Plant Science & Biodiversity Center Slovak Academy of Sciences, Institute of Botany

30th Conference of the European Vegetation Survey
May 9 – 13, 2022, Bratislava (Slovakia)

30th
EVS Bratislava
2022

Plant communities in changing environment

Book of abstracts

Bratislava (Slovakia)

2022

Organizer

Plant Science & Biodiversity Center Slovak Academy of Sciences, Institute of Botany, Bratislava

&

co-organizers

Slovak Botanical Society, Bratislava

Geobotany s.r.o., Bratislava

30th Conference of the European Vegetation Survey

May 9 – 13, 2022, Bratislava (Slovakia)

Plant communities in changing environment

Book of abstracts

Richard Hrivnák & Michal Slezák (eds)

ISBN 978-80-974243-0-5

Scientific Committee

Fabio Attorre, Sapienza University of Rome, Italy
Idoia Biurrun, University of the Basque Country, Bilbao, Spain
Milan Chytrý, Masaryk University, Brno, Czech Republic
Anna Kuzemko, M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine
Joop Schaminée, Wageningen Environmental Research, Wageningen, the Netherland
Emiliano Agrillo, Italian Institute of Environmental Protection and Research (ISPRA), Rome, Italy

Local Organizing Committee

Jozef Šibík, Mária Šibíková, Iveta Škodová, Monika Janišová, Katarína Vantarová, Jana Májeková, Milan Valachovič, Ivan Jarolímek, Denisa Bazalová, Lucia Čahojová, Simona Klačanová, Michaela Michálková, Richard Hrivnák, Michal Slezák and others (all Plant Science & Biodiversity Center SAS).

Citation

Hrivnák, R. & Slezák, M. (eds), 2022: Plant communities in changing environment. 30th Conference of the European Vegetation Survey (May 9 – 13, 2022, Bratislava, Slovakia). Plant Science & Biodiversity Center SAS, Bratislava. ISBN 978-80-974243-0-5

Plenary presentations

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Synthesizing information on European vegetation: where are we now?

Milan Chytrý and collaborators

Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, chytry@sci.muni.cz

Key words: Biodiversity, Biogeography, Database, EuroVegChecklist, EUNIS habitat, European Vegetation Archive, Resurvey, Vegetation change, Vegetation classification

Synthesizing information on European vegetation is one of the main goals of the European Vegetation Survey Group. Here, I review the work that has been done over the past ten years to achieve this goal, as well as promising research avenues for the future. There are two main types of syntheses: those based on vegetation types and those based on vegetation plots.

The syntheses based on vegetation types work with the units of the phytosociological classification system. The milestone works in this direction, both published in 2016, were the European Red List of Habitats and the list of European vegetation syntaxa (EuroVegChecklist). The Red List used a preliminary revision of the EUNIS habitat types, which was developed further simultaneously with the preparation of the EUNIS-ESy expert system. This expert system made it possible to create distribution maps and define diagnostic, constant and dominant species for EUNIS habitats (in 2020). The EuroVegChecklist also underwent some modifications proposed on the basis of detailed studies and regulated by the European Vegetation Classification Committee. A team of European vegetation experts produced maps of the European alliances at the country and region resolution (in 2022) and continues to compile a database with standardized descriptors of the ecological and biogeographical characteristics of each alliance. Information on the revised EUNIS habitats and the revised EuroVegChecklist has been recently summarized in the online database FloraVeg.EU, which also contains ecological information on the European plant species in relation to habitat and vegetation types.

The syntheses based on vegetation plots use data from the European Vegetation Archive (EVA, launched in 2014). EVA provided data for the revision of EUNIS habitats and several international classification studies, which resulted in refinements of the EuroVegChecklist. However, EVA also provided data for recent studies that made major contributions to the knowledge of other aspects of European vegetation diversity, namely species richness, functional diversity, phylogenetic diversity and habitat-specific patterns of plant invasions. The most recent initiative within EVA is ReSurveyEurope, which aims at collecting data from repeated vegetation sampling in permanent or quasi-permanent plots across Europe. With the increasing impact of environmental changes, the analysis of temporal trends in vegetation using ReSurveyEurope will be increasingly important.

Grassland with tradition – connecting plant diversity and land-use data in the Carpathian Mountains

Monika Janišová and collaborators

Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences, Banská Bystrica, Slovakia, monika.janisova@gmail.com

Key words: Grassland management, Meadows, Plant diversity, Landscape, Pastures, Species pool, Traditional farming

In most European countries, traditional farming is no longer practiced; it has been either substantially modified or replaced by modern farming approaches. However, in remote mountain areas of the Carpathian Mountains, historic land-use patterns and farming approaches have survived to the present day.

We developed a sampling methodology to survey traditionally managed grassland ecosystems holistically, including abiotic, biological and cultural phenomena, and reflect thus the multidimensionality of traditional farming. Our main objective was to reveal the connection between particular management practices and precisely measured plot plant diversity. At the same time, we focused on identifying traditional farming approaches that lead to high biodiversity and sustainable use of grassland in a particular region and confirming their impact through statistical tests.

The multitaxon vegetation sampling at seven spatial scales combined with soil analyses, detailed land-use information derived from interviews with the land parcel owners, satellite pictures and historical materials provide potentially valuable data for several scientific disciplines, including syntaxonomy, plant ecology, environmental anthropology and ethnology. Examples of grassland management practices based on traditional ecological knowledge can serve as an inspiration for developing modern biodiversity conservation strategies applicable to rural regions.

The data obtained so far are stored in the „Grassland with Tradition“ database, registered in the Global Index of Vegetation-Plot Databases (GIVD) with the identifier ID EU-00-032. To date, it contains data from 38 study sites in 8 countries (Austria, Czech Republic, Slovakia, Hungary, Poland, Romania, Serbia and Ukraine).

In our talk we will provide the first insight in land-use related plant composition and diversity parameters of traditionally managed grasslands across the Carpathian Mountains.

Acknowledgements: Our research was supported by the National Geographic Society, grant NGS-288R-18 on “Carpathian grasslands – genuine celebration of cultural and natural diversity“, and by the Slovak Academy of Sciences, grant VEGA 2/0095/19 on “Traditional ecological knowledge for grassland conservation and restoration“.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Vegetation and habitat survey in Ukraine

Anna Kuzemko[1,2]

[1]Department of Geobotany and Ecology, M.G. Kholodny Institute of Botany, Kyiv, Ukraine, anyameadow.ak@gmail.com
[2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic

Key words: databases, habitat classification, vegetation classification

Ukraine is the largest country, the entire territory of which is located on the European continent. The total area of Ukraine is 603,548 km^2, i.e. 5.7% of Europe's territory. Most of Ukraine lies within the Continental and Steppe biogeographical regions, the Carpathian Mountains represent the Alpine, and the Transcarpathian lowlands - the Pannonian bioregion. According to the modern geobotanical zoning of Ukraine (Didukh & Shelyag-Sosonko 2003), four natural zones are distinguished in Ukraine: Forest zone, Forest-Steppe zone, Steppe zone, Sub-Mediterranean zone, these zones include seven geobotanical provinces. This diversity of natural conditions has also led to the richness and diversity of vegetation and habitats of Ukraine.

Until the 1980s, the vegetation of Ukraine was studied using the so-called ecological-phytocenotic (dominant) approach that prevailed in the USSR. The result of these studies was a four-volume series "Vegetation of the UkrRSR": natural meadows (Afanasiev 1968), bogs (Bradis & Bachurina 1969), forests (Bradis et al. 1971), and steppes, outcrops, sands (Barbarych 1973), as well as Prodromus of Vegetation of Ukraine (Shelyag-Sosonko et al. 1991). The first works using the methodological approaches of J. Braun-Blanquet appeared in the early 1980s. Their main results are summarized in the three aproaches of syntaxonomy of Ukraine by Solomakha (1995, 1996, 2008). The results of these studies were critically revised and detailed in the multi-volume edition "Vegetation of Ukraine". To date, four volumes have been published: on high-mounaine (Malynovskyi & Kricsfalusyi 2000), aquatic (Dubyna 2006), halophytic (Dubyna et al. 2007) and meadow (Kuzemko 2009) vegetation. The most modern survey of the vegetation of Ukraine is a new edition of the Prodromus of Vegetation of Ukraine (Dubyna et al. 2019), prepared using the approach of J. Braun-Blanquet school. It includes 1003 associations belonging to 253 alliances, 128 orders and 74 classes, of which 605 associations, 107 alliances, 14 orders and four classes were described from the territory of Ukraine. However, only 46 alliances and 5 orders described from Ukraine were accepted in the EuroVegChecklist (Mucina et al. 2016). In addition to syntaxa of vascular plants, the Prodromus includes one class of algal vegetation (*Charetea*) and 11 classes of bryophyte vegetation. Unfortunately, lichen syntaxa were not included in the Prodromus, as most of the work on this topic were published when Prodromus was almost ready for publication (Khodosovtsev 2015; Khodosovtsev et al. 2011, 2017, 2019; Kapets et al. 2018).

Both the four-volume edition "Vegetation of Ukraine" and the Prodromus are based mainly on the author's syntaxonomic solutions and not on meta-analysis of vegetation plots. In the early 2000s, when this work began, there was not enough digitalized data for such a synthesis. However, after 2010 an active development of phytosociological databases in Ukraine has begun. As of the beginning of 2022, 12 purely Ukrainian databases were registered in the GIVD, and another 12 databases with a wider geographical coverage contain data from the territory of Ukraine. Three Ukrainian databases are currently part of the sPlot database and six databases are part of European Vegetation Archive (EVA). They are now widely used to revision some classes and orders of vegetation throughout Europe

(Peterka et al. 2017, Willner et al. 2017a, b, 2019, Marcenò et al. 2018, Landucci et al. 2020, Bonari et al. 2021, Jiroušek et al. 2022, etc.). Some similar EVA projects using Ukrainian data are still in progress. The National Phytosociological Database of Ukraine (UkrVeg) currently includes about 30,000 relevés, but there are still gaps in both some regions and vegetation classes. Further development of this database will allow for a large-scale analysis of Ukraine's vegetation in the near future.

In parallel with the development of vegetation classification, the habitat classification of Ukraine is being developed as well. The first works in this direction appeared in the early 2000s (Didukh & Shelyag-Sosonko 2001, Didukh & Kuzemko 2005, Yakushenko 2005). These works initiated the development of the national classification of habitats of Ukraine, which was named "UkrBiotop" and was based on the principles of the EUNIS system with some modifications. Three monographs were published using this system: on habitats of Forest and Forest-Steppe zones (Didukh et al. 2012), Crimea (Didukh et al. 2016) and Steppe zone (Didukh et al. 2020). Moreover, the National Habitat Catalog of Ukraine (Kuzemko et al. 2018) was prepared, which, like the analogous catalogs of the Czech Republic (Chytrý et al. 2001; 2010), Slovakia (Stanová & Valachovič 2002), Hungary (Bölöni et al. 2011), and Romania (Doniţã et al. 2005) is based on the original classification. Also, the lists of EUNIS habitats (Onyshchenko 2016), as well as Resolution 4 of the Berne Convention (Kuzemko et al. 2017) and Annex I of the Habitat Directive (Kuzemko 2017) were compiled for Ukraine, mainly to develop the Emerald network. Most recently, the Atlas of Grassland Habitats of Ukraine (Kuzemko et al. 2022) was published, based on a new version of the EUNIS and using the EUNIS-ESy expert system (Chytrý et al. 2020). The same system is used for habitat mapping with remote sensing methods (Shyriaieva & Prylutskyi 2021).

Russia's armed aggression against Ukraine has posed new challenges for Ukrainian phytosociologists, first of all, to assess the impact and damage to Ukraine's nature, including protected areas. Such changes will inevitably lead to certain changes in vegetation and habitats, which will need to be assessed in both the short and long term perspective and develop measures to restore them on the basis of this assessment.

Afanasiev, D.Y. (1968). Vegetation of the UkrSSR. Natural meadows of the UkrSSR. Naukova Dumka, Kyiv.

Barbarych, A.I. (ed.) (1973). Vegetation of UkrSSR, Steppes, outcrops, sands. Naukova Dumka, Kyiv.

Bölöni, J., Molnár, Z. & Kun, A. (szerk.) (2011). Magyarország élőhelyei. A hazai vegetációtípusok leírása és határozója. MTA ÖBKI, Vácrátót.

Bonari, G., Fernández-González, F., Çoban, S., et al. (2021). Classification of the Mediterranean lowland to submontane pine forest vegetation. Appl Veg Sci 24:e12544.

Bradis, Y.M. & Bachurina, G.F. (1969). Vegetation of the UkrSSR. Wetlands of the UkrSSR. Naukova Dumka, Kyiv.

Bradis, Y.M. (ed.) (1971). Vegetation of the UkrSSR. Forests of the USSR. Naukova Dumka, Kyiv.

Chytrý, M., Kučera, T. & Kočí, M. (eds) (2001). Katalog biotopů České republiky. Interpretační příručka k evropským programům Natura 2000 a Smaragd. Agentura ochrany přírody a krajiny ČR, Praha.

Chytrý, M., Kučera, T., Kočí, M., Grulich, V. & Lustyk, P. (eds.) (2010). Katalog biotopů České republiky. Ed. 2. Agentura ochrany přírody a krajiny ČR, Praha.

Chytrý, M., Tichý, L., Hennekens, S.M., et al. (2020). EUNIS Habitat Classification: expert system, characteristic species combinations and distribution maps of European habitats. Appl Veg Sci 23:648-675.

Didukh, Y. P., Fitsailo, T. V., Korotchenko, I.A., Iakushenko, D.M. & Pashkevych, N.A. (2011). Biotopes of Forest and Forest-Steppe zones of Ukraine. LLC Macros, Kyiv.

Didukh, Y. P., Mala, Y.I., Pashkevych, N.A., Fitsailo, T.V. & Khodosovtsev, A.Y. (2016). Biotopes of the Crimean Mountains. TOV NVP Interservis.

Didukh, Y.P. & Kuzemko, A.A. (2005). Classification of Halychina-Slobozhanshina Econetwork's ecosystems. Ukr Phytosociol Collect, Ser C, 23:38-60.

Didukh, Y.P. & Shelyag-Sosonko, Y.R. (2001). Classification of ecosystems is an imperative of the National Ecological Network (ECONET) of Ukraine. Ukr Bot J 58:393-403.

Didukh, Y.P. & Shelyag-Sosonko, Y.R. (2003). Geobotanic zoning of Ukraine and adjacent areas. Ukr Bot J 60: 6-17.

Didukh, Y.P., Borsukevych, L.M., Davydova, et al. (2020). Biotopes of Steppe zone of Ukraine. DrukArt, Kyiv-Chernivtsi.

Doniţã, N., Popescu, A., Paucã-Comãnescu, M., Mihãilescu, S. & Biriş, I.-A. (2005). Habitatele din România. Editura Tehnicã Silvicã, Bucureşti.

Dubyna, D.V. (2006). Vegetation of Ukraine. Higher aquatic vegetation. Kyiv, Phytosociocentre.

Dubyna, D.V., Dzyuba, T.P., Iemelianova, et al. (2019). Prodrome of the vegetation of Ukraine. Naukova Dumka, Kyiv.

Dubyna, D.V., Dzyuba, T.P., Neuhäuslova, Z., Solomakha, V.A., Tyshchenko, O.V. & Shelyag-Sosonko, Y.R. (2007). Vegetation of Ukraine. Halophytic vegetation. Kyiv, Phytosociocentre.

Jiroušek, M., Peterka, T., Chytrý, M., et al. (2022). Classification of European bog vegetation of the *Oxycocco-Sphagnetea* class. Appl Veg Sci 25:e12646.

Kapets, N.V., Barsukov, O.O., Vynokurov, D.S. & Khomyak, I.V. (2018). Pioner lichen communities of the teteriv river basin (Ukraine). Acta Bot Hung 60:331-355.

Khodosovtsev, A.Y. (2015). Endocarpo-Xanthocarpion tominii all. nov. and Caloplacetum albolutescentis ass. nov., a new syntaxa of lichen communities from loess outcrops in southern Ukraine. Chornom Bot J 11:317-326.

Khodosovtsev, A.Y., Boiko, M.F., Nadyeina, O.V. & Khodosovtseva, Y.A. (2011). Lichen and bryophyte associations on the lower Dnieper sand dunes: syntaxonomy and weathering indication. Chornom Bot J 7:44-46.

Khodosovtsev, A.Y., Maliuga, N.G., Darmostuk, V.V., Khodosovtseva, Y.A. & Klymenko, V.M. (2017). The corticolous Physcietea lichen communities in the old parks of Kherson region (Ukraine). Chornom Bot J 13:481-515.

Khodosovtsev, A.Y., Nadyeina, O.V. & Khodosovtseva, Y.A. (2014). Terricolous lichen communities of Plain Crimea (Ukraine). Chornom Bot J 10:202-223.

Kuzemko, A. (2017). Species and habitats from annexes of the Habitat Directive in Ukraine. NATURA 2000 network as an innovative system of protection of rare species and habitats in Ukraine. Proceedings of the scientific-practical seminar (Kyiv, February 15, 2017). Series: Conservation Biology in Ukraine, 1:64-70.

Kuzemko, A. (ed.) (2022). Atlas of grassland habitats of Ukraine. DrukArt, Chernivtsi.

Kuzemko, A., Sadogurska, S. & Vasyliuk, O. (eds) (2017). Interpretation manual of the habitats listed in Resolution No. 4 (1996) listing endangered natural habitats requiring specific conservation measures. The first version of the adapted unofficial Ukrainian translation (the third draft of the official version 2015), Kyiv.

