LDMC, LA, SLA). We calculated community-weighted means for each trait, multi-trait functional richness, functional evenness, and divergence for all leaf traits.

Results: Almost all species and functional diversity metrics were significantly affected by the grassland type. The effect of interaction between grazing intensity and grassland type was significant for almost all functional features, community-weighted means of LA, and species richness and evenness scores. An increasing trend of SLA was detected in all grasslands, but the change was also grassland type dependent. The detected changes suggest that with increasing intensity the selectivity of grazing animals is decreasing. We found that evenness was affected but functional evenness was not affected by grazing intensity. Functional evenness scores were related more to the grassland type than to changes in grazing intensity.

Conclusions: We stress that one-size- fits- all strategies cannot be recommended and actions should be fine-tuned at least at the level of grassland type. We found that out of the studied four typical grassland types of steppe zone, the species-rich loess grasslands were the most vulnerable and their species richness and functional diversity decreased the most rapidly even with the slightest increase in management intensity.

High resistance of grassland biodiversity to native woody encroachment in loess steppe fragments

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session 2, talk

Question: We explored the effect of native woody encroachment on grassland plant biodiversity in loess steppe fragments by analyzing the vegetation composition of grasslands with increasing level of encroachment. Both ancient and recovered grasslands were studied. We explored the following research hypotheses: (i) the increase of woody cover decreases total diversity, and the cover and species richness of dry grassland species; (ii) both grassland origin and woody cover affect grassland biodiversity in the studied grasslands.

Methods: Altogether 54 loess grassland fragments (31 ancient and 23 recovered grasslands) were studied in Hungary. Percentage cover of trees, shrubs and herbaceous vegetation were recorded in 400-m^2-sized plots. Effects of woody encroachment and grassland origin on diversity, total cover and richness, and richness and cover of dry grassland species were analysed.

Results: We found that moderate woody encroachment decreased neither the total herb cover nor the cover and species richness of dry grassland species. Grassland origin caused no significant difference in the reaction of herbaceous vegetation to woody encroachment. We found that both species richness and species composition were highly resistant to moderate woody encroachment, significant changes were detected only at high woody cover.

Conclusions: Moderate woody encroachment does not influence species composition and does not decrease diversity of loess grasslands. Thus, shrub encroachment cannot be regarded as degradation in contrast to overuse and/or misuse of grasslands. These findings suggest that moderately encroached loess grasslands can be easily restored by the suppression of woody species, as their species pool still contains many dry grassland species targeted for restoration.

(YIP) A new aspect of the dispersal of alien plants in grasslands - human-dispersed seeds can survive and disperse after the laundry cycle

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session 2, talk

Question: Invasive species represent a major threat for the biodiversity of grasslands worldwide. Unintentional human-mediated seed dispersal of alien plants on cloths and vehicles is a major threat for the flora of nature reserves. We studied a formerly overlooked component of human-mediated plant dispersal by assessing the effects of lavatory washing on the dispersed seeds. We asked the following questions: (i) Are cloth-dispersed seeds able to germinate after laundry washing? (ii) What are the effects of washing on the fitness of germinated seedlings and on the temporal dynamics of germination?

Methods: We studied the germination of 18 weed species, which have morphological adaptations for epizoochory and are commonly dispersed by people in grasslands. We tested six treatments (washing with water, washnut or detergent, at 30°C or 60°C) compared to an untreated control. We also tested the seed retention rate of the dry and the washed seeds of the species on three fabric types (blue jeans, fleece sweater, cotton socks).

Results: Our results showed that washing temperature was the most significant factor affecting germination. Washing at 30°C did not suppress germination of any of the studied species. Washing at 60°C supported the germination of two species, but suppressed six species. The intensive washing treatments at 60°C decreased significantly the synchrony of germination. Our measurements showed that more than 70% of attached seeds remain on our clothes for more than 8 hours and have the chance to enter the laundry cycle. 64% of washed seeds fall down from clothes during drying, thus, they might establish in an urban or rural environment. The remaining 36% of washed seeds can further disperse over a longer distance.

Conclusions: Our results showed that people are not purely transporting seeds from one location to another, but via the laundry cycle we also influence the fate of the transported seeds by affecting germination potential, seedling fitness and germination dynamics. These results have new implications for understanding the early stages of biological invasions. Our study highlights the importance of personal responsibility for unintendedly introducing exotic species to grasslands with high conservation value.

Changes in plant community composition along gradients of land management in São Miguel (Azores)

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session 4, poster

Question: The natural vegetation in many areas of the world has been completely replaced by pastures and monocultures, leading to biodiversity and ecological losses. The Azores are ideal to model those changes, with habitats ranging from natural to completely artificial, at relatively small distances. We aim to test bio indicators providing an integrated insight of the changes in soil microbial community along two gradients of land management intensity (MI) in Azorean grasslands and forests. In this work our main goal is to access the plant community composition of pasturelands in São Miguel and verify if it can be correlated with the gradient of land MI.

Methods: Samples were collected along two gradients of MI: High (grassland-corn rotation or production forest), Medium (permanent grassland or exotic forest) and Low (semi-natural grassland or natural forest). Soil analyses (bulk density, physicochemical parameters) followed standard protocols. Plant community composition and cover were assessed for three replicate plots (grassland 2x2 m, forest 5x5 m) per site, and herbarium specimens collected. So far, two sampling seasons have been conducted, Winter (W) 2018, Spring (S) 2018, in a total of 72 samples [2 ecosystems, 1 gradient, 3 rep (W), 9 rep (S)]. Two more sampling campaigns will be performed in the same period of 2019. We applied cluster, ordination and indicator species analysis to the plant data set.