Kuzemko, A.A. (2009). Vegetation of Ukraine. Meadow vegetation. Phytosociocentre, Kyiv, UA [In Ukrainian].

Kuzemko, A.A., Didukh, Y.P., Onyshchenko, V.A. & Šeffer, J. (eds) (2018). National Habitat Catalogue of Ukraine. FOP Klimenko Y.Y., Kyiv.

Landucci, F., Šumberová, K., Tichý, L., et al. (2020). Classification of the European marsh vegetation (Phragmito-Magnocaricetea) to the association level. Appl Veg Sci 23:297-316.

Malynovskyi, K.A. & Krichfalushiy, V.V. (2000). Vegetation of Ukraine. High mountain vegetation. Kyiv, Phytosociocentre.

Marcenò, C., Guarino, R., Loidi, J., et al. (2018). Classification of European and Mediterranean coastal dune vegetation. Appl Veg Sci 21:533-559.

Mucina, L., Bültmann, H., Dierßen, K., et al. (2016). Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Appl Veg Sci 19:3-264.

Onyshchenko, V.A. (2016). Habitats of Ukraine according to the EUNIS classification. Phytosociocentre, Kyiv.

Peterka, T., Hájek, M., Jiroušek, M., et al. (2017). Formalized classification of European fen vegetation at the alliance level. Appl Veg Sci 20:124-142.

Shelyag-Sosonko, Y.R., Didukh, Y.P., Dubyna, D.V., Kostylev, A.V., Popovich, S.Y., & Ustimenko, P.M. (1991). Prodromus of vegetation of Ukraine. Naukova Dumka, Kyiv.

Shyriaieva, D. & Prylutskyi, O. (2021). Exploratory analysis of the spectral reflectance curves of habitat types: a case study on Southern Bug River valley, Ukraine. In 63rd IAVS Symposium, September 20-23, 2021. Book of Abstracts. Debinski E., Diekmann M., Loidi J., Wiser S. & Zelený D. (eds), p.149.

Solomakha, V.A. (1995). Syntaxa of vegetation of Ukraine by the Braun-Blanquet method and their peculiarities. Kyiv, Taras Shevchenko National University of Kyiv.

Solomakha, V.A. (1996). The syntaxonomy of vegetation of Ukraine. Ukr Phytosociol Collect, Ser A, 4(5):1-120.

Solomakha, V.A. (2008). The syntaxonomy of vegetation of Ukraine. The third approximation. Phytosociocentre, Kyiv.

Stanová, V. & Valachovič, M. (eds) (2002). Katalóg Biotopov Slovenska. DAPHNE – Inštitút aplikovanej ekológie, Bratislava.

Willner, W., Jiménez-Alfaro, B., Agrillo, E., et al. (2017). Classification of European beech forests: a Gordian Knot? Appl Veg Sci 20:494-512.

Willner, W., Kuzemko, A., Dengler, J., et al. (2017). A higher-level classification of the Pannonian and western Pontic steppe grasslands (Central and Eastern Europe). Appl Veg Sci 20:143-158.

Yakushenko, D.M. (2005). Classification of Zhytomyr Polissya ecosystems. Ukr Phytosociol Collect, Ser C, 23:15-35.

Filling the gaps in vegetation classification

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Towards a syntaxonomic revision of *Pinus nigra* forest vegetation

Gianmaria Bonari[1], Federico Fernández-González[2], Dario Ciaramella[1], Süleyman Çoban[3], Kryštof Chytrý[4,5], Erwin Bergmeier[6], Alessandro Bricca[1], Andraž Čarni[7,8], Mirjana Ćuk[9], Michele De Sanctis[10], Yakiv Didukh[11], Giuliano Fanelli[10], Xavier Font Castell[12], Emmanuel Garbolino[13], Irina Goia[14], Stephan Hennekens[15], Petrit Hoda[16], Ute Jandt[17,18], Borja Jiménez-Alfaro[19], Ali Kavgacı[20], Ilona Knollová[4], Anna Kuzemko[11], Javier Loidi[21], Đorđije Milanovic[22], Marijana Novaković-Vuković[23], Alberto Selvaggi[24], Mária Šibíková[25], Urban Šilc[26], Milica Stanišić-Vujačić[27], Kiril Vassilev[28], Wolfgang Willner[5], Fotios Xystrakis[29], Željko Škvorc[30], Vladimir Stupar[22], Pavel Dan Turtureanu[31], Rossen Tzonev[32], Stefan Zerbe[1], Milan Chytrý[4]

[1]Faculty of Science and Technology, Free University of Bozen-Bolzano, Bolzano, Italy, gianmaria.bonari@unibz.it
[2]Institute of Environmental Sciences, University of Castilla-La Mancha, Toledo, Spain
[3]Department of Silviculture, Faculty of Forestry, Istanbul University-Cerrahpaşa, Turkey
[4]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic
[5]Department of Botany and Biodiversity Research, University of Vienna, Vienna, Austria
[6]Vegetation Ecology and Phytodiversity, University of Göttingen, Göttingen, Germany
[7]Institute of Biology, Research Center of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia
[8]School for Viticulture and Enology, University of Nova Gorica, Nova Gorica, Slovenia
[9]Department of Biology and Ecology, Faculty of Science, University of Novi Sad, Novi Sad, Serbia
[10]Department of Environmental Biology, Faculty of Mathematical, Physical and Natural Sciences, Sapienza University of Rome, Rome, Italy
[11]Department of Geobotany and Ecology, M.G. Kholodny Institute of Botany, Kyiv, Ukraine
[12]Department of Evolutionary Biology, Ecology and Environmental Sciences, University of Barcelona, Barcelona, Spain
[13]Climpact Data Science, Nova Sophia - Regus Nova, Sophia Antipolis Cedex, France
[14]Department of Taxonomy and Ecology & Laboratory of Plant Biology, Genetics, Microbiology and Biotechnology, Center of Systems Biology, Biodiversity and Bioresources, Babeş-Bolyai University, Cluj-Napoca, Romania
[15]Wageningen Environmental Research, Wageningen, The Netherlands
[16]Research Center for Flora and Fauna, Faculty of Natural Sciences, Tirana, Albania
[17]Geobotany and Botanical Garden, Martin Luther University Halle-Wittenberg, Halle, Germany
[18]German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Leipzig, Germany
[19]Biodiversity Research Institute, University of Oviedo, Mieres, Spain
[20]Faculty of Forestry, University of Karabuk, Karabuk, Turkey
[21]Department of Plant Biology and Ecology, University of the Basque Country (UPV/EHU), Bilbao, Spain
[22]Department of Forest Ecology, Faculty of Forestry, University of Banja Luka,Banja Luka, Bosnia and Herzegovina
[23]Department of Forest Ecology, Faculty of Forestry, University of Belgrade, Belgrade, Serbia
[24]Institute for Timber Plants and the Environment, Torino, Italy
[25]Institute of Botany, Plant Science and Biodiversity Center of Slovak Academy of Sciences, Bratislava, Slovakia
[26]ZRC SAZU, Institute of Biology, Ljubljana, Slovenia
[27]Department of Biology, Faculty of Natural Sciences and Mathematics, University of Montenegro, Podgorica, Montenegro
[28]Institute of Biodiversity and ecosystem research, Bulgarian Academy of Sciences, Sofia, Bulgaria
[29]Forest Research Institute, Hellenic Agricultural Organization DEMETER, Thessaloniki, Greece
[30]Faculty of Forestry and Wood Technology, University of Zagreb, Zagreb, Croatia
[31]A. Borza Botanical Garden, Babeș-Bolyai University,Cluj-Napoca, Romania
[32]Department of ecology and environmental protection, Faculty of Biology, Sofia University “St. Kliment Ohridski”, Sofia, Bulgaria

Key words: Database, EuroVegChecklist, Mountains, Vascular plants, Vegetation classification

Forests dominated by *Pinus nigra* are naturally distributed in mountainous regions of (sub)Mediterranean Europe, Anatolia, and partly North Africa. The ecology, and in part also the distribution, of these vegetation types are shared with forests dominated by *Pinus sylvestris*. Past classifications of *Pinus nigra* forests lack a formal, broad-scale approach, which hinders a better understanding of these communities. We realized that our previous efforts in investigating *Pinus nigra* forest vegetation of temperate and (sub-)Mediterranean Europe were biased due to a lack of consistent data, especially for the Balkans and Anatolia. Accordingly, with the double aim of preparing a comprehensive dataset of these forests in Europe and to refine EVA, we complemented the pine vegetation data in CircumMed forest database with >50 missing publications and unpublished data, resulting in >2500 *Pinus nigra*-dominated vegetation plots (i.e. *Pinus nigra* >14% cover). The aim of our study is to provide the first large-scale classification of these forests based on a comprehensive data set of vegetation plots. Currently, the diversity of these forests, including some old-established forest syntaxa, is classified in three classes – *Quercetea pubescentis*, *Junipero-Pinetea sylvestris*, and *Erico-Pinetea*; eight orders – *Junipero-Pinetalia sylvestris*, *Juniperetalia hemisphaericae*, *Querco-Cedretalia atlanticae*, *Querco-Cedretalia libani, Erico-Pinetalia*, *Junipero communis-Pinetalia nigrae*, *Berberido creticae-Juniperetalia excelsae*, and *Pinetalia pallasianae-kochianae,* and >10 alliances. However, large geographical and conceptual overlaps between these syntaxa exist and need to be numerically revised. To study species composition of *Pinus nigra* forests, including plantations, and ascertain the main ecological patterns, we will initially also consider data containing *Pinus sylvestris* forests to test the floristic independence of *Pinus nigra* forests over a large geographical range. We will perform an unsupervised divisive classification using TWINSPAN. We generally expect the same patterns already found in a preliminary analysis of the previous, incomplete dataset, i.e. (i) a clear distinction between planted and natural forests in the first division, (ii) *Pinus nigra* plantations of temperate European lowlands outside the native distribution range of the species having a different species composition from any previously described alliance of *Pinus nigra* forests and, (iii) within the natural distribution range, species composition strongly reflecting a west-east biogeographical division related to climatic differences. This study will provide vegetation classification at the alliance level for *Pinus nigra* forests and possibly other high-rank syntaxa, enabling automatic classification using an expert system. The standardisation of the content of classifications will aid future vegetation and ecological studies, ensuring comparability and synthesis of findings across the geographical scope of this study.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Novel habitats in Serbia – diversity, classification and services

Mirjana Ćuk[1], Željko Škvorc[2], Miloš Ilić[1], Dragana Vukov[1], Nenad Jasprica[3], Daniel Krstonošić[2], Vladimir Stupar[4], Ruzica Igić[1], Andraž Čarni[5,6]

[1]Department of Biology and Ecology, University of Novi Sad, Novi Sad, Serbia, mirjana.cuk@dbe.uns.ac.rs
[2]Faculty of Forestry and Wood Technology, University of Zagreb, Zagreb, Croatia,
[3]Institute for Marine and Coastal Research, University of Dubrovnik, Dubrovnik, Croatia
[4]Faculty of Forestry, University of Banja Luka, Banja Luka, Bosnia and Herzegovina
[5]Institute of Biology, Scientific Research Center of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia
[6]University of Nova Gorica, Nova Gorica, Slovenia

Key words: forest vegetation, hierarchical classification, *Robinia pseudoacatia*,

Novel ecosystems are one of the emerging future challenges for vegetation science. They are most often caused by accidental or intentional human activities, and very often built by significant participation of invasive species. Such habitats are often considered as degradation of natural vegetation, as they substitute native habitats. However, some novel habitats are already formed and structured phytocenoses, with pronounced or retained diversity of native species, becoming shelters for rare and endangered taxa. It is important to point out that novel habitats offer significant ecosystem services and the economic benefits of dominant species in this communities are great. Such habitats certainly deserve attention since there is almost no information about them.

In this paper, plantations and spontaneously formed black locust forests in Serbia are analyzed for the first time in history in a wider scale. During field research, we collected 248 phytosociological relevés from the entire north-western Balkans. The hierarchical classification confirmed that we can classify the black locust forests into a single alliance in the northern Serbia (Vojvodina), as *Balloto nigrae-Robinion* Hadač & Sofron 1980. This survey presents the floristic composition, the share of different floristic elements and proportion of taxa with economic importance. Also, ecological conditions in specific sites of black locust forest in the whole Serbia were elaborated.

Acknowledgements: This research was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, bilateral project 337-00-21/2020-09/31.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Vegetation of the Ukrainian Left Bank Forest-Steppe: classification and nomenclature

Denys A. Davydov

M.G. Kholodny Institute of Botany, National Academy of Science of Ukraine, Kyiv, Ukraine, tovarystwo@gmail.com

Key words: Phytosociology, Syntaxonomy, Typification

The Left Bank Forest-Steppe region (with square about 70 000 km^2) is situated in the eastern part of Ukraine. Vascular plant flora and vegetation of this territory were studied by author in detail in 2006–2021. Vegetation of the Left Bank Forest-Steppe zone of Ukraine includes 296 associations belonging to 88 alliances, 52 orders, 34 classes and represents different types of forest, shrub, meadow, steppe, sand, salt, marsh, aquatic and anthropogenic plant communities.

The classification scheme and the prodrome (including data about diagnostic species, ecology and distribution of separate syntaxa) were conducted with special attention to the nomenclature of accepted names and their typification. Except valid names of syntaxa and years of their valid publication the protologues, data about typification (with direct citation of types and their authors) and major synonyms were indicated. Four associations are new for Ukraine: *Egerietum densae* Steubing & al. ex Felzines 2016, *Comaretum palustris* Markov & al. 1955, *Erophilo vernae-Arabidopsietum thalianae* Kropáč in Krippelová 1981 and *Balloto nigrae-Syringetum vulgaris* Exner in Exner & Willner 2004. Four associations were described as new: *Ceratophylleto demersi-Vallisnerietum spiralis* Lazić ex Davydova & Davydov in Davydov & Davydova 2020, *Puccinellio giganteae-Camphorosmetum annuae* Davydov in Davydov & Davydova 2020, *Elymo repentis-Physocarpetum opulifolii* Davydov 2020 and *Impatientetum noli-tangeri-parviflorae* Davydov 2022. 31 preliminary designated lectotypes for accepted names of associations were proposed.

Acknowledgements: This research was partly supported by the Ukrainian State Fund of Fundamental Research F-83/53427. Also author is grateful to Dr. Pavlo Ustymenko for valuable comments and all brave Ukrainian defenders that made finalizing this publication possible.

Ruderal vegetation of Ukraine: a review of syntaxonomy and biogeographical peculiarities

Dmytro Dubyna[1], Svitlana Iemelianova[1,8], Tetiana Dziuba[1], Pavlo Ustymenko[1], Liubov Felbaba-Klushyna[2], Anastasia Davydova[1], Denys Davydov[1], Pavlo Tymoshenko[1], Borys Baranovski[3], Liubov Borsukevych[4], Liudmyla Vakarenko[1], Denys Vynokurov[1], Vadym Datsyuk[1], Natalia Yeremenko[1], Iryna Ivanko[3], Liudmyla Lysohor[5], Hanna Kazarinova[6], Lana Karmyzova[3], Larysa Makhynia[7], Natalia Pashkevych[1], Tetiana Fitsailo[1], Myroslav Shevera[1], Dariia Shyriaieva[1,8]

[1]M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Tereshchenkivska Str., 2, Kyiv, 01024, Ukraine; yemelianova.sv@gmail.com
[2]Uzhhorod National University, Universytets'ka St, 14, Uzhhorod, Zakarpattia Oblast, 88000, Ukraine
[3]Oles Honchar Dnipro National University, Haharina Ave, 72, Dnipro, Dnipropetrovsk Oblast, 49000, Ukraine
[4]Botanical garden of Ivan Franko National University of Lviv, Cheremshyny St, 44, Lviv, Lviv Oblast, 79000, Ukraine
[5]Kryvyi Rih State Pedagogical University, Haharina Ave, 54, Kryvyi Rih, Dnipropetrovsk Oblast, 50000, Ukraine
[6]V.N. Karasin Kharkiv National University, Svobody sq., 4, Kharkiv, 61022, Ukraine
[7]Bogomolets National Medical University, Tarasa Shevchenko Blv, 13, Kyiv, 01601, Ukraine
[8]Masaryk University, Kotlářská 2, Brno, 61137, Czech Republic

Key words: classification, vegetation, man-made habitats, invasion

The increase of human impacts in recent years has been accompanied by the transformation of the environment, in particular the digression of native plant communities and the formation of ruderal phytocoenoses. Such plant communities are natural-anthropogenic phytocomplexes of extrazonal character, the territorial differentiation of which, within a particular territory, depends on a complex of natural and historical factors. In this study, we aimed (i) to provide the classification of ruderal vegetation to association level; (ii) to evaluate ecological requirements and distribution of study vegetation within the territory of Ukraine.

The basic material for our analysis consisted of 8382 relevés (both private and from literature) sampled on the whole territory of Ukraine. We stored plots in "Database of the ruderal vegetation of Ukraine" (numbered in GIVD - EU-UA-011). Based on the data analysis we identified 8 classes, 16 orders, 36 alliances and 205 associations. We detected 29 associations as new ones for the territory of Ukraine. We found that coenoses of Scleranthion annui, Salsolion ruthenicae, Malvion neglectae, Arction lappae are more common in the Forest and Forest-Steppe zones; thermophylic and xerophytic phytocoenoses of Hordeion murini, Lactucion tataricae, Dauco-Melilotion and Onopordion acanthii are widespread in the Steppe zone. The regional specificity of the classes Robinietea and Polygono-Poetea annuae and Plantaginetea majoris, which are found in all botanical and geographical zones of Ukraine, is reflected at the level of associations. Nitrophilous mesic and wet plant communities of Galio-Urticetea and Bidentetea classes have been recorded mainly in anthropogenic habitats of the Forest and Forest-Steppe zones. The coenoses of Epilobietea angustifolii are characterized by geographical connection only with the Carpathian region, Ukrainian Polissia and the northern Forest-Steppe.