Results: The grasslands could be assembled into four groups, indicating a clear gradient from low to high MI. Some seasonal differentiation was found in the grassland -corn rotation (high MI), but not in the other two MI levels. Similar results were found for forests.

Conclusion: These aboveground results will allow to better understand possible differences in the respective belowground microbial communities that are presently being analysed.

Effects of water buffalo grazing on wet meadow seasonal productivity of Prespa National Park

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session 2, poster

Question: Grazing in wetlands is considered as one of the most effective methods for the creation and maintenance of wet grasslands on areas that under no management interventions would be dominated by dense and often mono-specific stands of high emergent helophytes, such as reed beds of *Phragmites australis*. The purpose of the present research was to collect original data on the production characteristics of the littoral vegetation and to study the seasonal effects of water buffalo (*Bubalus bubalis*) grazing on the productivity of the littoral plant communities.

Methods: The research was conducted during 1997-2002 on a surface of 4.5 ha at the west shore of Lake Mikri Prespa, in the core area of Prespa National Park. Depending on the influence of the fluctuating water levels, four vegetation zones were identified in the study area. From the higher to the lower locations, the zones were: a) dry grassland, b) temporarily flooded zone, c) reedbed fringe, and d) reedbed proper. Water buffalo grazing was applied at a mean stocking rate of 1.5 animal units per ha per year. Additional treatments, namely summer cutting and winter burning, were applied in combination with water buffalo grazing. In each of the four vegetation zones, measurements of cover, vegetation composition and production in fixed and portable plots were performed. At the two lower zones, additional measurements were held on the cover and composition of vegetation in plots treated by yearly summer cutting and winter burning of the vegetation, as well as on the structural characteristics of the reed at all treatments. Vegetation in the first two zones included grasses, graminoids, legumes and forbs. From these, the vegetation in the reedbed fringe did not include legumes, while in the reedbed proper there were only grasses, graminoids and litter.

Results: The maximum production by month at the fixed plots was found in May for the dry grassland and in April, May and June at the lower zones, depending on the rate of water level decrease after its maximum late spring values. The maximum seasonal production at the dry grassland was recorded in spring, while at the wetter zones in spring and in summer. The above-ground/ emergent seasonal production at the portable plots was found maximum in spring at the first zone (3899 $kg*ha^{-1}$), in spring and summer at the second (5413 $kg*ha^{-1}$), in summer at the third (8646 $kg*ha^{-1}$) and in summer and autumn at the fourth zone (10,580 $kg*ha^{-1}$). Water buffalo grazing caused a substantial reduction in the cover of high emergent helophytes (by 29%) and increase of wet grassland species cover (by 32%), thus creating a wet grassland habitat type on a surface previously dominated by reeds. Additionally, grazing significantly affected reed structure by reducing the densities of fresh and dry stems, their height and diameter (by 69%, 58%, 84% and 26% respectively, compared to the control plots). Grazing was also very effective in maintaining low values for these parameters, thus preventing the re-establishment of reeds on the grazed plots.

Conclusions: As a conclusion, water buffalo grazing can be used as a management practice for the restoration and maintenance of wet grasslands at the littoral zone of Lake Mikri Prespa in the framework of a long-term management plan.

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Semi-dry grasslands of Central and Eastern Europe - syntaxonomic and biogeographical aspects

[KEYNOTE LECTURE]

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The semi-dry grasslands of Central and Eastern Europe, including the so-called meadow steppes, belong to the most species-rich vegetation types of the northern hemisphere and form an important part of the forest-steppe zone. In my talk, I will present results of a syntaxonomic revision, based on a large supra-national dataset. Moreover, I will discuss the biogeographical setting of semi-dry grasslands in the context of recent paleobotanical and phylogeographic findings.

For our syntaxonomic revision, we used a dataset of 34,173 relevés from Central and Eastern Europe which were assigned to the class Festuco-Brometea using the diagnostic species listed in the EuroVegChecklist. Based on several TWINSPAN classifications as well as expert knowledge, we established formal definitions for the order Brachypodietalia pinnati and the following alliances: Mesobromion erecti, Cirsio-Brachypodion pinnati (incl. Fragario-Trifolion montani, Agrostio-Avenulion schellianae, Scabioso ochroleucae-Poion angustifoliae and Adonido vernalis-Stipion tirsae), Scorzonerion villosae and Chrysopogono-Danthonion. Another alliance, Armerion elongatae (= Koelerio-Phleion phleoidis p.p.), is transitional towards the class Koelerio-Corynephoretea and its status needs further evaluation. We also established formal definitions of all associations of the Mesobromion and Cirsio-Brachypodion within the study area.

Our results show that meadow steppes of the forest-steppe zone of Eastern Europe are very similar to semi-dry grasslands of Central Europe. In fact, there is growing evidence that the European semi-dry grasslands represent an ancient species pool of forest-steppe vegetation which has existed continuously for several glacial circles. While the semi-dry grasslands of Western Europe are thought to be a product of human activities since the Neolithic, there is numerous evidence for the persistence of steppe-like vegetation in eastern Central Europe throughout the Holocene. The main factors allowing grassland persistence in these regions were (1) the climate of the early Holocene, which was warmer and drier than today, (2) fire and grazing by wild herbivores, potentially slowing down the encroachment of forests when the climate became wetter at the onset of the mid-Holocene, and (3) the early arrival of neolithic farmers, which gave the forests little time to gain full dominance.

Apart from the “mid-Holocene bottleneck”, the Last Glacial Maximum (LGM) constituted another critical period for the species pool of semi-dry grasslands in Central Europe. Large parts of Eurasia are thought to have been covered by “steppe-tundra” (also known as “mammoth steppe”), a biome seemingly lacking an analogue in the present. However, the “steppe-tundra” was probably a mosaic of vegetation types which under current climatic conditions rarely co-occur in one region: desert steppes, grass steppes, meadow steppes, tundra and small patches of taiga forests. For the Carpathians, the presence of taiga and hemiboreal forests even during the LGM has been confirmed by both pollen and macrofossil evidence. Hemiboreal coniferous forests, as currently found in easternmost Europe and southern Siberia, harbour many species of semi-dry grasslands and are often part of a continental type of forest-steppe.

New findings show that phytosociology can provide additional support for the hypothesis of a long-term continuity of semi-dry grassland species within Central Europe.

(YIP) Biodiversity in pastures of the "haymilk" region Neumarkt in der Steiermark

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session 1, talk

Questions: What is the mean species richness in pastures of traditionally managed grasslands in Styria, that are currently used for an economic milk production? Does grazing intensity influence species richness? Which factors promote species richness in traditionally managed pastures in a mountain region of Styria?

Methods: We sampled the pastures of farmyards in the market village Neumarkt in der Steiermark (Austria) that take part in a haymilk program. Hay-production and at least 120 days of pasturing are obligatory. The correlation of species richness with social affiliation, grazing intensity and environmental factors were investigated.

Therefore, we analysed 58 nested-plot series (0.0001 – 10 m^2 plot size) along different grazing intensities. For classification we implemented data from an earlier work (2005) from the surrounding area. We classified the plant communities using TWINSPAN analysis, DCA ordination and semi-supervised classification with K-means. The influence of environmental factors on plant richness was analysed by a multi model interference (GLM). Grasses to herbs ratio was calculated for different grazing intensities. We calculated β-diversity by means of z-values derived from the species-area relationship and tested the influence of grazing intensity.

Results: The current relevés represent two associations of the *Cynosurion* alliance: the relative nutrient-poor Festuco commutatae-Cynosuretum and the nutrient-richer Lolio perennis-Cynosuretum. The DCA shows nutrients and moisture as the strongest environmental gradients with a clear division of the two associations. For the grazing intensities we get a heterogeneous image. The most important factor for species richness is slope (positive) followed by grazing intensity (negative). Extensively grazed pastures show highest species richness. A grasses-herbs ratio of 1:2 was calculated for all grades of intensity. The *z-value* analysis shows the highest values on smallest spatial scales. Moderate grazing intensity affects species gain positively only in the largest plot sizes.

Conclusions: The investigated grazing model benefits an establishment of biodiversity-rich grasslands with high proportion of herbs in pastures. We assume this plant-richness to be the reason for high-quality fodder that ends up in a high-quality milk-product. An advancement of the haymilk programme could include increasing the forb proportion, for example by a greater flexibility concerning mowing dates. Furthermore, an establishment of protein-rich dicotyle plants from the regional species pool would be preferable.

(YIP) Microclonal multiplication of rare plant Stipa donetzica Czupryna in vitro conditions

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session 2, poster

Question*: Stipa donetzica* Czupryna (*Poaceae*) is a very rare and endemic species for Ukraine. It is locally distributed in the Luhansk region (eastern part of Ukraine) (Kondratiuk & Chuprina, 1992; Ostapko, 2001). The reduction in the number of populations is observed due to anthropogenic influence. *Stipa donetzica* is included into the collection of the Donetsk and Kryvyi Rih Botanical Gardens (Ukraine).

Methods: One effective method of *Stipa* plants preservation is microclonal multiplication under *in vitro* conditions, with the subsequent transfer to greenhouse and open ground conditions. The aim of our work was to select the conditions for seed sterilization and the optimal nutritional medium for microclonal multiplication. The object of the research were *Stipa donetzica* plants of the Kryvyi Rih Botanical Garden reproduction, seeds were obtained from the Kryvyi Rih Botanical Garden NAS of Ukraine in June 2015. Different sterilization procedures were tested for seed sterilization: ethanol in concentration 70% and Bilyzna 15% (commercial bleach) during several time periods for seed treatment.

Results: The most efficient seed sterilization with the lowest contamination and the highest seed germination value was achieved by use of 70% ethanol - 2 min, then 15% Bilyzna - 15 min and 3-time rinses with sterile water during 15 min. After sterilization, the seeds were transferred on hormone-free sterile nutrient agar medium Murasige and Skoog (MS_{30}) (Murashige & Skoog, 1962) with 30 g/l sucrose + 1mg/l TDZ (1-phenyl-3- (1,2,3-thiadiazol-5-yl) urea)) sucrose (22-26^{0}C, 14-hour light period, illumination - 3000 - 4500 lx). The seeds germinated after 1 week of cultivation. Formations of numerous shoots (from 3 to 7 from one seed) were observed.

After 2 weeks after germination, the plants were transferred on the MS_{30} medium supplemented with 1mg/l BAP (6-benzylaminopurine) and 0.2mg/l NAA (1-naphthylacetic acid) or 0.2mg/l IAA (indole-3-acetic acid) for elongation of the shoots and rooting.

After 10 days of cultivation on the MS_{30} medium with growth regulators, roots began to form. The plants were transferred in the pots with soil and were grown in the greenhouse (22-26^{0}C, 14-hour light period, illumination - 3000 - 4500 lx), after 1 month of cultivation on medium MS_{30} with growth regulators. Later, the young plants were transferred to a permanent place in an open ground on the experimental area, which imitated a natural steppe flora (in the Fomin botanic garden, NAS of Ukraine).

Bryophytes in Central European grasslands

Excursion course on the occasion of the 16th Eurasian Grassland Conference (EGC), May 2019, in Austria and Slovenia

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Introduction

Bryophytes are important vegetation components, especially in forests and wetlands. Even in grassland and other herbal vegetation types (dunes, dwarf shrub heaths, arable fields and ruderal vegetation) they occur frequently under certain conditions.