We recorded 325 alien species in the ruderal plant communities of Ukraine. The highest proportions of alien species were found in the phytocoenoses of *Polygono-Poetea annuae* (36.8%), *Stellarietea mediae* (31.5%) and *Plantaginetea majoris* (27.2%). Of the total number

of alien species, Mediterranean species prevail (30%). Plants of Mediterranean-Iranian-Turanian (16.6%), North American (16.3%) and Asian origin (15.9%) also play a significant part in the formation of the species composition of the studied plant communities. In the ruderal vegetation of Ukraine, 23 transformer species were identified. They cause significant changes in the species composition and structure of the plant communities. The phytocoenotic activity and participation of such species in plant communities indicate an intensification of the process of plant invasions and an increasing degree of threats for native phytocoenoses which are in contact with man-made habitats.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Description of desert vegetation communities of the Saharo-Arabian region

Mohamed Z. Hatim[1], John Janssen[2], Ricarda Pätsch[3], Milan Chytrý[3], Manfred Finckh[4], David Kleijn[1], Kamal Shaltout[5], Monier Abd El-Ghani[6], Mohamed El-Sheikh[7], Jesus Charco[8], Salima Benhouhou[9], Nacera Boucheneb[10], Nabil Benghanem[11], and Joop Schaminée[1, 2]

[1]Plant Ecology and Nature Conversation Group, Environmental Sciences Department, Wageningen University and Research Centre, P.O. Box 47, 6700 AA Wageningen, The Netherlands, mohamed.hatim@wur.nl
[2]Wageningen Environmental Research, Wageningen University and Research Centre, P.O. Box 47, 6700 AA Wageningen, The Netherlands
[3]Department of Botany and Zoology, Faculty of Science, Masaryk University, Kotlarska 2, 611 37 Brno, Czech Republic
[4]Biodiversity, Evolution and Ecology, Institute for Plant Science and Microbiology, Universität Hamburg, Hamburg, Germany
[5]Botany and Microbiology Department, Faculty of Science, Tanta University, Egypt
[6]Department of Botany and Microbiology, Faculty of Science, Cairo University, Giza, Egypt
[7]Botany and Microbiology Department, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia
[8]Departamento de Sistemas y Recursos Naturales, Universidad Politécnica de Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain
[9]Département de Botanique, Ecole Nationale Supérieure Agronomique, El Harrach, Algeria
[10]Institut National de Recherche Forestière, Bainem, Cheraga, Algiers, Algeria
[11]Département des sciences biologiques et agronomiques, Université Mouloud Mammeri, Tizi-Ouzou, Algeria

Keywords: Classification, Phytosociology, Desert Vegetation, Saharo-Arabian region

The Saharo-Arabian region is one of the biggest desert regions in the world. Many studies on the vegetation of the countries of this region have been done. Yet those studies did not give an account of the whole region and were local. In this study, we aim at making a convincing classification of the region vegetation based on the collected data from literature and available databases.

We collected all available data from the literature, large databases (e.g., sPlot), and datasets provided by the international collaborators to build a central database representing the whole region. We analysed the collected data using modified TWINSPAN and came up with a description of the area desert vegetation.

Acknowledgments: We would like to thank the sPlot group for approving our project to access their database according to their rules.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Meadows and pastures of the Parâng Mts, Southern Carpathians, Romania

Katarína Hegedüšová[1], Jana Májeková[1], Janka Smatanová[1], Pavel Širka[2], Ingrid Turisová[3], Eva Uhliarová[4], Karol Ujházy[2], Iveta Škodová[1]

[1]Plant Science and Biodiversity Center, Institute of Botany, Slovak Academy of Sciences, Bratislava, Slovakia, katarina.hegedusova@savba.sk
[2]Faculty of Forestry, Technical University in Zlovlen, Zvolen, Slovakia
[3]Faculty of Natural Sciences, Matej Bel University, Banská Bystrica, Slovakia
[4]Stupy 2179/13, Banská Bystrica, Slovakia

Key words: Classification, Mountain meadows, Pastures, Parâng Mts, Romania

The Parâng Mts belong to the Parâng-Sureanu-Lotrului mountain group. It is one of the highest mountains in Romania. Geologically, the mountain range is composed mainly of crystalline rocks. Parâng itself is divided into several massifs. We present a classification of meadows and pastures of the part Parângul Mic. The research was carried out in summer 2019 in the surroundings of the villages Petroșani, Bănița, Peștera, Jieţ, Petrila, Obârşia Lotrului and Rânca. Field sampling was performed according to principles of the Zürich-Montpellier school on plots of 4×4 m. To assess vegetation units we used a dataset of 63 phytosociological relevés stored in TURBOWIN and harmonized and analysed using the program JUICE. The β-Flexible Method with Jaccard distance as a similarity measure and logarithmic transformation were used for the numerical classification of relevés using PC-ORD 5.0 software. Detrended correspondence analysis (DCA) was applied for visualizing the similarity of vegetation types and for comparison of environmental conditions of individual syntaxa. Differences among associations and Ellenberg and Jurko indicator values were tested using ANOVA and Tukey HSD (post-hoc) test with $p<0.05$. The identified vegetation types were classified to the five groups along the altitudinal gradient: *Festuco-Agrostietum capillaris* (all. *Cynosurion*) – 33 relevés, *Violo declinatae-Nardetum* (all. *Potentillo-Nardion*) – 12 relevés, *Alchemillo xanthochlorae-Poetum alpinae* (*Poion alpinae*) – 3 relevés, *Centaureo nervosae-Nardetum strictae* (all. *Potentillo-Nardion*) – 8 relevés, and *Potentillo chrysocraspedae-Festucetum supinae* (all. *Juncion trifidi*) – 7 relevés. The most significant differences between the associations were recorded in environmental variables temperature and altitude.

Acknowledgements: This research was supported by the Scientific Grant Agency of the Ministry of Education, science, research and sport of the Slovak Republic and the Slovak Academy of Sciences VEGA no. 2/0132/21.

FloraVeg.EU – a new online database of European vegetation and flora

Milan Chytrý[1], Irena Axmanová[1], Dana Holubová[1], Petr Novotný[2], Marcela Řezníčková[1], Idoia Biurrun[3], Gianmaria Bonari[4], Natálie Čeplová[1], Jiří Danihelka[1], Pavel Dřevojan[1], Riccardo Guarino[5], Stephan Hennekens[6], Veronika Kalusová[1], Tomáš Kebert[7], Ilona Knollová[1], Zdeňka Lososová[1], Corrado Marcenò[8], Gabriele Midolo[1], Pavel Novák[1], Ricarda Pätsch[1], Zdenka Preislerová[1], Martin Rohn[9], Dariia Shyriaieva[1,10], Petra Štěpánková[1], Lubomír Tichý[1], Martin Večeřa[1], Wolfgang Willner[11]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, chytry@sci.muni.cz
[2]Department of Biology Education, Faculty of Science, Charles University, Prague, Czech Republic
[3]Department of Plant Biology and Ecology, University of the Basque Country UPV/EHU, Bilbao, Spain
[4]Faculty of Science and Technology, Free University of Bozen-Bolzano, Italy
[5]Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, University of Palermo, Italy
[6]Wageningen Environmental Research, Wageningen, The Netherlands
[7]Department of Botany, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic
[8]University of Perugia, Italy
[9]Babická 2379/1a, Praha, Czech Republic
[10]M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine
[11]Department of Botany and Biodiversity Research, University of Vienna, Vienna, Austria

Key words: Database, EUNIS, Europe, EuroVegChecklist, Indicator values, Open data, Syntaxon, Traits, Vascular plants, Vegetation classification

FloraVeg.EU is a new online database providing basic information on European vegetation types, habitats and plant species. It relies on the IT infrastructure recently developed for the Pladias Database of the Czech Flora and Vegetation. It provides public access to various datasets compiled within projects of the Vegetation Science Group at Masaryk University and the IAVS Working Group European Vegetation Survey. The database consists of three modules: (1) The Species module informs about characteristics of European vascular plant species, including ecological traits such as habitus and growth form, as well as leaf, flower, fruit, and seed traits. Additionally, it includes biogeographical information and ecological characteristics such as species origin, environmental relationships, indicator values, and relationships to vegetation and habitat types. (2) The Vegetation module includes the classes, orders and alliances according to the EuroVegChecklist, which will be regularly updated according to the decisions of the European Vegetation Classification Committee. Each of these syntaxa is characterized by a country-based distribution map and data on dominant life forms, phenological optimum, soil properties, biogeographical features, successional status and degree of naturalness. A list of diagnostic species is also provided for each class. (3) The Habitats module includes terrestrial and freshwater habitats at the three highest hierarchical levels of the EUNIS classification. Each habitat is characterized by a brief description, a point-based distribution map, diagnostic, constant, and dominant species, and a list of corresponding alliances. Individual species, vegetation types and habitats in these three modules are illustrated by thousands of photographs. The Download section of FloraVeg.EU provides datasets in a spreadsheet format that can be used for analyses.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Acknowledging boreal rich-fen forests in the EUNIS habitat classification

Anni Jašková[1]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, annipyy@mail.muni.cz

Key words: Boreal forests, Habitat classification, EUNIS

Boreal rich-fen forests are transitional vegetation communities between boreal spruce forests and open rich fens, and therefore, hard to classify. They also bear a resemblance with the tall-herb spruce forests of European Russia. Boreal rich-fen forests are endangered, species-rich communities, dominated by *Picea abies* and *Betula pubescens* in the tree layer, and with a well-developed shrub layer in the Boreal context. The field layer is rich in grasses, sedges and particularly herbaceous species, such as *Filipendula ulmaria*, *Rubus arcticus*, *Viola palustris* and *V. epipsila*. The moss layer contains rich-fen specialists, such as *Sphagnum teres* and *Campylium stellatum,* intermixed with forest bryophytes, such as *Hylocomium splendens.*

Boreal rich-fen forests are relatively rare and have been overlooked in European vegetation classification syntheses including the EUNIS habitat classification and the EuroVegChecklist. So far, there has not been adequate data available for their analysis in the European context, and consequently, their syntaxonomical position is currently unresolved.

In the EUNIS habitat classification, boreal rich-fen forests resemble most closely *Picea* mire forests (T3K), but in the current version, they are defined by generalist conifer forest species and mire species, from which boreal rich-fen forests differ particularly through their specialist bryophytes. Since the time of the last update, new data has been added to the European Boreal Forest Vegetation Database (EBFVD) that would enable their acknowledgment and improvement of the type definitions of the EUNIS habitat classification (and also of the EuroVegChecklist).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Tall-herb vegetation of the south Moravian forest-steppe

Klára Klinkovská[1], Jan Roleček[1,2]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, klinkovska.klara@gmail.com
[2]Department of Paleoecology, Institute of Botany, Czech Academy of Sciences, Brno, Czech Republic

Key words: *Geranion sanguinei*, Fringe vegetation, Syntaxonomy, *Trifolio-Geranietea*, Vegetation classification

Vegetation dominated by tall herbs is an important component of forest-steppe mosaics but is often overlooked and not well understood from a phytosociological perspective. The main aim of this study was to describe tall-herb dominated vegetation in South Moravia and its position in the vegetation mosaics. Species composition of these stands was recorded using phytosociological relevés in the 2020 and 2021 vegetation seasons. The dataset was completed with relevés from the Czech National Phytosociological Database. The resulting dataset containing 224 relevés was analysed using multivariate methods. Using the Modified Twinspan algorithm, the data were classified into four vegetation types and one of them was further divided into three subtypes.

These vegetation types differ in their ecology and geographical distribution. The most mesophilous and species-rich community is distributed in the White Carpathians. At the border of the Bohemian massif occurs the most heliophilous community with acidophilous species. Basiphilous tall-herb communities at the rock outcrops dominated by *Geranium sanguineum, Origanum vulgare* and *Vincetoxicum hirundinaria* can be found in the limestone regions of the Moravian Karst and the Pálava Hills. The vegetation type from the central part of South Moravia, which grows mainly on the loess substrate, was further divided into three subtypes. One of them is transitional to the steppe grasslands, the second is mainly connected to the margins of forests and shrublands, and the last one is characterized by the species with ruderal tendency. These types were compared with the vegetation units described in the literature. Some previously overlooked communities were identified, and most vegetation types were delimited differently from those included in the current national overview Vegetation of the Czech Republic.

Acknowledgements: This study was supported by the Czech Science Foundation grant 20-09895S.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Formal classification of riparian forest and scrub communities in Western Balkans

Dragan Koljanin[1], Andraž Čarni[2], Željko Škvorc[3], Jugoslav Brujić[1], Đorđije Milanović[1], Vladimir Stupar[1]

[1]Department of Forest Ecology, Forestry faculty, University of Banjaluka, S.Stepanovića 75a, BA-78000 Banja Luka, Bosnia and Hercegovina, draagaan98@gmail.com
[2]Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Novi trg 2, SI-1000 Ljubljana, Slovenia and School for viticulture and enology, University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia
[3]Department of Forest Genetics Dendrology and Botany, Faculty of forestry, University of Zagreb, Svetosimunska 25, HR-10000 Zagreb, Croatia

Key words: Ilyrian floral province, Phytosociology, Riparian community, Vegetation

Floodplain forests and scrublands are communities conditioned by strong impact of water. Inside this group, different communities are developed depending on factors such as type of flooding (stagnant or moving water), duration of flooding, water table level and its fluctuation, river current strength, substrate ability to retain water etc. These factors are changing along relatively short gradients, which make transitional communities quite common, making the classification of this type of vegetation challenging.

We compiled a data set of about 1600 relevés collected in Slovenia, Croatia and Bosnia and Herzegovina from existing databases. Undersampled areas and vegetation types in Bosnia and Herzegovina were sampled during 2021. Relevés were first classified to classes *Alno glutinosae-Populetea albae*, *Salicetea purpureae*, *Alnetea glutinosae* and *Franguletea* using EuroVegChecklist Expert System in Juice software. Each of these four classes was further analyzed using hierarchical classification and ordination in R.

Our results strongly suggest the presence of two alliances of *Alno glutinosae-Populetea albae* (*Alno-Quercion* and *Alnion incanae*), two alliances of *Alnetea glutinosae (Alnion glutinosae* and *Betulion pubescentis*). Of the four groups of clusters of *Salicetea purpureae* three were recognized as *Salicion albae*, *Salicion triandrae* and *Salicion eleagno-daphnoidis* while the fourth cluster could not be placed into any existing alliance following the floristic composition. There was only one alliance (*Salicion cinereae*) recognized in *Franguletea*.

Aliances are presented by diagnostic, constant and dominant species, and by already described associations, while their ecological conditions (estimated by bioindicator values) and their geographical distribution within the region was also presented.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Preliminary results of the syntaxonomic revision of the class *Molinio-Arrhenatheretea* in the European context

Kuzemko Anna[1], María Pilar Rodríguez Rojo[2], Milan Chytrý[3] and data contributors

[1]Department of Geobotany and Ecology, M. G. Kholodny Institute of Botany, Kyiv, Ukraine, anyameadow.ak@gmail.com
[2]Institute of Environmental Sciences, Castilla-La Mancha University, Toledo, Spain
[3]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic

Key words: Classification, Expert system, Grasslands, Wet meadows

Molinio-Arrhenatheretea is the main class of grassland vegetation in Europe. In the EuroVegChecklist (Mucina at al. 2016), it includes 10 orders and 48 alliances. However, some of these syntaxa overlap significantly in terms of floristic composition and environmental characteristics, and some of them have questionable status. Therefore, there is a need to revise them at the European level. We have set the following tasks: i) to define the boundaries of the *Molinio-Arrhenatheretea* class ii) to review the syntaxonomic diversity of the class in Europe, iii) to reveal the floristic, ecological and biogeographical features of the syntaxa, and iv) to resolve the status of some doubtful syntaxa. Data for the study were selected from the European Vegetation Archive (EVA project No. 87) on the criteria of belonging to EUNIS habitats of group R (grasslands) and partially Q (wetlands). A total of 303,227 relevés were included in the analysis, which, after checking the nomenclature, included 7,739 species of vascular plants. The data set was analysed using the TWINSPAN algorithm, which suggested several vegetation units. These were used to create a preliminary version of the expert system to identify the alliances and orders of the *Molinio-Arrhenatheretea* class. To improve the lists of differential species of syntaxonomic units in the expert system, we made additional syntaxonomic and ordination analyses for the smaller datasets at the level of original orders to obtain units that are well separated from each other both floristically and ecologically.

The European Vegetation Photographs (EVP)

Corrado Marcenò[1], Dana Holubová[2], Gianmaria Bonari[3], Alessandro Silvestre Gristina[4], Riccardo Guarino[5], Veronika Kalníková[2], Flavia Landucci[2], Deana Láníková[2], Zdeňka Lososová[2], Pavel Novák[2], Ricarda Pätsch[2], Safiya Praleskouskaya[1], Zdenka Preislerová[2], Dariia Shyriaieva[2,6], Kateřina Šumberová[7], Roberto Venanzoni[1], Milan Chytrý[2]

[1]Department of Chemistry, Biology and Biotechnology, University of Perugia, Italy, corrado.marceno@unipg.it
[2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic
[3]Faculty of Science and Technology, Free University of Bozen-Bolzano, Italy
[4]Institute of Biosciences and BioResources (IBBR), Italian National Research Council (CNR), Unit of Palermo, Palermo, Italy
[5]Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, University of Palermo, Italy
[6] M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine
[7] Institute of Botany of the Czech Academy of Sciences, Brno, Czech Republic

Key words: Database, EuroVegChecklist, Photograph, Vegetation

The EVP is a collaborative project to collect photos of European vegetation alliances. During the last months, a small group of EVS collaborators started to amass photos using the application „Botanical photo-gallery“ (www.botanicalphotogallery.eu), developed by Dana Holubová and colleagues. The database already includes around 1400 photos of 250 alliances. This contribution aims (ii) to give an overview of the collected photos and the missing data and (ii) to invite the EVS colleagues to support the photo collection.
Uploading the photos into the application is relatively easy and just a few mandatory data are required: alliance name, author, date, locality, and country. We further recommend stating the association name, names of dominant plants, and the coordinates. Each photo contains a copyright stamp with the author's name.

Our forthcoming goal will be to implement the amassed photos into the new online database of the European flora and vegetation (FloraVeg.EU) and to provide at least one photo of each of the alliances listed in the EuroVegChecklist (https://www.synbiosys.alterra.nl/evc/) by the end of 2022. Once enough photos will be collected, the second goal will be to prepare a report for publication in one of the IAVS journals.

We hope that many of you will contribute photos of European vegetation types to create a European photo collection useful for future vegetation studies and teaching activities.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Contribution to the knowledge of chasmophytic vegetation in the Forebalkan, Central part of Northern Bulgaria

Momchil Nazarov[1], Gana Gecheva[2], Constantin Mardari[3], Beloslava Genova[2], Josef Šibík[4], Nikolay Velev[1], Kiril Vassilev[1]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev str. 23, 1113 Sofia, Bulgaria, mnazarov357@gmail.com
[2] University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Plovdiv, Bulgaria
[3]Anastasie Fătu Botanic Garden, Alexandru Ioan Cuza University, Dumbrava Roșie str. 7–9, 700487 Iași, Romania
[4]Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences

Key words: *Asplenietea trichomanis*, Bulgaria, Calcareous bedrocks, Classification

This work is focused on the syntaxonomy and ecology of plant communities within 8210 Calcareous rocky slopes with chasmophytic vegetation which belongs to class *Asplenietea trichomanis*. The study was carried out in Gabrovo municipality, which is characterized by semi-mountainous relief and widespread of calcareous bedrocks. The climate is temperate continental. The research territory has limited surface water resources represented by Yantra river and her tributaries, and a small karst lake.

During the field work were collected 19 phytocoenological relevés using the Braun-Blanquet approach. The used plot size was 4 m^2. In addition, we collected data for important abiotic factors such as slope, altitude, bedrock and inclination. All relevés are contributed to the Balkan Vegetation Database (EU-00-013). The nomenclature of species was standardized according to the Euro+Med PlantBase. The hierarchical clustering was performed in the PC-ORD software package using the Bray-Curtis dissimilarity and the flexible beta clustering algorithm. The species covers values were square root transformed and clusters were standardized to equal size. The diagnostic species were determined by calculating the Phi-coefficient and only the statistically significant values evaluated by Fisher's exact test ($P<0.05$) were considered. Detrended Correspondence Analysis was used to reveal the major environmental gradients.

The syntaxonomical diversity of chasmophytic vegeation is represented by 1 class (*Asplenietea trichomanes*), 1 order (*Potentilletalia caulescentis*), 1 alliance (*Cystopteridion*) and 2 associations (*Asplenietum rutae-murario-trichomanis*, *Cystopteridetum fragilis*).

Association *Asplenietum rutae-murario-trichomanis* Kuhn 1937 is found on sunny or semi-shaded places on cliffs, scarps and ridges or on rocky walls usually in not very urbanized villages on northern, eastern, northeastern, northwestern or western slopes. It includes species-poor communities (average species number per relevé is 7) with open to semi-open horizontal structure and total cover of 35–80%, from which the mosses and lichens dominating with cover between 10% and 70%. The diagnostic and dominant species is *Asplenium ruta-muraria.*

Association *Cystopteridetum fragilis* Oberdorfer 1938 is found on shady places on cliffs, scarps and ridges on northern, northeastern or northwestern slopes. It differs ecologically from ass. *Asplenietum rutae-murario-trichomanis*, being identified on sites characterized by more mesic conditions. Its phytocoenoses are also species-poor (average species number per relevé is 10) and has semi-opened horizontal structure with total cover 70–85% from which mosses and lichens have 40-85%. Diagnostic and dominant species is *Cystopteris fragilis.*

The central parts of the Forebalkan area preserve unique calcareous rocky habitats and chasmophytic vegetation. Totally, two associations (*Cystopteridetum fragilis, Asplenietum rutae-murario-trichomanis)* were registered for the first time for vegetation diversity of Bulgaria.

Transcaucasian Vegetation Database – current state and basic analyses

Pavel Novák[1], Dominik Zukal[1], Veronika Kalníková[1,2]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, pavenow@seznam.cz
[2]Beskydy Protected Landscape Area Administration, Rožnov pod Radhoštěm, Czech Republic

Key words: Armenia, Azerbaijan, *Carpino-Fagetea*, Caucasus, Classification, Database, Georgia, Phytosociology, Vascular plants, Vegetation plot

Transcaucasian Vegetation Database (AS-00-005) is a novel dataset of vegetation plots focusing on Transcaucasia (Armenia, Azerbaijan, Georgia). It is included in the Global Index of Vegetation-Plot Databases and participates in the European Vegetation Archive. The study region is situated in the Caucasus Biodiversity Hotspot. It harbours unique species richness of vascular plants (~6400 species, endemic rate of ~25%) and related high vegetation diversity. The database currently involves more than 1200 vegetation plots. About a half of its plots have been recorded during field surveys of the authors since 2015 and contain accurate geographical coordinates, data on sampling sites and measured soil pH and conductivity. The remaining plots (sampled from 1929 to 2020) were digitized from the literature. Forest and shrub communities represent ~64 % of the database, while natural and semi-natural non-forest vegetation types form ~32%. They mainly include alpine grasslands, subalpine tall forb formations, open screes, gravel river bars and wetlands. Anthropogenic vegetation constitutes the rest of the database; it primarily represents wall and trampled habitats. On an example of mesic deciduous forests of the phytosociological class *Carpino-Fagetea sylvaticae* (i.e. oak-hornbeam, ravine and Oriental beech forests), we show the variability in species composition of the vegetation of the region and its key attributes. The principal gradient in their variance reflected macroclimatic differences and vegetation history. Communities recorded in humid and warm-temperate western Georgia (Colchic region) with numerous Arcto-Tertiary relicts were distinguished from communities sampled in temperate-submediterranean central Transcaucasia (central and eastern Georgia, northern Armenia, western Azerbaijan). Further division of the dataset revealed groups of plots more based on ecological differences at the finer scale. It reflected well the main mesic deciduous forest formations of the area under study.

Acknowledgement: The study was supported by the Czech Science Foundation (project 19-28491X).

Systematics, taxonomy, and sustainable management of some critical vascular plant groups of the Central Apennines, Italy

Matthew Chidozie Ogwu

Goodnight Family Department of Sustainable Development, Appalachian State University, 212 Living Learning Center, 305 Bodenheimer Drive, Boone, NC 28608, USA. ogwumc@appstate.edu

Key words: *Centaurea* sp., *Clinopodium* sp., *Lathyrus pannonicus*), *Senecio doronicum* gr., *Taraxacum* sect. *Palustria*, *Veronica* gr. *austriaca*

Plants are essential to understanding ecosystems and the impacts of human development. The deciduous montane forests of the central Apennines (Italy, South-Central Europe) is considered a true biodiversity hotspot because of the endemic plant species. However, extreme weather and human development are increasingly threatening this pristine habitat. Taxonomic clarification and sustainable management of critical plant groups and populations within the central Apennines such as *Anthyllis vulneraria*, *Centaurea* sp., *Clinopodium* sp., *Lathyrus pannonicus*, *Senecio doronicum* gr., *Siler* complex*, Taraxacum* sect. *Palustria*, *Veronica* gr. *austriaca*, etc. provides an avenue to understand climate change impacts. New plant species, subspecies, varieties, and sections continue to be recorded within the central Apennines despite the already documented ones needing ecological, systematics, sustainable utilization, and conservation attention. The spread of invasive species, loss of indicator species, progressive warming especially in high altitudes, and other anthropogenic and natural threats are reshaping this hitherto intact ecosystem. If unchecked, plant adaptation to environmental change might produce phenotypic plasticity in lieu of genetic diversity. Policies from the European Union and the Italian government can help address topical confusion surrounding this center of diversity for many vascular plants as well as new knowledge on plant population and groups by using bibliographic data, field collection, and analysis of morphological data, research, and consultation of herbaria data. For instance, systematics and taxonomic undertaking can focus on the existence or absence of significant variations within, between, and among closely related vascular plant populations and groups within the central Apennines and include a description of their physical attributes, geographical bearings, soil characteristics, economic and cultural activities of the people residing in and around the environment. This will enable the design and implementation of a sustainable plant germplasm management program for the area to complement existing efforts and have a global impact especially in areas where similar taxa occur.

Towards the vegetation synthesis of *Montio-Cardaminetea*

Tomáš Peterka[1], Petra Hájková[1,2], Michal Hájek[1] & data contributors

[1]Ústav botaniky a zoologie, Přírodovědecká Fakulta, Masarykova Univerzita v Brně, Kotlářská 2, CZ-611 37 Brno, peterkatomasek@seznam.cz
[2]Paleoekologické oddělení, Botanický Ústav AVČR, v.v.i., Lidická 25/27, CZ-602 00 Brno

Key words: Classification, Cocktail method, Europe, Spring vegetation

Phytosociological classification of spring vegetation (*Montio-Cardaminetea*) differs among European countries. Here we suggest the first version of a unified classification at the alliance level. Two independent classification approaches were used, i.e. unsupervised classification and supervised classification followed by semi-supervised one. Unsupervised classification included hierarchical cluster analysis in PcOrd based on Sorensen distance measures and (ii) non-hierarchical ISOPAM method. Cluster analysis classified relevés from entire Europe (total relevé number 4111 after geographical stratification), while ISOPAM were applied on smaller "regional" datasets such as the Alps, Balkan Peninsula, the Carpathians, the Bohemian Massif, British Islands and northern Europe. By supervised classification, we tried to reproduce all the spring alliances listed in the EuroVegChecklist. The cores of individual alliances were defined by formal definitions using the Cocktail method. Results of the supervised classification were further checked by semi-supervised K-mean clustering, which searches for other biogeographically or ecologically meaningful vegetation types. Clusters produced by unsupervised classification largely matched units defined or identified by (semi-) supervised approach. Besides alliances already listed in EuroVegChecklist, i.e. *Caricion remotae*, *Mniobryo-Epilobion hornemannii*, *Koenigio-Microjuncion*, *Philonotidion seriatae* (=*Cardamino-Montion*), *Swertio perennis-Anisothecion squarrosi*, *Cratoneurion commutati*, *Lycopodo europaei-Cratoneurion commutati*, two spring alliances were distinguished: *Anthelion julaceae* Shimwell 1972 (sub-alpine oligotrophic acid springs of Scotland) and *Cratoneuro filicini-Calthion laetae* Hadač 1983 (sub-alpine herb-rich mesotrophic springs).

Classification, ecological differentiation, and conservation value of Pontic sandy grasslands in Southern Bug River basin (South-Western Ukraine)

Dariia Shyriaieva[1,2]

[1]Geobotany and Ecology Department, M.G. Kholodny Institute of Botany, NAS of Ukraine, Kyiv, Ukraine, darshyr@gmail.com
[2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic

Key words: *Festucion beckeri*, *Koelerio-Corynephoretea*, Land cover, Phytosociology, Vegetation classification, Vegetation survey

The sandy areas of the Southern Bug River basin are well-known as habitats of endemic species, e.g. pearl knapweeds *Centaurea margaritacea* agg. At the same time, phytosociological data for psammophytic vegetation of the region is still lacking in the databases and literature. This study aims to survey plant communities of sandy grasslands in the Southern Bug River basin and investigate the main environmental factors determining their differentiation. Using JUICE 7.1 and R for the data analysis, I classified 105 own vegetation relevés to eight main clusters representing vegetation diversity. In particular, I identified 1) open sandy grasslands of the *Festucion beckeri* alliance (4 clusters); 2) closed hemipsammophytic steppes (2 clusters); 3) annual-dominated pioneer sandy vegetation of disturbed areas (2 clusters). Communities of sandy grasslands in the Southern Bug River basin partly represent types not found in the adjacent areas. According to the CCA analysis, the major environmental factors determining the differentiation of vegetation units were the amount of organic carbon, three bioclimatic parameters, namely the minimum temperature of the coldest month, the precipitation of the driest quarter, and the precipitation of the coldest quarter, the disturbance history and land-use including ploughing and intensive grazing.

Studied sandy grasslands are home to several rare and endemic plant species, including 10 species listed in the Red Data Book of Ukraine and five species listed in regional red lists of the Mykolaiv and Odesa regions. However, their current extent reflects critically low preservation levels. The land-cover analysis using the QGIS3.16 program showed that sandy grasslands are distributed on 0.46% of the total sandy area. These findings raise conservation concerns and thus, call for future protection of sandy grassland in the Southern Bug River valley. Following that, I proposed the establishment of eight new nature conservation areas in the study area.

Acknowledgements: This research was supported by the Visegrad Fund (Scholarship #52010644).

Delimitation of *Aremonio-Fagion* and *Fagion sylvaticae* in transitional zone between NW Balkan Peninsula and Pannonian Plain

Vladimir Stupar[1], Đorđije Milanović[1], Željko Škvorc[2], Andraž Čarni[3]

[1]University of Banjaluka, Faculty of Forestry, S.Stepanovića 75A, BA-78000 Banja Luka, Bosnia and Herzegovina, vladimir.stupar@sf.unibl.org
[2]Department of Forest Genetics Dendrology and Botany, Faculty of Forestry, University of Zagreb, Svetosimunska 25, HR-10000 Zagreb, Croatia
[3]Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Novi trg 2, SI-1000 Ljubljana, Slovenia; University of Nova Gorica, Vipavska 13, SI-5000 Nova Gorica;Slovenia

Key words: Beech forests, Illyrian province, Vegetation classification

Refugial Illyrian beech forests (IBF) of Aremonio-Fagion are characterized by the significant presence of forest plant species of the Illyrian chorotype. However, their distinction from mesophilous temperate forests of Fagion sylvaticae in the ecological and biogeographical transition zone between the northwestern Balkan Peninsula and the Pannonian Plain is not clear. Based on the analysis of about 2000 relevés from beech forests of the submontane to montane belt of the Balkan-Pannonian transition zone in Slovenia, Croatia, Bosnia and Herzegovina, and Serbia, we attempted to delineate IBF from Fagion sylvaticae. The data were analyzed using numerical classification and ordination methods in TURBOVEG, Juice and R. Our preliminary results show that there is a gradient from west to east which is strongly correlated with the number of Illyrian species in each relevé. We set the threshold for distinguishing IBF from Fagion sylvaticae at two illyrian species per relevé, so that relevés with three or more illyrian species belong to IBF, while relevés with two or fewer illyrian species belong to Fagion sylvaticae. Thus, relevés from Serbia and the majority of relevés from N Bosnia and Herzegovina and N Croatia were assigned to temperate Fagion sylvaticae, while relevés from Slovenia and NW Croatia were assigned mainly to Aremonio-Fagion. It is also significant that species with narrower Illyrian distribution, such as: Lamium orvala, Omphalodes verna, Hacquetia epipactis, Homogyne sylvestris, Scopolia carniolica, Helleborus niger and H. atrorubens never appear in relevés with two or less Illyrian species. This suggests that further refinement of the scope of illyrian species may be needed, as these "true" illyrian species may be indicators of IBF in this transition zone.

Acknowledgements: This research was supported by the bilateral project between Bosnia and Herzegovina and Slovenia "Biodiversity of submontane beech forests along the climatic gradient on the southern edge of the Pannonian Plain" (BI-BH /19-20-024 and 19/6-020/964-29-1/18).

Project to reanalyze and refine rich fen vegetation classification in Finland

Teemu Tahvanainen[1], Tiina H.M. Kolari[1], Risto Virtanen[2]

[1]University of Eastern Finland, Department of Environmental and Biosciences, Joensuu, Finland teemu.tahvanainen@uef.fi
[2]Botanical Museum, University of Oulu, Oulu, Finland

Key words: Habitat assessment, Mires, Peatlands

Distribution of rich fens shows drastic difference between rarity in the south and commonness in the north, across the latitudinal gradient in Finland. The south-boreal climate favors bog succession and fens are naturally rarer than in the north. Rich fens have been preferred for clearance of agricultural land over centuries, causing loss of habitats in the south. Traditional use of semi-natural pastures supported rich fen habitats and cessation of the practice led to habitat loss. Most extensive losses resulted from forestry drainage during 1960s to 1980s in south and middle-boreal zones, where 71 % of total peatland area is drained. The situation is better in the north-boreal zone, where 76 % of peatlands remain undrained. The remaining rich fens are affected by catchment disturbances and climate change. We compiled ca. 2000 relevés from literature and collect ca. 200 new relevés with water chemistry data. The data spans about one hundred years and from the Åland to northernmost Lapland. In data from 2021 field season (n = 112), 75 % of rich fen sites had Calcium concentrations below 8 mg/l and only 7 % of sites had over 20 mg/l. In southern Finland, rich fen habitats had very limited area and, in most cases, only few true rich fen species were met. The data set underlines the rarity and threat to rich fens in southern Finland and conforms their relatively poorly buffering that makes them sensitive to hydrological and climate changes. We aim to reveal new detail of differentiation of rich fen plant communities for their refined classification, distribution and changes in Finland.