In general, terrestrial bryophytes prefer soils with a higher moisture level and a lower nutrient level. Low cover of the herb layer often indicates the occurrence of terrestrial bryophytes. However, even a 100 % cover of the herb layer does not mean that bryophytes are absent on the soil surface. You should always check this carefully during the fieldwork, simply by pushing the grasses apart.

Bryophyte recording in herbal vegetation (e.g. grassland)

The assemblage of terrestrial bryophytes in herbal vegetation is called the moss layer (including lichens as well). Anyone who samples vegetation plots should strive to include terrestrial bryophytes and lichens in the relevé.

Epilithic bryophytes growing on stones and rocky outcrops in dry grassland should better not be included in the moss layer. They do not share the same ecological conditions as the moss and herb layer and therefore stand somewhat “outside” the vegetation relevé. Usually, we ignore those epilithic bryophytes during a vegetation record. However, considering the vegetation plot as a holocoenosis (and depending on our question and time budget), it can be useful to include them as rock layer in the relevé. In this case, the general cover value of rocks in the relevé must be recorded, and the epilithic bryophytes will provide a new diagnostic feature of inner-plot heterogeneity. In this case, we must keep in mind that comparability can be assumed only between relevés of the same deepness of investigation.

Estimation of cover values of bryophytes

To estimate cover values of bryophytes, the usual rules of phytosociological sampling do not fit completely. Using percentage cover values, you will never have any problems besides that extremely small percentage covers are difficult to estimate. Combined abundance-dominance scales like “Braun Blanquet new”, however, cause some problems. Cover values below 5 % cover (r, +, 1 and 2m) are based on the counting of individuals. Normally, bryophyte species (with exceptions, of course) are below 5 % in herbal vegetation! If you found a tiny group of bryophytes, smaller than a Cent-coin, this can include dozens of “individuals” of acrocarpous mosses, and in liverworts or pleurocarpous mosses, the recognition of “individuals” is as difficult as in perennial grasses, for instance.

So, I recommend a pragmatic approach for the “Braun-Blanquet new” scale: if I find a small (below 5 % cover) bryophyte “group” within a relevé once, I use the “r”, twice the “+”, and beyond that my standard cover value for bryophytes is 1. From 5 % cover upwards, everything is fine ("2a" and more), and I never use "2m" for bryophytes.

Collecting

Many characteristic bryophytes in grassland can be recognized in the field with some experience. Others should be checked under the microscope, even if our bryophyte knowledge is excellent. So during vegetation recording, we have to collect at least some bryophytes (and lichens). Collecting bryophytes and lichens is easy, usually they do not need any elaborate preparation. We can collect small samples, wrap it in labelled paper and dry it. I prefer small paper bags made for seed samples, but this luxury variant has a disadvantage. These bags are produced with water-soluble glue, and if it rains, or if you have collected *Sphagnum* and other wetland bryophytes, you will find a mix of properly labelled paper sheets and loose bryophytes in your collecting bags at the end of the field day. A cheap and good variant is to use pieces of old newsprint. Wrap it tightly around the bryophyte specimen (some pressure is possible, but not needed) in a way that the newspaper border is situated outside for labelling (with a soft pencil!). Store it tightly in your collecting bags so it cannot unwrap again. A plastic collecting bag is fine during the day, but not for storing fresh specimens. Take the collection of the day out of the collecting bags in the evening of every field day to dry the samples inside their paper. It is not necessary to unwrap them. Dry material can then be stored tightly side-by-side, waiting for examination with a microscope in long winter nights.

Seasonality

Most bryophytes grow as wintergreen perennials; seasonality is no problem. They can be collected and determined all around the year, although the best times for collecting bryophytes are late autumn, snow-free winter and early spring, when vascular plants are not so conspicuous and many bryophytes show sporophytes. However, especially in dry grassland, ruderal stands or segetal vegetation, we can find some short-living bryophytes only after longer periods with permanent soil moisture, mainly in spring or autumn. Such bryophytes quickly disappear during dryer periods (summer) or after strong frost periods (winter) and will be missed in many relevés.

Some species that are hardly distinguishable without sporophytes or brood bodies, which are not always present, for instance species of the large genera *Bryum* and *Weissia*, cause a comparable problem. You often must be content with genus level in the species list.

General morphological types and characters of bryophytes

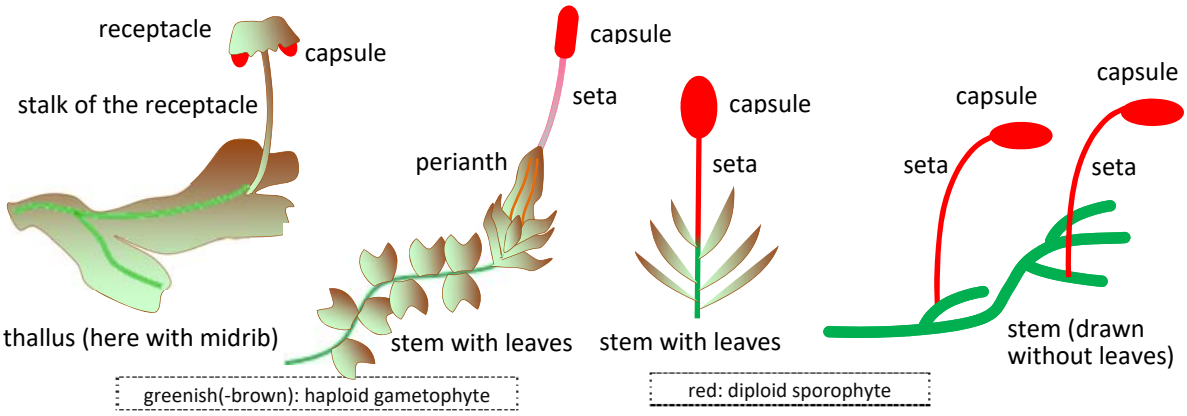
Please note: This chapter describes important morphological features and differences of bryophytes frequently found in grassland and ruderal stands. Morphological features and exceptions pertaining to species of other habitats are omitted. Therefore the descriptions given below apply in general, but exceptions do exist.