Acknowledgements: This research was supported by the Ministry of Environment, Finland (Project LETTO-PUTTE).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Syntaxonomical survey of silver fir forests in Slovakia

Ujházy Karol[1], Ujházyová Mariana[2]

[1]Faculty of Forestry, Technical University in Zvolen, T. G. Masaryka 24, SK- 96001 Zvolen, Slovakia, karol.ujhazy@tuzvo.sk
[2]Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, T. G. Masaryka 24, SK- 96001 Zvolen, Slovakia

Keywords: *Abies alba*, Braun-Blanquet approach, Carpathians, Nomenclature, Plant communities, Vegetation units

Plant communities of fir forests in Slovakia were studied in detail by multiple authors during the 20th century. Resulting list of 21 fir-dominated associations included several narrow and/or regional units. In spite of their floristic similarity and distribution in similar site conditions with beech and mixed montane forests, system of units was built separately within coniferous forests of a broad class *Vaccinio-Piceetea*.

In the recent national syntaxonomical revision, the forests dominated by *Abies alba* were joined and classified within a broad dataset of mesophilous beech, fir and mixed montane forest communities. Concept of narrow alliances within the narrowly defined orders *Fagetalia sylvaticae* and *Luzulo-Fagetalia sylvaticae* was applied. The alliances were delimited according to diagnostic species, and Modified Twinspan was used for association classification. Floristic similarity of fir and beech forests resulted to their common clustering within higher units. Finally, we revised the nomenclature and assigned majority of regional units to the syntaxa of broader distribution, which resulted to the pattern of nine associations within four alliances.

Four associations of acidophilous fir forests were classified in the *Luzulo-Fagetalia sylvaticae* order in a separate alliance *Vaccinio-Abietion albae*. Variability in species composition within Slovakia is conditioned mainly by edaphic, climatic and phytogeographical factors in this alliance. In addition to associations of wider European range (*Vaccinio myrtilli-Abietetum albae*, *Calamagrostio villosae-Abietetum albae*, *Luzulo luzuloidis-Abietetum albae*), *Soldanello hungaricae-Abietetum* is exclusively linked to the Western Carpathians. Mesotrophic to eutrophic communities were included to vicariant alliances *Fagion sylvaticae* (Western Carpathians) and *Symphyto cordati-Fagion sylvaticae* (Eastern Carpathians). In the first one, *Galio rotundifolii-Abietetum* were accepted for hemioligotrophic suboceanic communities of the North-Western Slovakia and *Glechomo hirsutae-Abietetum albae* for eutrophic fir forests. Another unit of eutrophic fir forests (*Euphorbio dulcis-Abietetum albae*) was found to be similar to the Eastern Carpathian beech forests of the second alliance. Calcareous fir forest communities were included to the *Lonicero alpigenae-Fagion sylvaticae* alliance, and its Western Carpathian suballiance of *Tanaceto clusii-Fagenion sylvaticae*. *Calamagrostio variae-Abietetum albae* represents species-rich calcareous communities of extreme habitats with a cold microclimate where fir is competitively stronger than beech. In the species-rich understorey calciphilous and acidophilous species are combined. *Arunco-Abietetum albae* occurs in the lowest parts of montane gorges and northern steep rocky slopes of valleys with inverse microclimate. Species of calcareous rocky habitats are mixed with eutrophic species here.

Acknowledgments: This work was supported by the Scientific Grant Agency of the Slovak Republic (VEGA 1/0624/21).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Classification of the transition communities of semi-dry and mesic grasslands at the interface of Eastern European and Western European phytogeographical provinces

Domas Uogintas[1], Anna Kuzemko[2], Solvita Rūsiņa[3], Jazep Stepanovič, Elena Kulikova, Valerijus Rašomavičius[1]

[1]Nature Research Centre, Institute of Botany, Vilnius, Lithuania, domas.uogintas@gamtc.lt
[2]M. G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine, Kyiv, Ukraine
[3]University of Latvia, Faculty of Geography and Earth Sciences, Riga, Latvia

Key words: Classification, *Festuco-Brometea*, *Molinio-Arrhenatheretea*

The recent syntaxonomical reviews of vegetation at regional and continental scales has started ushered in a new era of vegetation science. Despite the accumulated vegetation data and unified classification at alliance level of European vegetation, transitional zones between phytogeographical regions are still understudied. These areas have a mixture of pools of two or more bordering vegetation/climatic zones. It is one of the main reasons why such vegetation classification is a challenge.

The aim of the research is to answer the following questions: i) what are syntaxonomical and phytogeographical delimitations between two related classes – *Festuco-Brometea* and *Molinio-Arrhenatheretea* at the interface of two phytogeographical provinces in hemiboreal zone? ii) what type of *Festuco-Brometea* communities are in the hemiboreal zone, if there are any? iii) what is the status of Eastern European steppe and forest-steppe order *Galietalia veri* in hemiboreal zone?

We performed our research in the hemiboreal and temperate forest zone encompassing four countries – Latvia, Lithuania, Belarus and Ukraine. Data were included from Latvia, Lithuania, Belarus and the forest zone of Ukraine. Data were selected using a list of characteristic and diagnostic species, which included *Arrhenatherion*, *Agrostion*, *Bromion ereci* (*Mesobromion erecti*), *Cirsio-Brachypodion* (s.l. incl. *Fragario viridis-Trifolion montani*), *Filipendulo-Helictotrichion pratensis* and *Armerion elongatae* alliances. In total, the dataset contained 2279 vegetation plots and 1124 taxa. We conclude that *Festuco-Brometea* distribution continues in North Eastern Europe and are significantly affected by common communities of *Molinio-Arrhenatheretea* class but the overlap with communities of the class *Molinio-Arrhenatheretea* is strong and represents a north-eastern limit of *Festuco-Brometea* distribution.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Vegetation diversity of Bulgaria – recent knowledge and future perspectives

Kiril Vassilev, Nikolay Velev

Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev str. 23, 1113 Sofia, Bulgaria, kiril5914@abv.bg

Key words: Braun-Blanquet, Phytocoenological databases, Syntaxa, TURBOVEG

The aim of the presented study is to reveal the recent knowledge of the vegetation diversity of Bulgaria and to point at the existing knowledge gaps about some vegetation types and poorly studied country regions.

Over the last 20 years, various studies of the vegetation of Bulgaria have been conducted as being part of many national and international research initiatives. Due to the significant diversity of ecological conditions in Bulgaria, the vegetation is represented by 59 classes and 248 alliances so far. During the last 15 years, after the fast development of the phytocoenological databases, a lot of data about known vegetation types in Bulgaria was digitized and made easily accessible. Nowadays, such data for the most part is stored in three databases – one national (Bulgarian National Database) and two regional (Balkan Vegetation Database, Balkan Dry Grassland Database). At national level, the vegetation has been unevenly studied for decades. Vegetation data was mainly collected from semi-mountainous and mountainous regions of Bulgaria and from protected areas and NATURA 2000 network sites. In the same time, some vegetation types remain poorly studied, especially those in lowlands and agricultural areas. The best studied vegetation types are grasslands and broad leaved forests.

In the last five years, as a result of many targeted studies of all vegetation types in different regions of the country, the number of the available relevés was increased by 8000 and reached up a total of 24 217 relevés today. Some of these lack metadata such as sample plot area, GPS coordinates, altitude, species list not fully completed, etc. Actually, some 22 200 relevés are suitable for any reliable vegetation classification analyses. In fact, 39.1% of all relevés are derived from 185 digitized literature sources but the rest 60.9% present unpublished data. Approximately 75% of the relevés have been collected after 2000 year.

The systematic approach of studying all vegetation types in recent years has helped to gather data of vegetation types that have been traditionally neglected and poorly studied in Bulgaria. A couple of examples could be pointed at in this respect: a) the ruderal vegetation of classes *Papaveretea rhoeadis* (745 relevés), *Artemisietea vulgaris* (535), *Digitario sanguinalis-Eragrostietea minoris* (427), *Epilobietea angustifolii* (396), *Sisymbrietea* (370), *Polygono-Poetea annuae* (299) and *Bidentetea* (113); b) the shrub vegetation of *Crataego-Prunetea* class (323); c) the macrophyte vegetation of *Phragmito-Magnocaricetea* class (856); d) the aquatic vegetation of classes *Potamogetonetea* (165) and *Lemnetea* (113).

The vegetation types richest of relevés are the following classes: *Festuco-Brometea* (3510 relevés), *Carpino-Fagetea sylvaticae* (2472), *Molinio-Arrhenatheretea* (2039), *Juncetea trifidi* (1386), *Vaccinio-Piceetea* (1374) and *Quercetea pubescentis* (1300). Still extremely limited data exist about the classes *Juncetea maritime* (11 relevés), *Cakiletea maritimae* (8), *Charetea intermediae* (2), *Adiantetea* (1), *Cymbalario-Parietarietea diffusae* (1) and *Oxycocco-Sphagnetea* (1).

Methods in vegetation classification and survey

Comparing model-based and distance-based ordinations

Zoltán Botta-Dukát

Centre for Ecological Research, Institute of Ecology and Botany, Vácrátót, Hungary, botta-dukat.zoltan@ecolres.hu

Key words: AIC, Distance-based, Model-based, Ordination

Model-based ordinations have become more and more popular in the last years. Although they still need more computation time than their distance-based alternatives, due to the development of algorithms they can be calculated within an acceptable time for medium-sized datasets. Their recommenders emphasize the theoretical background (instead of ad hoc selection of distance measure), correct separation of changes in location and dispersion, clear assumptions, and available tools for checking these assumptions.

In the lecture, I will illustrate other advantages of model-based ordination: information criteria can be used for deciding the optimal number of axis, and less axis is enough.

For example, in an analysis of vegetation data collected in the Kiskunság along the water-availability gradient from open sand grassland to wet meadows, model-based ordination correctly identified wetness as the only important gradient, while in distance-based ordination 19 eigenvalues were higher than random expectation of broken-stick model. Although the difference is less extreme in other studied examples, in all of them the number of the important axis was lower for model-based ordination.

Acknowledgements: This research was supported by the NKFIH (project number K-124671)

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Methods of vegetation survey in segetal weeds: accuracy of methodological details differs according to survey aims

Jana Bürger[1], Filip Küzmič[2]

[1]Crop Health, Faculty of Agricultural and Environmental Sciences, University of Rostock, Rostock, Germany, jana.buerger@uni-rostock.de
[2]Jovan Hadži Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia

Keywords: Herbology, Phytosociology, Weed vegetation

In a recent study of arable weed surveys, we found strong differences in species richness between observations originating from different scientific disciplines, namely herbology (weed science), and phytosociology. Species numbers per plot and per regional species pool were lower in the observations originating from a herbological background. We supposed the difference may have been caused at least partly by differing survey methodology, for example surveying field centers vs field edges. However, such information was unavailable for a large part of the phytosociological data.

Here, we present a literature review of weed surveys in and around arable fields published in national and international journals or as theses. We extracted all information that was given regarding the aims and methodology of survey, including field selection, plot positioning, abundance measures, and additional variables of environment and management. We paid special attention to balance the sources according to time span and geographic position.

We included 143 sources in the subsequent analyses, with publication years between 1939 and 2021, covering all European regions. We found that a large proportion of publications does not report on certain aspects of the employed methodology that influence e.g. species richness: plot positioning in the field (~45%) or plot size (~18%). This proportion varies between groups of papers with a different aim. Phytosociological studies generally report less details of their methodology than studies on the influence of environment or management on weed vegetation.

We make a recommendation for future surveyors to include certain information on the methodology, which, with little additional effort in the field, can significantly contribute to the usefulness of the data also beyond the original purpose of a study.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Approaching the typology of West Mediterranean semi-deciduous oak woodlands by semi-supervised classification

Jorge Capelo[1,2,4], Carlos Vila-Viçosa,[1,3,4,5], Tiago Costa[1,4,5], João Gonçalves[1,4,6], João Honrado[1,4,5] & Jesus Muñoz-Pajares[1,4,7]

[1]CIBIO-InBIO -Research Centre in Biodiversity and Genetic Resources, University of Porto, Portugal,jorge.capelo@cibio.up.pt
[2]National Institute of Agrarian and Veterinarian Research, Oeiras, Portugal
[3]Natural History and Science Museum, University of Porto, Portugal
[4]BIOPOLIS Program in Genomics, Biodiversity and Land Planning, University of Porto, Portugal
[5]Biology Department, Faculty of Sciences, University of Porto, Portugal
[6]proMetheus—Research Unit in Materials, Energy and Environment for Sustainability, Instituto Politécnico de Viana do Castelo, Portugal
[7]Departament of Genetics, Faculty of Sciences, University of Granada, Spain

Key words: Classification, Phytosociology, Plants, Vegetation

We approach the classification, by numerical methods, of semi-deciduous oak woodlands dominated by species of the *Q.faginea* and *Q. canariensis* taxonomic complexes in the West Mediterranean biogeographical Sub-Region.

An initial typology is obtained from a subset of relevées by unsupervised classification (ISOPAM) and ordination constrained by both environment and phylogeny (RDA). Further, the vegetation-types so obtained are then translated to a set of floristic rules. We obtain the rules by using the formerly classified relevés as trainning set in a classification and regression tree (CART). Further, the floristic rules are then applied to the whole relevée set and a compreensive classification is obtained (c.f. COCKTAIL). As a better resolved oak taxonomy and biogeography are also implied in the final classification, a consistent asociation-level syntaxonomy might be derived in the future.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Inventory of halophytes in central Europe

Daniel Dítě[1], Róbert Šuvada[2] & Zuzana Dítě[1]

[1]Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences, Bratislava, Slovakia. zuzana.dite@savba.sk
[2]State Nature Conservancy of the Slovak Republic, Administration of the Slovenský kras National Park, Brzotín, Slovakia

Key words: Bioindication system for soil salinity, Ecological preferences, Facultative halophytes, Habitat affinity, Obligate halophytes, Specialists, Supra-national classification

We present a multi-country database of vascular plants of temperate inland salt marshes and salt steppes in Europe. It was carried out by quantitative representation of species in different habitats divided into saline and non-saline, based on 20 years of field observation and annotated literature. We classified 190 species into three categories of salt tolerance: 47 of them are obligate halophytes, 59 facultative halophytes and 84 are accessory species. In addition we compiled a checklist with a calculated halophytic value of each species, and sorted them on a 9-point scale (salt numbers) in descending order reflecting their individual preference for soil salinity. Comparison of our approach with the most regularly used ecological indicator values in Europe based on measuring chloride levels in the soil (Ellenberg, Borhidi, Breckle) showed high correlation. It provides a cost-effective alternative method for determining the level of soil salinization, without the need for laboratory analysis of soil samples. The inventory of salt tolerant species reflects the current knowledge and is subjected to constant modification due to plant adaptations to the rapidly changing climate and environment (e.g. area shifts and migration of species). Halophytic value and salt number can be determined for any other species not present in our list by applying the calculation table in the proposed methodology. The classification system based on a habitat approach can be used also for creating indication systems for other
groups of plant specialists with a narrow ecological niche.

Acknowledgements: This research was financially supported by the VEGA Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic, project no. 2/0001/20, title “Islands of continental saline vegetation in temperate Europe – what they have in common and in what they differ?“.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Biomass content studies of sandy grasslands following the Danube from the Pannonian region to the Romanian plain

Attila Fűrész[1], Ferenc Pajor[2], Gábor Szabó[1], Gergely Pápay[1], Eszter S.-Falusi[1], Ildikó Turcsányi-Járdi[1], Dániel Balogh[1], Péter Csontos[3], Károly Penksza[1]

[1]Hungarian University of Agriculture and Life Sciences, Institute of Agronomy, Páter Károly utca 1. H-2100, Gödöllő, Hungary, furatis1@gmail.com
[2]Hungarian University of Agriculture and Life Sciences, Institute of Animal Science, 2100 Gödöllő Páter K. u. 1.
[3]Centre for Agricultural Research, Institute for Soil Sciences, Herman O. út 15, H-1022 Budapest, Hungary

Key words: Grassland management, Nutritional values, Plants

Festuca taxa are important grassland species in the Pannonian vegetation. Based on grassland management surveys, habitats of narrow-leaved or small *Festuca* species are an indicator of poor productive capacity, but are important in terms of nature conservation. The importance of these habitats is likely to increase with climate change, as the potential for dry habitats spreads.

Cut samples of biomass were made along the Danube from 37 areas, beginning from the Little Hungarian Plain, across the central great sandy plains of the Carpathian Basin (where it is divided into three parts, north, middle and south) to the southernmost part of the Basin at Deliblato, Serbia. The last samples were made beyond the Carpathians on the Romanian Great Plain and Bulgaria.

Absolute dry matter content of *F. vaginata* was high in all samples, but it showed a slight increase towards the southern area, with the highest values above 500 mg/kg in sample of Deliblato (DFv). Crude protein values were low, they didn't reach the 100 mg/kg limit. Crude fat was the lowest, ranging only between 18 and 25 mg/kg. Amount of crude fibre were not significant differences between the sample areas, it was around 300 mg/kg. There were differences in the proportions of the fibre fraction.

Based on the analyzed samples, there is an increasing trend in dry matter towards the southern areas. There were also significant differences between the analyzed species.

Acknowledgements: This research was supported by the OTKA K-125423.

Systematic grid square approach for vegetation and habitat analysis on a relict lowland forest near Rome

Dario La Montagna, Francesca Buffi, Vito Emanuele Cambria, Michele De Sanctis, Fabio Attorre, Giuliano Fanelli

Department of Environmental Biology, Sapienza University of Rome, 00185, Rome, Italy. dario.lamontagna@uniroma1.it

Key words: EU Habitat, LIFE project, , Synchronic analysis, Vegetation

Palo Laziale wood is a small biotope (129 ha) on the coast near Rome. Despite being one of the last patches of lowland forest in the region, it contains numerous priority habitats and species of high conservation interest. The vegetation consists mainly of Turkey oak woodland with small ponds and temporarily flooded meadows. The forest suffered an impressive dieback in 2003, coinciding with a particularly hot year. To reconstitute the Palo ecosystem, the Life PRIMED project (LIFE17 NAT/GR/000511) was launched.

As part of the project, monitoring of the flora was carried out to analyse the state of the ecosystem and to better understand the causes of the dieback. The monitoring was made with a synchronic approach by comparing 1ha plots, where presence data were collected of all plant species.

Multivariate analyses were carried out: 1) a cluster analysis for detecting groups of species; 2) NMDS analysis fitted with environmental variables taken during the LIFE project and Ellenberg indicators.

A high level of environmental heterogeneity was found, which led to the subdivision of the area into six ecologically distinct environmental units, including mesophilic xeric and thermophilic woods, and different types of grassland, including dunes vegetation. It has emerged that the area affected by woodland dieback is the one with the greatest capacity of water in the soil.

In the light of the results obtained, it was possible to map all the vegetation types and ecological groups all over the area and to recognise the different types of EU habitat present.

Given the high heterogeneity of the vegetation and the impossibility of carrying out phytosociological relevés, this approach allowed us to identify the vegetation units in the site and made evident the area affected by forest dieback and the possible environmental factors that favoured it. In addition, this work lays the foundations for permanent plots in this area to be monitored over time.

Acknowledgements: This research was supported by the EU in the framework of the European LIFE project LIFE17 NAT/GR/000511 LIFE PRIMED.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Possibilities of speciation following anthropogenous environmental changes in the central sandy area of the Carpathian Basin through the example of *Festuca* taxa

Károly Penksza [1], Gergely Pápay[1], Ildikó Turcsányi-Járdi[1], Attila Fűrész[1], Eszter Saláta-Falusi[1], Dániel Balogh[1], Zsuzsa Lisztes-Szabó[2], Dénes Saláta[3], Márta Fuchs[3], Erika Michéli[4]

[1]Hungarian University of Agriculture and Life Sciences, Institute of Agronomy, Páter Károly utca 1. H-2100, Gödöllő, Hungary, penksza.karoly@uni-mate.hu
[2]Isotope Climatology and Environmental Research Centre, Institute for Nuclear Research, Bem tér 18/c H-4026 Debrecen, Hungary.
[3]Hungarian University of Agriculture and Life Sciences, Institute for Wildlife Management and Nature Conservation, Páter Károly utca 1. H-2100, Gödöllő, Hungary
[4]Hungarian University of Agriculture and Life Sciences, Institute of Environmental Sciences, Páter Károly utca 1. H-2100, Gödöllő, Hungary

Key words: Flow cytometry, Taxonomy, Vegetation

After deforestation and shrubcutting, bare soil patches of areas exposed to anthropogenous effects had provided an opportunity new vegetation to form. Our goal was to check and revise the dominant *Festuca* species of vegetation types formed under extraordinary conditions in the Carpathian Basin. Individuals of examined taxa were analysed using 26 parameters of the inflorescences. Ploidy was analysed using flow cytometry. Meanwhile, we made coenological records in every type of sandy grasslands along the Danube from Austria to Romania. Furthermore, we set up a collection of living plants, which ensures individuals growing in the same conditions to molecular surveys. We also modelled the appearance, composition and dominant species of new vegetation on bare soil surfaces. The area has been being managed since 2006. The study area lies on the Pest plain near the left bank of the Danube.

As a result of this work, we confirmed the appearance of *F. vaginata, F. psudovaginata, F. javorkae, F. wagneri* in the natural grasslands, and discovered new occurrences *of F. brevibila* and *F. javorkae* in the area. In Slovakia, F. wagneri appeared as a new species of the flora of the country. *F. pseudovaginata* habits only the Pannon region, we found endemic and natural stands of it, but on secondary habitats it was confirmed as a completely new species.

On bare soil surfaces of areas exposed to anthropogenous effects, two species of the genus *Festuca* have become dominant. One of them was *F. pseudovaginata* but further studies are still needed on the other species. Survey continues in order to clear other hardly identificable taxa.

Acknowledgements: This research was supported by the OTKA K-125423.Author LSZ was supported by the European Union and the State of Hungary, co-financed by the European Regional Development Fund in project GINOP-2.3.2.-15-2016-00009 'ICER.'

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Ellenberg-type indicator values for species of European vascular flora: an algorithmic approach

Lubomír Tichý[1], Milan Chytrý[1], Irena Axmanová[1], Jürgen Dengler[2,3,4], Riccardo Guarino[5], Florian Jansen[6], Gabriele Midolo[1], Michael P. Nobis[7], Koenraad Van Meerbeek[8,9] and collaborators

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic
[2]Vegetation Ecology Research Group, Institute of Natural Resource Sciences (IUNR), Zurich University of Applied Sciences (ZHAW), Grüentalstr. 14, 8820 Wädenswil, Switzerland unI
[3]Plant Ecology, Bayreuth Center of Ecology and Environmental Research (BayCEER), University of Bayreuth, Universitätsstr. 30, 95447 Bayreuth, Germany
[4]German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstr. 4, 04103
[5]Department of Biological Chemical and Pharmaceutical Sciences and Technologies (STEBICEF), University of Palermo, Italy
[6]Faculty of Agricultural and Environmental Sciences, University of Rostock, Germany
[7]Dynamic Macroecology, Swiss Federal Research Institute WSL, Birmensdorf, Switzerland
[8]Department of Earth and Environmental Sciences, KU Leuven, Belgium
[9]KU Leuven Plant Instituten, KU Leuven, Belgium

Key words: Bioindication, Ecological gradients, Species composition, Species traits, Vegetation

Ellenberg indicator values are an expert-based ranking of species according to their ecological optima with nine- or twelve-degree ordinal scales for seven main ecological gradients. Here we aim to combine the original Ellenberg's system for Germany with compatible systems across Europe.

We surveyed existing literature and databases containing indicator values for European vascular plants and selected those with scales that matched the original scales defined by Ellenberg for light, temperature, soil moisture, reaction, nutrients and salinity. Then we compared the original Ellenberg dataset with the other datasets of Ellenberg-type indicator values. We selected ten datasets that showed consistent trends with the Ellenberg datasets and averaged all the values for each combination of species and the environmental factor. The values for species without published indicator values were estimated from indicator values of co-occurring species in the vegetation plots from the EVA database.

We provide indicator values for about 8,500 European plant species. About 7,500 species got the value directly as an average of published values, and about 1000 species received the value based on the estimation from co-occurrences in EVA.

The new indicator values with nine-degree (or twelve-degree) scales are fully compatible with the definition of so-far published Ellenberg-type indicator values and can be used for large-scale analyses mainly in temperate Europe and the central Mediterranean or as a source of missing values in local studies.

The field application of INBOVEG: a powerful tool to improve data collecting

Sophie Vermeersch, Pieter Vandenbroecke, Aaike De Wever, Sten Migerode, Kevin Vertongen, Els De Bie

Research Institute for Nature and Forest, Brussels, Belgium, sophie.vermeersch@inbo.be

Key words: Data collection, Field application, Phytosociology

As a vegetation meta database, INBOVEG is a powerful vegetation data management tool (https://www.vlaanderen.be/inbo/en-gb/data-applications/inboveg/). Moreover, it contributes to the facilitation of vegetation research and the acquisition of robust results. It offers a standardized environment to collect data. Nonetheless, the success of this database is related to its widespread use. The development of an offline application to enter the data on field should be a time saver and minimize the errors due to the input of data via the web application. Furthermore, the use of mobile phones enables the use of many free and open sources applications related to the INBOVEG mobile application. The main properties of the Inboveg mobile application includes its user-friendly format, its flexibility concerning a wide variety of survey methods and ongoing development for its wider use. The types of surveys that can be built, imply unrelated plots, time series, belt transects or a combination of all these previously cited possibilities. Recently a new development has been released: the use of ppd (point to plant distances). In the future the development of the use of line transects could be considered. The mobile application possesses the opportunity for managing, visualization and the export of large amounts of data. Moreover, the collection of data can be performed by different mappers simultaneously.

Special needs can be provided by linking adapted lists related to specific research questions, packaged in drop down lists. In addition to the definition of the attributes of the different plots (plot information, taxa, cover/abundance,…) and the easy export to the database or server, the application represents a complete and powerful tool for data collection.Therefore, the use of a mobile application could offer new opportunities in the future to promote citizen science in Flanders.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Beyond the floristic horizon: a formation level classification of European phytosociological classes

Wolfgang Willner[1], Don Faber-Langendoen[2]

[1]Department of Botany and Biodiversity Research, University of Vienna, Austria, wolfgang.willner@univie.ac.at
[2]NatureServe, Arlington VA, US

Key words: Braun-Blanquet approach, Class, EcoVeg approach, EuroVegChecklist, Formation, International Vegetation Classification

The question how to organize phytosociological classes into higher units is as old as the Braun-Blanquet system. Here we suggest that the upper levels of the International Vegetation Classification (IVC) based on the EcoVeg approach is a promising framework. We established a tabular linkage between the classes of the EuroVegChecklist (EVC) and the IVC formations. We organized the EVC classes into 21 formations and flagged classes that did not fit comfortably within an existing formation. In general, the IVC approach adds a set of physiognomic and ecological criteria that effectively organizes the EVC classes, which are already being increasingly informed by physiognomy. Therefore, the formation concepts are relatively natural extensions of concepts already embedded in the classes. However, physiognomic placement of Braun-Blanquet classes can be difficult when the sampling of the vegetation is at finer grain than usual in the respective formation (tall-scrub, annual pioneer communities). In a few cases, we split EVC classes because they seemed too heterogenous to be assigned to a single formation. Delimitation of these classes has often been a matter of debate for many decades, and the IVC perspective might help to solve these intricate issues. We also flagged formations that would require splitting of otherwise homogeneous classes. In these cases, mismatches between phytosociological classes and IVC formations might better be solved by emending the current formation concepts.

Plant diversity and its drivers

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The importance of beta diversity to characterize beech forest successional stages: from coppice to primeval forests

Giandiego Campetella[1], Zhu Zhengxue[1], Stefano Chelli[1], James Tsakalos[1,2], Lubov Bosrukiewicz[3], Marco Cervellini[1], Sandor Bartha[4], Roberto Canullo[1]

[1]School of Biosciences and Veterinary Medicine, University of Camerino, Italy; diego.campetella@unicam.it
[2]Harry Butler Institute, Murdoch University, Murdoch, Perth, WA, Australia
[3]Lviv University Botanical Garden, Lviv, Ukraine
[4]Institute of Ecology and Botany, Centre for Ecological Research, Vácrátót, Hungary

Key words: Diversity changes, Forest understory, Scale dependence, Stand development

Forest understory poorly contributes to forest biomass. However, it may contain 90% of plant diversity and it contributes significantly to ecosystem functions (e.g., litter decomposition and nutrient cycling). Timber harvesting may impact forest structure and stability, by altering resource amount/heterogeneity and conditioning factors inducing secondary succession. Understanding forest succession after harvesting is important for biodiversity conservation and for developing sustainable management practices. We compared alpha and beta diversity in different stages of forest stand development. Beta diversity was represented by the Compositional Diversity; CD (diversity of species combinations recorded at different spatial scale.

Understory diversity is a function of the changing canopy structure: we expect minimum CD during periods of canopy closure and peaks when the canopy is more open, providing a similar U-shaped response of CD along with the successional recovering steps. We selected more than 15 beech forest stands in different successional phases, from freshly coppiced stands to old-growth forests, also including a primeval beech forest in the Carpathians Mountains as a reference. We sampled understory vegetation (all vascular species <2 m of height) by transect sampling. Presence of species was recorded along 10 × 10 cm micro-quadrates. As the vegetation patterns are fully censused along the transects, these data are appropriate for further computerized sampling at different resolutions. We calculated both classic (H') and bioinformatic version (CD) of Shannon's diversity.

Our results indicate that after CD peaks occurring in post logged stands, as the succession proceeds, the CD maximum values became smaller and occurring at larger spatial resolution (old coppice stands). Then, as we pass to forest mature stands till to primeval old-growth forest, CD values become larger, and the characteristic scale decreases. Our results confirm previous suggestions that beta diversity indices are sensible indicators of forest understory vegetation patterns while alpha diversity changes less along the different successional phases.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Factors driving the distribution and beta diversity of the Central European forest-steppe

Kryštof Chytrý[1,2], Jan Divíšek[2,3], Helena Prokešová[2], Mário Duchoň[4], Wolfgang Willner[1], Vít Grulich[2], Milan Chytrý[2*], Stefan Dullinger[1*]

[1]Department of Botany and Biodiversity Research, University of Vienna, Vienna, Austria; krystof.chytry@gmail.com
[2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic
[3]Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic
[4]Regional Association for Nature Conservation and Sustainable Development (BROZ), Karlova Ves, Slovakia
[*]Shared last authorship

Key words: Biome, Central Europe, Feedback, Forest-steppe, Microclimate, Topography

The occurrence and origin of dry grasslands and their rich biota in the moderately humid Central European climate have puzzled scientists for over a century. Modern palaeoecological and phylogeographical data support earlier hypotheses that these grasslands are late Pleistocene relicts and can therefore be considered part of the Eurasian forest-steppe biome. It is still unclear, though, which factors maintain the stable co-occurrence of steppe and forest in such landscapes, as well as which factors drive the species sorting within the forest-steppe biome in Central Europe.

Firstly, regarding the distribution of the forest-steppe biome in Central Europe, we propose a conceptual framework summarising the effects of (1) climate, (2) topography and (3) disturbances. We demonstrate this framework using data from 108 forest-steppe sites in the Carpathian Basin. Second, we studied the beta-diversity patterns in Central European forest-steppe using an original dataset of vegetation plots from three major forest-steppe habitats (forest, ecotone and steppe) at 32 sites. Specifically, we studied the species turnover between these sites and the proportion of distribution range types in relation to (1) climate, (2) geographical location and (3) substrate.

We stress the importance of interaction between climate and topography as a driver of the distribution of the forest-steppe biome. In flat landscapes, forest and steppe can naturally co-occur only within a narrow climatic belt, while in rugged landscapes, they can also coexist in relatively dry or humid landscapes. The mechanistic driver behind this pattern is the microclimate that is shaped by both climate and topography. The species sorting in forest-steppe landscapes is strongly determined by the substrate. The distribution of species belonging to specific range types can be explained by the environmental conditions at the core of their native distribution ranges.

The conceptual framework we propose, as well as the complexity of the distribution patterns in the forest-steppe biome, should be taken into account when discussing the environmental history of the forest-steppe in Central Europe and in conservation planning.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Artificial snowing of ski slopes: disaster or gentle caress?

Simona Klačanová, Jozef Šibík

Plant Science and Biodiversity Center, Institute of Botany, Bratislava, Slovakia, simona.klacanova@savba.sk

Keywords: Artificial snow, Ecological variables, Snow ecology

Most ski resorts in Slovakia are using the technology of artificial snowing, as the natural snow cover in the areas is no longer sufficient. The study aims to examine the difference between the two groups – ski slopes treated and untreated with artificial snow.

Vegetation data of a total of 36 relevés were acquired in 18 Slovak ski resorts using the twin plot technique on artificially snowed and naturally snowed ski slopes. Twin plots on ski slopes were selected using the digital elevation model of Slovakia, where their slope, elevation, and cardinal orientation were calculated. This was done to minimize differentiation in vegetation caused by topographic factors and to only follow the gradient of long-lasting snow cover.

To better understand the ecological variables and their relationships with each other within the two twin plots, we have performed Spearman's rank-order correlation tests. The tested variables were unweighted Ellenberg's indicators values, heights of flowering and non-flowering graminoids and herbs and their cover, the cover of mosses, the cover of litter, and species richness. Dissimilarities between the twin plots were calculated and generalized linear models were used to observe the dependence between the response variable - dissimilarity and the predictor of environmental variables. The model applied on naturally snowed slopes showed significant results for factors as nutrients, light, moisture, and temperature, while the one applied on slopes with artificial snow showed significance for heights of flowering and non-flowering herbs. In case of artificially snowed plots, strong positive correlation was found between cover of mosses and moisture. Naturally snowed plots have shown strong relationships between factors such as soil reaction, temperature, and nutrients.

In each of the studied groups, different relationships occurred, pointing on their ecological divergence. However, the effect of artificial snow cannot be yet perceived as good, nor bad for the environment.