All bryophytes perform an alternation of generations between a haploid gametophyte phase (the green plant) and a diploid phase (the sporophyte) without chlorophyll producing the spores (contrary to the vascular plants that have evolved the diploid sporophyte phase as the green plant). Bryophytes comprise three taxonomic groups, the hornworts (Anthoceropsida), the liverworts (Hepaticopsida) and the mosses (Bryopsida). Hornworts are extremely rare and species poor and look like thallose liverworts. Liverworts and hornworts rarely occur in grassland and other plant communities. Most bryophytes we will find are mosses.

For determination, we distinguish four (taxonomically irrelevant) morphological habitus types:

The **(1) thallose liverworts** and hornworts have no leafy structures and occur in green (mostly dichotomous) ribbons, irregular patches, or dissected rosettes. They always have isodiametric cells with elliptical chloroplasts. They can only be confused with the prothallia of ferns, which are heart-shaped and mostly one cell layer thick, while many thallose liverworts are more highly differentiated. The thalli of lichens are never pure green and consist of densely packed hyphae (plectenchyma) with chlorophyllous algae or cyanobacteria nested inside.

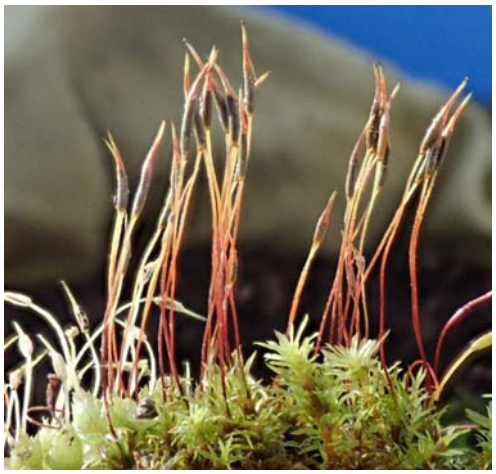
The **(2) foliose liverworts** are characterized by two distichous rows of leaves in one plane. They grow mainly prostrate, with a distinctly dorsiventral habit: the dorsal side shows the two (rarely seemingly four in Scapaniaceae) rows of leaves, the ventral side is attached to the substrate with rhizoids and sometimes has a third row of morphologically different, so-called underleaves, which are generally much smaller. All leaves are circular or oblong, but never lanceolate or linear, with a broad and often oblique attachment to the stem. The apex is often rounded, or the leaves are bicuspidate or even tricuspidate. A midrib is lacking, the cells are isodiametric, rarely oblong, never rhomboidal or elongated. The sporophyte is short-living, with globose, shiny black capsules, never opening with a lid, and the seta is colourless and fragile.



(1) thallose liverwort **(2) foliose liverwort** **(3) acrocarpous moss** **(4) pleurocarpous moss**

The **mosses** are generally spirally foliate, with narrow leaf base transversely attached. The leaves are often narrow, with only one obtuse or acute apex and frequently with a midrib. Cells are differently shaped, sometimes isodiametric ("parenchymatic") but often narrowly elongated (“prosenchymatic”). The sporophyte is long-living, with capsules mostly green or brown, frequently opening with a lid; the seta is pigmented. Exceptionally, distichous foliation occurs, but the leaves either have a midrib (*Fissidens*), or are narrowly linear (*Distichum*). Complanate habitus is not so rare, pretending a distichous foliation at the first view, but the spiral foliation is still visible in the arrangement of the leaf scars. The mosses occur in two habitus types: **(3) acrocarpous mosses** have more or less unbranched, upright growing shoots, with

sporophytes appearing at the apex. The **(4) pleurocarpous mosses** have prostrate or ascending, much branched shoots, with sporophytes appearing on short side braches.

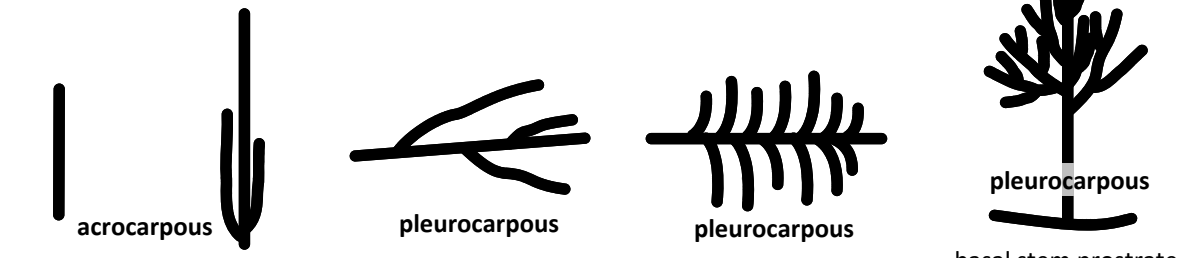


sporophytes of mosses

sporophytes of liverworts

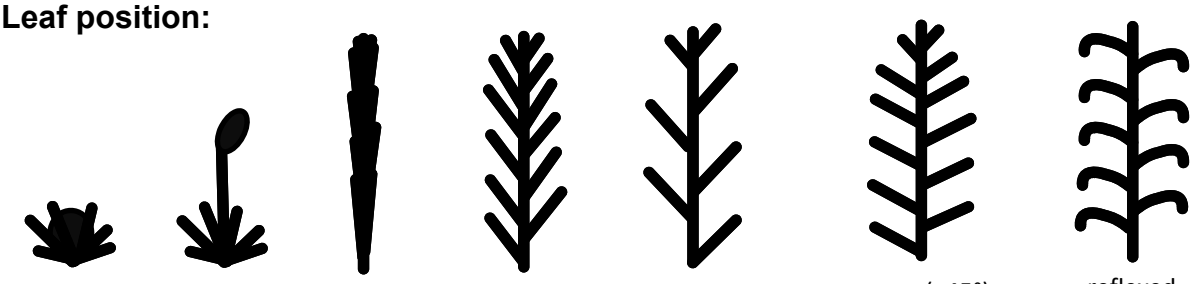
Characters of the gametophyte

Branching pattern of the stem (leaves not drawn):



erect, un-branched | erect, basally branched | prostrate, irregularly branched | prostrate, pinnate | basal stem prostrate, branches dendroid

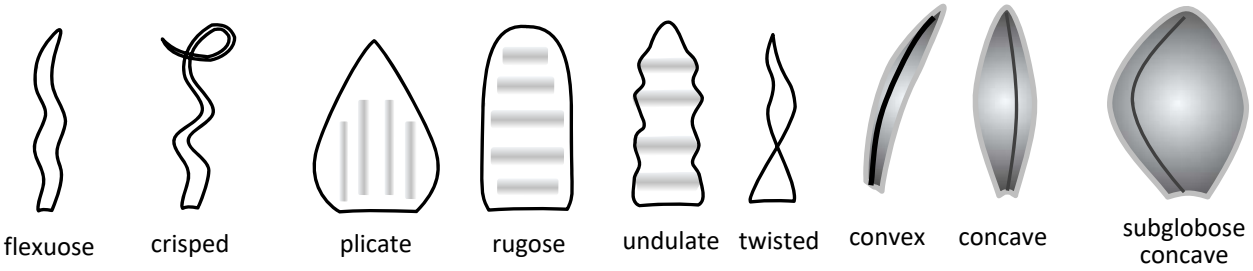
Leaf position:



acaulescent, leaves in rosettes | apressed | erecto-patent (<45°) | distant | patent (>45°) | reflexed, squarrose

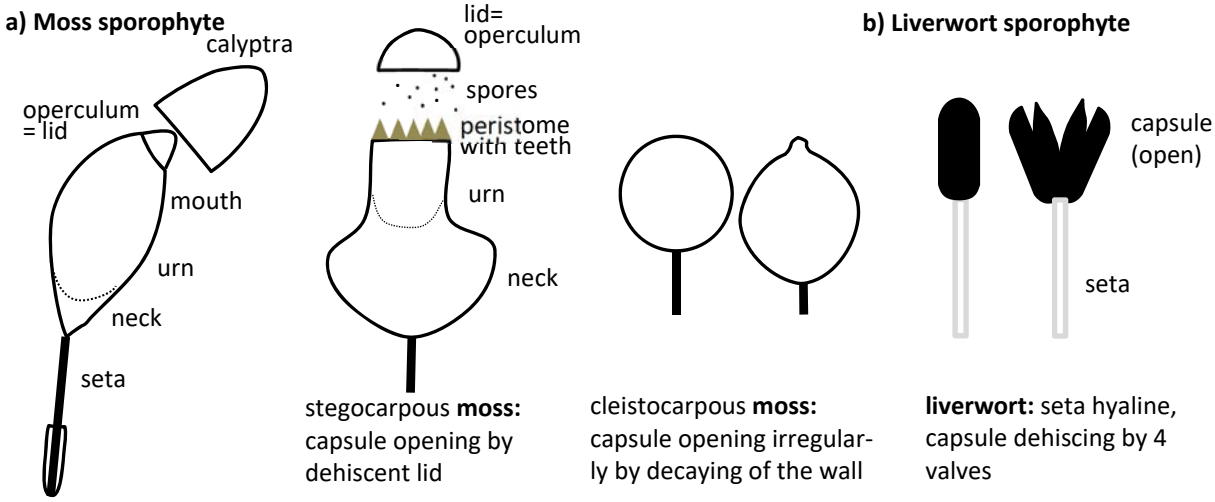
julaceous | homomallous, falcate | **liverworts**: distichous bicuspidate leaves from dorsal side. | **liverworts**: distichous ovate leaves from ventral side with underleaves

Leaf appearance:



Characters of the sporophyte

Parts and features of the capsules:

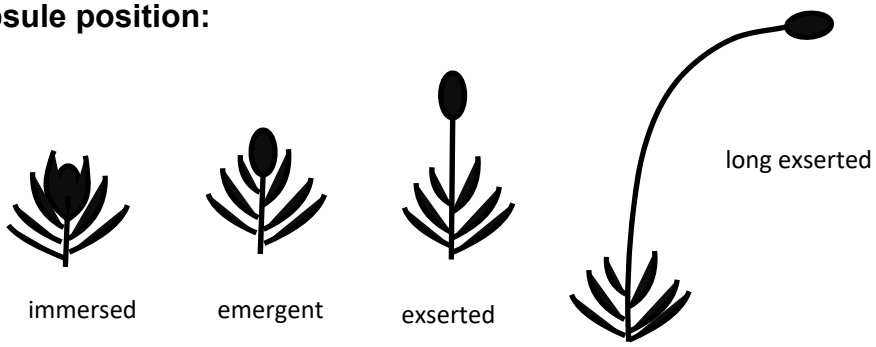


stegocarpous **moss:** capsule opening by dehiscent lid

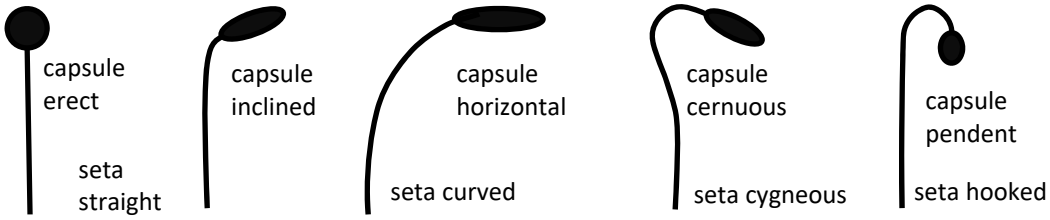
cleistocarpous **moss:** capsule opening irregularly by decaying of the wall

liverwort: seta hyaline, capsule dehiscing by 4 valves

Capsule position:

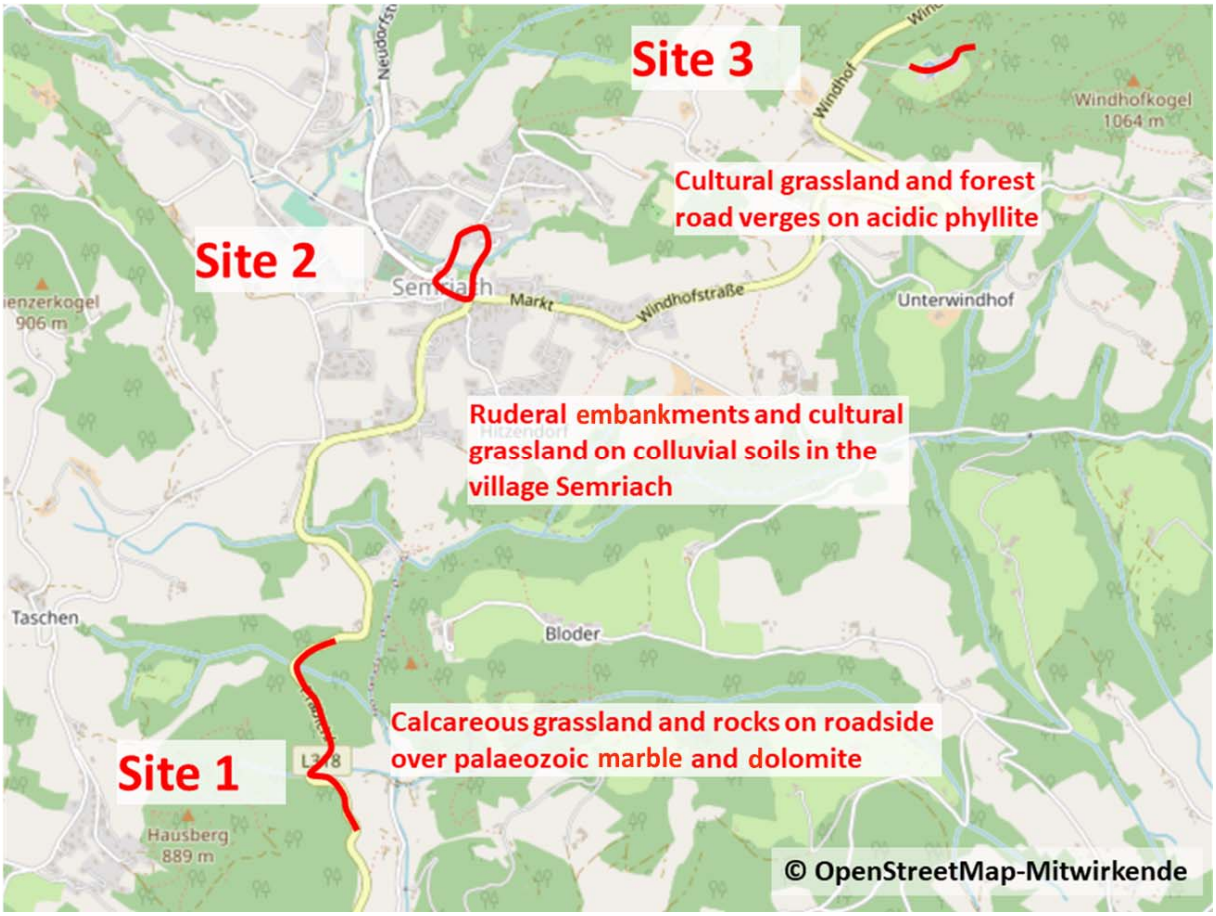


Capsule inclination and seta curvature:



Sites of the field course

The course focuses on field knowledge and not on bryophyte determination with a microscope in the laboratory. We will make a short trip to the north of Graz and collect different, mainly common species. We will visit three sites around the village Semriach:



Site 1: Austria, Styria, 15 km north of Graz, 1.7 km south of Semriach, 47°12'12.92"N, 15°23'47.90"E, 640 m alt.; road verges and calcareous rocks (palaeozoic marble and dolomite).

Site 2: Austria, Styria, 17 km north of Graz, Semriach, village center, 47°13'07.58"N, 15°24'08"E, 700 m alt.; ruderal places and cultural grassland (tertiary colluvium).

Site 3: Austria, Styria, 17 km north of Graz, Semriach, settlement Ulrichsbrunn, 47°13'29"N, 15°25'34"E, 955 m alt.; cultural grassland and forest road embankments (palaeozoic phyllite).

Participants can expect that about 30 species will be collected. Of course, we did not select species-rich grassland sites of high conservation value but roadsides, settlements and ruderal places. There we can easily collect the species without endangering populations.