Acknowledgments: This research was supported by the grants VEGA 0119/19 and APVV 16-0431.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Management type and biogeography shape neophyte richness in European annual weed and ruderal vegetation

Filip Küzmič[1,2], Zdeňka Lososová[3], Irena Axmanová[3], Veronika Kalusová[3], Erwin Bergmeier[4], Milan Chytrý[3], Florian Jansen[5], Urban Šilc[1]

[1]ZRC SAZU, Jovan Hadži Institute of Biology, Ljubljana, Slovenia, filip.kuzmic@zrc-sazu.si
[2]University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia
[3]Masaryk University, Faculty of Science, Department of Botany and Zoology, Brno, Czech Republic
[4]University of Göttingen, Department of Vegetation Science & Plant Diversity, Göttingen, Germany
[5]University of Rostock, Faculty of Agricultural and Environmental Sciences, Rostock, Germany

Key words: Alien plants, Biological invasions, Europe, European Vegetation Archive, Exotic plants, Habitat type, Invasibility, Man-made habitats, Non-native plants

Human-made habitats are highly invaded by alien plant species. We asked: (i) What is the level of neophyte invasion on European arable land and ruderal sites with annual vegetation, (ii) what are the biogeographical patterns of these invasions, and (iii) what is the effect of different management types on neophyte invasion?

We obtained 32 036 vegetation plots of annual vegetation occurring in human-made habitats from the European Vegetation Archive (EVA). We assessed the level of invasion at the species pool and plot scales by calculating species number and percentage of neophytes in three management types (cereal, row crop, ruderal) and seven biogeographical regions (Alpine, Atlantic, Boreal, Continental, Mediterranean, Pannonian, and Steppic). For neophytes, we distinguished between those of European and non-European origin.

We found 483 alien species (15% of the cumulative number of species) in the annual vegetation of man-made habitats. Almost half of them (47%) were of non-European origin. The mean percentage of neophytes per plot was highest in row crops and lowest in cereals. The participation of neophytes in the cumulative number of species differed considerably between biogeographical regions, with the highest number of neophytes in the Atlantic region and lowest in the Steppic region. On the plot scale, the highest percentage of neophytes was found in the Steppic region and the lowest in the Boreal region.

Our study shows that disturbance and biogeographical setting influence the level of neophyte invasion on both the species pool and plot scale. Although the number of neophytes of European and non-European origin is very similar, the latter group of neophytes is much more frequent.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Determinants of invasion by single versus multiple plant species in temperate lowland forests

Vojtěch Lanta[1], Lukáš Čížek[2], Jiří Doležal[1,2]

[1]Department of Functional Ecology, Institute of Botany of the Czech Academy of Sciences, Průhonice, Czech Republic, vlanta@centrum.cz
[2]Department of Biodiversity and Conservation Biology, Institute of Entomology, Biology Centre of the Czech Academy of Sciences, České Budějovice, Czech Republic
[3]Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic

Key words: *Aster lanceolatus*, Functional diversity, Habitats, *Impatiens parviflora*, Invasive species, Lowland forests, Phylogenetic diversity, Resident species

Invasions of alien plants pose a serious threat to native biodiversity and ecosystem processes. Forests are considered more resistant to invasion due to limited light availability in understories. However, disturbance and abiotic stress open tree canopies and promote invasion. Their combined effects together with the resistance of resident species may determine the numbers and abundances of invasive species. Here we explore how canopy openness, water stress, and taxonomic and functional properties of resident communities affect the invasion by a frequent single invasive species (*Aster lanceolatus* and *Impatiens parviflora*) compared to that by multiple invaders in Central European lowland forests. Different abiotic factors and species-specific mechanisms of invasiveness determined the success of single versus multiple invaders. The massive spread of *A. lanceolatus* was associated with the long-distance seed dispersal and exploitation of available resources by fast growth resulting in formations of compact clonal patches in disturbed, open-canopy floodplain forests. The success of *I. parviflora* was caused by avoiding competition via tolerating less favorable conditions under the dense tree canopy on drier sandy soils. *A. lanceolatus* thus suppressed resident species richness, while *I. parviflora* spread in communities of higher functional and phylogenetic diversity. Multiple invasive species, mostly represented by subordinate species with low cover, colonized forests that were rich in resident species. We conclude that a combination of intense disturbance and stress favor the invasion of single dominant species that act as drivers of changes in native communities. Multiple invasive species colonize forests with less extreme conditions acting more as passengers who increase rather than decrease forest diversity.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Variability of plant traits in urbanized area of Brno

Andrea Lobpreisová, Zdeňka Lososová and data contributors

Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, 444475@mail.muni.cz

Key words: Database Pladias, Maps, Plant traits, Urban environment

The urban environment is a fine-grained mosaic of different habitats, from natural, semi-natural to man-made habitats. This allows species with different environmental requirements to live side by side in cities. The purpose of this study is to evaluate the role of urban environmental factors on the functional diversity of plants in Brno. The flora of Brno was mapped in the period from 2011 to 2021. The presence of spontaneously occurring species has been recorded in grid-cells of 1.1 × 1.5 km. The study area covers the entire urban gradient from the city centre to the periphery. For each sampling cell, information on environmental factors such as distance of the sampling cell from the city centre, mean altitude, length of roads and railways, land use heterogeneity, and percentage of built-up area, arable land, meadows, forests, and water area, was collected.

Our dataset contains 69,423 records or 1,643 spontaneously occurred taxa within the city. For these taxa information about their traits were retrieved from the database Pladias The attention was focused on these following characteristics: ecological characteristics of plants, their origin, dispersal strategies, pollination, leaf characteristics, life form, and other related traits that can characterize general trends in species composition patterns. The output is a series of maps created in GIS software that shows the composition of plant traits in the urban area of Brno and dependence analysis of these traits on other environmental factors. Our results present the general trends in species composition patterns and highlight the importance of land use mozaic on urban plant functional diversity.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Seed dispersal database for the European flora

Zdeňka Lososová[1], Irena Axmanová[1], Milan Chytrý[1], Gabriele Midolo[1], Sylvain Adbulhak[2], Dirk Nikolaus Karger[3], Julien Renaud[4] , Jeremy Van Es[2], Pascal Vittoz[5], Wilfried Thuiller[4]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, lososova@sci.muni.cz
[2]Alpine National Botanical Conservatory, Gap, France
[3]Swiss Federal Research Institute for Forest, Snow, and Landscape Research, Birmensdorf, Switzerland
[4]Laboratory of Alpine Ecology, University of Grenoble Alpes, Grenoble, France
[5]Institute of Earth Surface Dynamics, Faculty of Geosciences and Environment, University of Lausanne, 1015 Lausanne, Switzerland

Key words: Dispersal ability, Dispersal unit, Habitat preferences, Plant traits

The dispersal ability of plants is one of their crucial attributes, determining their spread to new habitats and regions. However, data on dispersal distances are available only for a limited number of species. Here we aim to compile a database of seed dispersal distances and major dispersal types for a wide range of European vascular plants. We assigned plant species to seven dispersal-distance classes based on the morphology of dispersal units, life form, seed release height, seed mass, and habitat preferences. Each class comprises species with similar dispersal distances. Thus our delimitation could be used as semi-quantitative trait. To evaluate our classification of species into dispersal classes, we related the dispersal classes to the estimated dispersal distances calculated with the function dispeRsal in R (obtained based on several trait combinations, but not habitat preferences and human dispersal mode). In total, we classified 9,776 European species into the seven dispersal-distance classes. Therefore, the presented database is the most complete source of dispersal abilities of European plants. The use of semi-quantitative information distinguishes our database from others that only contain categorical variables such as dispersal type and dispersal vector. Our classification is closely related to the calculated estimates of dispersal distances. Our database can be used in ecological studies and dynamic vegetation modelling that account for plant dispersal from local to continental scales.

Acknowledgements: This research was funded through the 2019-2020 BiodivERsA joint call for research proposals, under the BiodivClim ERA-Net COFUND program, and with the funding organizations Swiss National Science Foundation SNF (project: FeedBaCks, 193907), Agence nationale de la recherche (ANR-20-EBI5-0001-05), the Swedish Research Council for Sustainable Development (Formas 2020-02360), the German Research Foundation (DFG BR 1698/21-1, DFG HI 1538/16-1), and the Technology Agency of the Czech Republic (SS70010002).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Degree of synanthropization of flora of different types of landscapes of the Northern Prychornomoria (Ukraine)

Ivan Moysiyenko

Department of Botany, Kherson State University 27, Universytetska St., Kherson, Ukraine 73000

Key words: Grasslands, Vegetation classification, Wetlands

A comparative study of the flora of 17 types of landscapes in the Northern Prychornomoria (Northern Black Sea coastal region) was conducted. Based on mathematical processing of samples of flora of 17 types of landscapes, it was found that they are divided between three classification classes (Pearson's correlation coefficient = 0.8) and 11 subclasses (Pearson's correlation coefficient = 0.5).

The first Seaside class includes flora of marine and coastal azonal landscapes with a distinct halophytic component (Fig. 1). It is divided into two subclasses, which correspond to the Seaside Saline (Valley of Kurgans) and Sandy Sea Island (Dzharylgach) landscapes.

The second Valley class includes flora of river and river valley landscapes where hygrophytic plants dominate. The class is divided into two subclasses, which correspond to the Lower Dnipro terrace-sandy (Oleshky) and Lower Dnipro floodplain (Potemkinskyi) landscapes.

The third Steppe class unites all the diversity of zonal steppe landscapes, which are divided into seven subclasses. The division into two groups of subclasses is well expressed. One of the groups includes three classes of drained middle and southern steppe landscapes, characterized by a low level of synanthropization of flora. Another group includes various steppe landscapes, which are united by a high level of synanthropization of flora.

Based on a comparison of the synanthropization of the flora of specific types of landscapes, the following conclusions can be drawn:

–all studied landscapes are characterized by a high level of synanthropization of flora (above 50%);

–the least synanthropized are azonal, intrazonal and extrazonal landscapes;

–the most synanthropic are poorly drained or drained steppe landscapes;

–heavily drained steppe landscapes are less synanthropic compared to similar poorly drained steppe landscapes;

–south-steppe zonal landscapes are more synanthropic than medium-steppe landscapes (northern);

–drained steppe landscapes with rocky outcrops are less synanthropic compared to similar landscapes, but without rocky outcrops.

A plan to conserve the last *Sphagnum*-dominated communities in the karst dolines of Castelluccio Plains (Central Apennines)

Safiya Praleskouskaya, Corrado Marcenò, Fabio Maneli, Paola Angelini, Marilena Ceccarelli, Roberto Venanzoni

Department of Chemistry, Biology and Biotechnology, University of Perugia, Italy, pro.sofia.dms@gmail.com

Key words:Habitat conservation, Pressures, Transition mires, Sphagnum

Castelluccio karst plains (Central Italy) host the only site with *Sphagnum* populations in Umbria: *S. subsecundum* at Pian Piccolo and *S. platyphullum* at Pian Grande of Castelluccio. According to Natura 2000 network, these communities are included in Habitat 7140. In S Europe they reach their southern distribution limits with consequent impoverishment of diagnostic species. Despite the habitat surfaces being extremely localized, such post-glacial relicts play an important role as an indicator of climate change. So far, these communities are still poorly investigated, and a detailed study on their phytosociological assessment and ecology is still missing yet essential to give the correct guidelines for their future protection and conservation.

As a preliminary investigation, 36 relevés were made following hydrology-guided transects and the Braun-Blanquet method. As a result, three main vegetational aspects were detected: i) *Caricion gracilis* with *Sphagnum* in the wettest area; ii) ecotonal transition on more acidic and organic soil with *Caricion nigrae* within *Sphagnum*, *Aulacomnium palustre* and *Polytrichum commune*; iii) *Nardo-Agrostion* grassland in the driest conditions.

The main pressures observed until now are: i) extremely dry conditions in August; ii) intensive mowing and iii) grazing of large livestock. The first factor leads to complete desiccation of *Sphagnum* for long periods of time; the second factor accelerates this process removing the protection given by vascular plants, which act like moisture traps and shade providers. Furthermore, intensive mowing often removes entire layers of *Sphagnum*. The third factor leads to heavy trampling, which destroys already low coverage patches of the rare peat moss genus in Central Italy.

An evaluation of approaches to sustainable management of grasslands with the presence of *Sphagnum* spp., through different types of mowing techniques, is carried out to evaluate how these can affect the conservation of such an endangered Habitat.

Acknowledgements: The study is funded by the LIFE IMAGINE (19 IPE/IT/000015) project, which aims to create an integrated management system that guarantees the achievement of the conservation objectives of the Habitats and Birds Directives.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Macroecological drivers of vascular plant species composition in semi-natural grasslands: a regional study from Lower Silesia (Poland)

Małgorzata W. Raduła[1], Tomasz H. Szymura[1], Magdalena Szymura[2], Grzegorz Swacha[3]

[1]Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław, Wrocław (Poland), malgorzata.radula@uwr.edu.pl,
[2]Institute of Agroecology and Plant Production, Wrocław University of Environmental and Life Sciences, Wrocław (Poland)
[3]Botanical Garden, University of Wrocław, Wrocław (Poland)

Key words: Distance-based Moran's eigenvector map, Habitat continuity, Human pressure, Redundancy Analysis, Spatial analysis, Vegetation plot

Semi-natural grasslands are important habitats in the European agricultural landscape. They provide numerous ecosystem services, such as forage production, ground and surface water regulation, and carbon sequestration. In the face of declining area of grasslands, information on macroecological drivers of their species composition is important for scientific theories development, and for nature conservation purposes. The increasing availability of high-accuracy vegetation and environmental data stored in electronic databases facilitates the explanation of macroecological patterns and processes. The aim of this study was to examine the effects of environmental gradients, landscape structure, human pressure, habitat continuity in time, and spatial structure on species composition of vascular plants in semi-natural grasslands. The analysis was performed for 689 vegetation plots distributed across an ~20,000 km^2 area (Lower Silesia region, Poland). To find the most important factors of grasslands species composition, the multivariate approach was used. Additionally, vegetation plots were grouped according to the continuity of grassland in time (old, medium, and recent grasslands). Then, the groups were compared in terms of their species composition, most frequent habitat type, and site characteristics. We found that the most influential factors shaping species composition were: temperature and precipitations, long-term habitat continuity, and topography. Grasslands with different habitat continuity in time were unevenly distributed over space and environment. Old grasslands (existing since the 1940s) usually occurred in wet habitats, and medium grasslands (existing since the 1980s) occured in highlands in most cases. In the study, we highlighted the potential of freely available vegetation and environmental databases, as well as historical topographic maps in the macroecological studies on plant species composition patterns. The result also showed that vegetation databases are useful in the recognition of grassland complexes contributing the regional biodiversity.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Diversity patterns of alien vascular plants in railway stations of Slovakia

Michal Slezák[1,2], Matej Dudáš[3], Pavol Eliáš Jr.[4], Katarína Hegedüšová[1], Richard Hrivnák[1], Jana Májeková[1], Ivana Svitková[1]

[1]Plant Science and Biodiversity Center, Institute of Botany, Slovak Academy of Sciences, Bratislava, Slovakia, slezak.miso@gmail.com
[2]Institute of Forest Ecology, Slovak Academy of Sciences, Zvolen, Slovakia
[3]Department of Botany, Institute of Biology and Ecology, Faculty of Science, University of Pavol Jozef Šafárik, Košice, Slovakia
[4]Institute of Biological and Environmental Sciences, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture, Nitra, Slovakia

Key words: Neophytes, Non-native species, Rail transport, Species diversity, Urban environment

Railway has been identified as important man-made habitats and dispersal corridors for alien plant species. Biodiversity research of vegetation in 30 railway stations evenly distributed across Slovakia was carried out in spring 2021. We recorded vascular plants and their percentage cover using Tansley sampling scale for each 1-hectare plot. Redundancy analysis (RDA) and Canonical correspondence analysis (CCA) with forward selection procedure and Monte Carlo permutation test were used to test the species composition-environmental relationships. Linear regression assessed the importance of anthropogenic (number of city inhabitants, number of all, passenger and cargo trains) and climatic variables as potential predictors for the number and percentage of alien and especially, neophyte plant species.

We found a total of 113 alien plants, including 45 neophytes. The most frequent alien species (recorded in >70% of plots) were *Bromus tectorum*, *Lactuca serriola*, *Senecio vulgaris*, *Veronica arvensis* and *Viola arvensis*. The highest frequencies (>50%) among neophytes showed *Geranium purpureum*, *Senecio vernalis* and *Stenactis annua*. The species richness values were in the range of 13–34 species per plot (mean 22) for aliens and of 2–11 species (mean 6) for neophytes. Linear regressions indicated significant (P<0.05) response of alien richness to Pannonian region, number of all and cargo trains. The alien percentage was additionally driven by elevation and number of passenger trains. Species richness of neophytes was significantly determined by Pannonian region and number of cargo trains. These two predictors accompanied by number of all and passenger trains were found to be significant for neophyte percentage. RDA suggested importance of Pannonian region, number of all and cargo trains, which explained 15.7% of variation in alien species composition. The most important sources of neophyte composition variation in CCA were elevation and number of passenger trains, which jointly accounted for 15.3% of data variation.