Bryophytes in different grassland or ruderal classes of Central Europe

The lists are based on BERG & DENGLER (2005) and on the expert system of MUCINA et al. (2016), checked and added by several thousand grassland relevés from the vegetation databases from Mecklenburg-Vorpommern and Austria (JANSEN et al. 2012, WILLNER et al. 2012). Phytosociological nomenclature follows MUCINA et al. (2016), bryophyte nomenclature

follows HODGETTS (2015). Bold letters indicate species that could be collected during the field trip, the numbers in parentheses are the site numbers listed above.

Polygono-Poetea annuae

Barbula convoluta **(3)**, ***Barbula unguiculata*** **(1, 2, 3)**, ***Bryum argenteum*** **(1)**, *Bryum rubens*, ***Ceratodon purpureus*** **(1, 2)**, *Lunularia cruciata*, *Marchantia polymorpha* subsp. *ruderalis,*

Sisymbrietea

Bryum argenteum **(1)**, ***Bryum caespiticium*** **(2)**, ***Funaria hygrometrica*** **(2)***, Leptobryum pyriforme*, *Pseudocrossidium hornschuchianum*

Papaveretea rhoeadis (= Stellarietea mediae)

Anthoceros agrestis, *Bryum atrovirens* agg., *Dicranella staphylina*, *Ditrichum cylindricum*, *Leptobryum pyriforme*, *Notothylas orbicularis*, *Phaeoceros carolinianus*, *Tortula acaulon* (= *Phascum cuspidatum*), *Physcomitrium pyriforme*, *Riccia bifurca*, *Riccia glauca*, *Riccia sorocarpa*, *Riccia warnstorfii*, *Tortula truncata* (= *Pottia truncata*)

Koelerio-Corynephoretea and Sedo-Scleranthetea (→ Nardo-Callunetea)

Atrichum undulatum **(3)**, ***Brachytheciastrum velutinum*** **(3)**, *Brachythecium albicans*, ***Bryum argenteum*** **(1)**, *Campylopus introflexus*, *Cephaloziella divaricata*, ***Ceratodon purpureus*** **(1, 2)**, ***Dicranum scoparium*** **(3)**, ***Hylocomium splendens*** **(3)**, ***Hypnum cupressiforme*** **(1, 3)**, *Hypnum jutlandicum*, ***Pleurozium schreberi*** **(3)**, ***Polytrichum formosum*** **(3)**, *Polytrichum juniperinum*, *Polytrichum piliferum*, *Racomitrium canescens* agg., *Racomitrium lanuginosum*, *Rhynchostegium megapolitanum*, *Syntrichia ruraliformis*, ***Syntrichia ruralis*** **(2)**

Festuco-Brometea

Aloina rigida, ***Campylium chrysophyllum*** **(1)**, *Dicranella varia, Didymodon fallax,* ***Didymodon ferrugineus*** **(1)**, ***Ditrichum flexicaule*** **(1)**, *Encalypta vulgaris,* ***Entodon concinnus*** **(1, 2)**, *Fissidens taxifolius,* ***Homalothecium lutescens*** **(1)**, ***Hypnum cupressiforme*** **(1, 3)**, *Leiocolea alpestris, Lophocolea minor*, *Pottia lanceolata*, *Preissia quadrata*, *Pterygoneurum ovatum*, *Pterygoneurum subsessile*, ***Rhytidiadelphus triquetrus*** **(1, 2)**, ***Rhytidium rugosum*** **(1)**, ***Thuidium abietinum*** **(1, 2)**, ***Thuidium assimile*** **(1, 2, 3)**, ***Tortella inclinata*** **(1)**, *Tortella squarrosa*, *Weissia brachycarpa*, *Weissia controversa*

Species on calcareous rocks sometimes occur on gravel and soil in Festuco-Brometea

Ctenidium molluscum **(1)**, ***Encalypta streptocarpa*** **(1, 2, 3)**, ***Fissidens dubius*** **(1)**, ***Grimmia pulvinata*** **(2)**, ***Homalothecium sericeum*** **(1)**, ***Schistidium apocarpum*** **agg. (1, 2)**, ***Tortella tortuosa*** **s. l. (1)**, ***Tortula muralis*** **(1, 2)**

Molinio-Arrhenatheretea (All. Cynosurion)

Amblystegium serpens **(1, 2, 3)**, ***Barbula unguiculata*** **(1, 2, 3)**, ***Brachythecium rutabulum*** **(1, 2, 3)**, ***Brachythecium salebrosum*** **(2, 3)**, ***Calliergonella cuspidata*** **(2)**, ***Cirriphyllum piliferum*** **(2, 3)**, ***Climacium dendroides*** **(2)**, ***Eurhynchium angustirete*** **(3),** ***Oxyrrhynchium hians*** **(1, 2, 3)**, *Fissidens taxifolius*, ***Lophocolea bidentata*** **(2)**, *Physcomitrium pyriforme*, *Plagiomnium affine*, ***Plagiomnium cuspidatum*** **(2)**, ***Plagiomnium undulatum*** **(2, 3)**, ***Rhytidiadelphus squarrosus*** **(2, 3)**, ***Pseudo-scleropodium purum*** **(3)**

Useful books for the determination of bryophytes:

Although for Switzerland and Austria no contemporary determination books on bryophytes are available, the "Moosflora" of FRAHM & FREY (2004) covers many areas of Central Europe, except the high alpine region (please note, that this book contains a lot of errors, especially regarding page references). Excellent pictures of Central European mosses were presented by LÜTH (2004–2011) and they are available online under http://www.bildatlas-moose.de. FREY et al. (2006) have published a useful book in English, with keys for all European species. Good pictures and explanations can be found in a book of the British Bryological Society (ATHERTON et al. 2010). SCHUMACKER & VÁŇA (2005) presented a key for all European Hepaticae. For deeper insights, the books of the British bryologist Anthony J. E. Smith on liverworts (SMITH 1990) and on mosses (SMITH 2004) are recommended.

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