Acknowledgements: This research was supported by the Scientific Grant Agency VEGA no. 2/0108/21.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Aboveground biomass production by individual plant species in semi-natural hay grasslands in the Sudetes Mountains (Central Europe)

Grzegorz Swacha[1], Mateusz Meserszmit[1], Lenka Pavlů[2], Vilém Pavlů[2,3], Klára Kajzrová[4], Teowdroes Kassahun[2], Małgorzata W. Raduła[5], Jan Titěra[2,3], Zygmunt Kącki[1]

[1]Botanical Garden, University of Wrocław, Poland, grzegorz.swacha@uwr.edu.pl
[2]Grassland Research Station Liberec, Crop Research Institute, Praha, Czechia,
[3]Department of Ecology, Faculty of Environmental Sciences, Czech University of Life Sciences, Czechia,
[4]Department of Agroecology and Crop Production, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Prague, Czechia,
[5]Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław, Wrocław, Poland

Key words: Climate, Diversity, Herbage yield, Management, Meadows, Soil

Mesic semi-natural grasslands are widespread vegetation type in mountainous and sub-mountainous regions of Central Europe. Grasslands play a significant role in biological diversity conservation, but they also deliver multiple ecosystem services and provide a feed base for ruminant livestock. Aboveground biomass production in grasslands was the object of investigation in many previous studies. Unlike in other studies, which mostly focused on the total biomass in grasslands, this study utilized the measured dry weight of individual vascular plant species. This allowed the robust investigation of the relative contribution of individual species to the total biomass. Secondly, we examined the causes of variation in biomass production by individual species across soil acidity and fertility, climatic and topographic features, and disturbance regime gradients using multivariate analyses. This study was conducted in the Sudetes Mountains in Poland and the Czech Republic over an area of 5500 km^2. Two types of Natura 2000 habitats were sampled: lowland hay meadows (6510) and mountain hay meadows (6520). We sampled 58 grasslands found along broad environmental gradients. This study showed that mesic semi-natural grasslands in the Sudetes Mountains consist of a number of species with a differing relative contribution to the total biomass. Out of 165 species found in biomass samples, just five widely distributed and dominant grass species formed approximately half of the total biomass. The other half was dependent on 160 species. It can be concluded that rare and low-abundance species combined to play an equally important role in the production of biomass. These species are simultaneously the core of diversity in semi-natural grasslands. This study identified pH as the most important determinant of biomass production by individual species, followed by land management, temperature, and precipitation. Using the t-value biplots we showed positive and negative correlations between biomass of individual species and each of the explanatory variable.

Acknowledgements: This work was funded by the European Union from the European Regional Development Fund under Interreg VA Czech Republic-Poland from the project 'Grassland biomass as a renewable energy source-Biodiversity-Biomass-Biogas' (CZ.11.4.120/0.0/0.0 /16_026/0001092).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Vegetation databases augment species distribution atlases in biodiversity patterns mapping

Tomasz H. Szymura[1], Grzegorz Swacha[2], Adam Zając[3], Magdalena Szymura[4], Zygmunt Kącki[2], Dominika Chmolowska[5], Henok K. Tegegne[1]

[1]University of Wrocław, Department of Ecology, Biogeochemistry and Environmental Protection, Poland, tomasz.szymura@uwr.edu.pl
[2]University of Wrocław, Botanical Garden, Poland
[3]Jagiellonian University, Institute of Botany, Kraków, Poland
[4]Wrocław University of Environmental and Life Sciences, Institute of Agroecology and Plant Production, , Poland
[5]Polish Academy of Sciences, Institute of Systematics and Evolution of Animals, Kraków, Poland

Key words: Distribution atlases, Species richnes, Spatial pattern, Vegetation databases

The rapid decline of biodiversity in the Anthropocene rais concerns for both scientists and public opinion. Actions mitigating this decline should be based on scientific knowledge, including information on spatial patterns of biodiversity distribution and factors shaping it. The crucial obstacle for it is lack of appropriate data on species distribution. In the entire world, the actions of merging datasets to obtain more comprehensive data sources are undertaken.

Typically, the data on plant species distribution are derived from distribution atlases. In Poland, the basic source of information is „Atlas of distribution of vascular plants in Poland“ (ATPOL) which shows the distribution of 3,053 vascular plant taxa in a square grid, sized 10 x 10 km. However, a considerable amount of information on plant species distribution could be also derived from vegetation databases. The Polish Vegetation Database (PVD) comprises 117,327 vegetation plots with known localization and recording 2,625 vascular plant taxa. In this project, we merged the two databases by applying a unified species nomenclature that allows joining the data. From the species list, species with unclear taxonomic status and/or difficult to identify in the field were excluded. After taxonomic nomenclature simplification and merging, the joined database comprises data on the distribution of 3,377 taxa, mostly at species level, in a 10 × 10 km grid. The PVD added to the total taxa list 391 taxa not recorded by the ATPOL, while 750 taxa recorded in ATPOL, were not found in PVD. Among 3,071 analyzed grid squares, the PVD revealed presence of taxa, not recorded by the ATPOL, in 73% of the squares. The species number per square typically (median value) increased by 9 taxa, it was about 1.6% of all species in a square. Species omitted by the ATPOL but recorded in the PVD typically represents quite common taxa, perhaps ‘boring‘ for taxonomist. The data were used to draw a map of vascular plant species richness in Poland. The direct assessment of spatial sampling bias is possible only for PVD, by applying a species accumulation curve method. However, the differences in species richness between these two datasets help in sampling bias assessment for the ATPOL.

Acknowledgements: This research was supported by the National Science Centre, Poland, project number 2019/35/B/ NZ8/00273.

Establishing the Ukrainian Database of Plant Traits

Denys Vynokurov[1,2], Olga Chusova[2], Anastasia Davydova[2], Denis Davydov[2], Hanna Kolomiets[3], Ivan Moysiyenko[4], Nadiia Skobel[4], Viktor Shapoval[5], Oleksandr Shynder[6], Dariia Shyriaieva[2,7]

[1]Department of Plant Biology and Ecology, University of the Basque Country UPV/EHU, Bilbao, Basque Country, Spain, denys.vynokurov@gmail.com
[2]Geobotany and Ecology Department, M.G. Kholodny Institute of Botany, NAS of Ukraine, Kyiv, Ukraine;
[3]Buzkyi Gard National Nature Park, Myhia, Mykolaiv region, Ukraine
[4]Department of Botany, Kherson State University, Kherson, Ukraine
[5]Falz-Fein Biosphere Reserve "Askania-Nova" NAAS of Ukraine, Askania-Nova, Ukraine
[6]M.M. Gryshko National Botanical Garden, NAS of Ukraine, Kyiv, Ukraine
[7]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic

Key words: Database, Functional traits, Plant diversity, Ukraine, Vascular plants

Considering the growing demand for plant trait data and taking into account the lack of trait data from Eastern Europe, we launched a new database aiming to collect all the available plant trait data from Ukraine. We compiled the available plant traits from various literature sources (Reva & Reva 1976; Dobrochaieva et al. 1987; Grisiuk et al. 1989; Hrodzynsky 1990; Golubiev 1996): life history (annuals, biennials, perennials) for 5203 species of Ukrainian flora; plant height – for 4786 species; phenology (flowering months) – 5811 species; life form by Raunkiaer – 3549 species; life form by Serebriakov – 3906 species; life form by Golubiev – 2775 species; useful plants (wild edible, medicinal, decorative, essential oil, fodder, melliferous, vitamin plants) – 5811 species. In addition, we measured some plant traits which were not available in the literature. We focused mainly on the species which are currently missing in other European databases of plant traits (e.g., characteristic species of steppic vegetation). We measured such traits as seed mass (178 species), seed shape (178); leaf area (178), leaf nitrogen concentration and leaf phosphorus concentration (135).

The established database is the basis for numerous studies including vegetation ecology, plant conservation, ecosystem services etc. We also plan to supplement the database with new trait measurements and make the data available for use by researchers after publication.

Dobrochaeva, D.N., Kotov, M.I., Prokudin, Yu.N. et al. (1987). The Identification Key to the Flora of Ukraine [Opredelitel vysshih rastenij Ukrainy]. Naukova dumka, Kyiv.

Golubiev, V.N. (1996). Biological flora of Crimea [Biologicheskaya flora Kryma]. NBS-NNC, Yalta.

Grisiuk, N.M., Grinchak, Y.L. & Elin, E.Y. (1989). Wild edible, technical and melliferous plants of Ukraine. [Dikorastushchie pishchevye, tekhnicheskie i medonosnye rasteniia Ukrainy]. Urozhai, Kyiv.

Hrodzinskyi, A.M. (1990). Medicinal plants: Encyclopedic reference book [Likarski roslyny: Entsyklopedychnyi dovidnyk]. Ukrainska Entsyklopediia, Kyiv.

Reva, M. L., Reva, N.N. (1976). Wild edible plants of Ukraine [Dyki yistivni roslyny Ukrainy]. Naukova dumka, Kyiv.

Spatio-temporal vegetation changes

Wetland vegetation composition change- 10 years revisited

Dragana Čavlović[1], Jelena Beloica[2], Ivana Bjedov[1], Marija Nešić[1]

[1]University of Belgrade Faculty of Forestry, Department for Landscape Architecture and Horticulture, Belgrade, Serbia, dragana.cavlovic@sfb.bg.ac.rs
[1]University of Belgrade Faculty of Forestry, Department for Ecological engineering for soil and water resources protection, Belgrade, Serbia

Key words: Ecotones, Land cover change, Occurrence Probability, Sørensen's similarity index, Vegetation structure, VSD+, Wetland vegetation

The study took place at Ramsar site Zasavica (Serbia), a wetland with very dynamic vegetation. We have studied 5 different plant communities, at 5 permanent plots, covering different vegetation types (3 forest plots, 1 grassland and 1 water). Phytocoenological surveying was conducted in spring of 2011, and control research was undertaken in spring of 2021, when all 5 plots were revisited and phytocoenological relevés were taken. Sørensen's similarity was used as an index showing the floristic differences in species composition. CORINE land cover/land use change was analysed for the 2012/2018-time frame, as well as presence of invasive species. Also, the plant composition was compared to the Occurrence Probability data previously obtained by modelling, using VSD+ and PROPS models, as well as Habitat Suitability Index for years 2011 and 2021.
The main goal of this study was to analyse the wetland vegetation composition in the time frame of 10 years, and to assess its dynamics.

Vegetation structure at all studied sites experienced significant changes. At forest plots, changes were less pronounced, with the exception of the plot that underwent conversion/restoration. The changes were the most evident at grassland plot, since it was mostly overgrown by shrubs. Land cover/land use cover analysis at the same plot also showed change- the transition from Natural grassland towards Transitional woodland-shrub class. Outburst of invasive plant species wasn't recorded while revisiting sites. Occurrence Probability of species in forest plots was fair to low, compared to the surveyed species in observed time frame. At grassland and water plots, the Occurrence Probability was mainly low.

Vegetation of wetlands is very dynamic and prone to constant changes; therefore, frequent monitoring should be established. Regarding the predictions of species occurrence or habitat suitability, it is necessary to take into account these variabilities, and incorporate monitoring results, for further modelling process improvements.

Acknowledgements: This research was supported by The Ministry of Education, Science and Technological Development of the Republic of Serbia as part of the Agreement on financing the scientific research work of Scientific Research Organizations in 2022, no. 451-03-68/2022-14/200169.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The Dzharylhatsky National Nature Park: syntaxonomy and mapping

Anastasia Davydova

M. G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, Kyiv, Ukraine, anasta3kz@gmail.com

Key words: Coastal biotopes, Dynamics, Protected area, Vegetation

The Dzharylhatsky National Nature Park is located in the south of Ukraine in Skadovsk district of Kherson region. The territory of the protected object consists of the island of Dzharylhach, separate mainland areas and part of the water area of Dzharylhach Bay. The total area of the National Nature Park is 10 000 hectares.

The work is based on materials of field research were studied by the author during 2015–2019. The classification scheme of the vegetation includes 19 classes, 24 orders, 27 alliances, 66 associations, three subassociations. The largest number of syntaxa was found in the central part of the Dzharylhach Island and in two mainland areas. The most distributed types of communities on the island are aquatic (class *Zosteretea* Pignatti 1953), halophytic (*Festuco-Puccinellietea* Soó ex Vicherek 1973) and psammophytic (*Festucetea vaginatae* Soó ex Vicherek 1972) vegetation, on mainland areas – halophytic (*Festuco-Puccinellietea*) and antropogenic (*Robinietea* Jurko ex Hadač et Sofron 1980). Two associations (*Junco maritimi-Cladietum marisci* (Br.-Bl. & O. de Bolòs 1957) Géhu & Biondi 1988 and *Puccinellio fominii-Frankenietum pulveruletae* Davydova et Davydov 2020) and the one class (*Saginetea maritimae* Westhoff et al. 1962) are new for Ukraine. Seven classes, six orders, seven alliances, 18 associations, three subassociations have been revealed in the Dzharylhatsky National Nature Park for the first time.

A 1:10000 scale vegetation map of the Dzharylhach Island has been developed. The map shows the territorial differentiation of vegetation. It has also been used for the reconstruction of the island vegetation changes over the past 20 years. A comparison of cartographic materials revealed that the predominant processes in vegetation cover are halophytization and xerophytization of plant communities.

Landscape changes are characterized mainly by climatogenic changes, due to which freshwater and hydrophylous species and their communities gradually disappear. Changes of individual phytocoenoses is mainly due to recreational effects, which leads to degradation and destruction of phytocoenoses.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Forest-grassland coexistence in Eurasian forest-steppes

László Erdős[1,2], Péter Török[2], Zoltán Bátori[3], György Kröel-Dulay[1], Khanh Vu Ho[4], Joseph W. Weldman[5], Csaba Tölgyesi[3]

[1]Centre for Ecological Research, Institute of Ecology and Botany, Vácrátót, Hungary, erdos.laszlo@ecolres.hu
[2]MTA-DE Lendület Functional and Restoration Ecology Research Group, Debrecen, Hungary
[3]University of Szeged, Department of Ecology, Szeged, Hungary
[4]University of Szeged, Doctoral School of Environmental Sciences, Szeged, Hungary
[5]Texas A&M University, Department of Ecology and Conservation Biology,College Station, USA

Key words: Fire, Herbivory, Transitional zone, Tree-grass ecosystem

Ecosystems featuring a mosaic of woody and herbaceous life-forms cover a considerable proportion of the Earth's terrestrial surface. One of the key ecological issues related to these ecosystems is the reason for their mere existence, that is, why and how trees and herbs coexist without one excluding the other. We developed a series of conceptual models to explain the existence of the forest-steppe biome that stretches from Eastern Central Europe to Eastern Asia.

Our first model shows that if mean climate was the only factor, forests would dominate in humid continental regions and grasslands would prevail in semi-arid regions, but extensive mosaics would not occur. Our next models incorporate climate variability, specific soil and topographical conditions, herbivores, and fire, which expand suitable conditions for forests and grasslands, such that grasslands may occur in more humid regions and forests in more arid regions than predicted by mean climate alone. Vegetation-fire, vegetation-herbivore, and vegetation-microclimate feedback loops stabilise the forest-grassland mosaic pattern, limiting tree establishment in grasslands and promoting tree survival in forests. Our final model is able to explain the driving forces underlying the permanent forest-grassland coexistence in Eurasian forest-steppes, which may help conservation efforts to protect these valuable ecosystems. This may be of particular importance in Eastern Central Europe, where forest-steppes survive in the form of small fragments.

Acknowledgements: This research was supported by the OTKA FK 134384 grant.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Drivers of meta population dynamics of the high mountain flora in the central Alps

Norbert Helm[1], Kryštof Chytrý[1], Karl Hülber[1], Dietmar Moser[1], Johannes Wessely[1], Harald Pauli[2], Andrea Lamprecht[2], Patrick Saccone[2], Manuela Winkler[2], Martin Rutzinger[3], Andreas Mayr[3], Andreas Kollert[3], Stefan Dullinger[1]

[1]Department of Botany and Biodiversity Research, University of Vienna, Rennweg 14, 1030 Vienna, Austria (norbert.helm@univie.ac.at)
[2]Faculty of Life Sciences, University of Vienna, Althanstrasse 14, 1090 Vienna, Austria
[3]Department of Geography, University of Innsbruck, Innsbruck, Austria

Key words: Alpine vegetation, Climate change, Community assembly, Environmental filtering, Interactions, Neutral processes

Climate change has induced an ongoing transformation of the high mountain flora. While recent monitoring studies show that colonization events in alpine areas increased considerably, the number of extinctions lags behind modelled expectations. An explanation for this may be that besides alterations in the environmental conditions, also demographic processes and species interactions have a strong influence on the observed changes in species composition.

Here, we attempt to distinguish the role of neutral dynamics and biotic interactions from directed abiotic shifts in recent alpine vegetation change. We do so by focusing on fine-scale monitoring data collected over 20 years on 594 plots arranged in transects in the alpine-nival ecotone of Mt. Schrankogel in the Stubaier Alps, Austria. We tested whether colonization and extinction events of 29 vascular plant species could be related to suitability of the habitat, species interactions and neutral processes. We derived habitat suitability from species distribution models fitted to additional 827 plots distributed over the entire mountain. Species interactions were expressed by the availability of unvegetated gaps and the proportion of the target species within the resident vegetation. Neutral processes were indicated by propagule pressure which was derived by the cover of the target species in the neighborhood the target cell.

We show that all three factors are significantly correlated to the observed colonization and extinction events across all species and that relevance and type of response to these factors differ between species. Our results suggest that environmental filtering and neutral processes are the strongest factors driving recent changes in alpine plant communities and that the effect of species interactions on colonization and extinction events strongly depends on the ecology of the species.

Acknowledgements: This research was funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC-Adv grand MICROCLIM, Grant Agreement No. 883669)

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Change of plant traits along slopes in enclosed karstic depressions (dolines) on Karstic Plateau(SW Slovenia)

Aljaž Jakob[1], Mateja Breg Valjavec[2], Andraž Čarni[1,3]

[1]Research Center of the Slovenian Academy of Sciences, Institute of Biology, Ljubljana, Slovenia, aljaz.jakob@zrc-sazu.si
[2]Research Center of the Slovenian Academy of Sciences, Anton Melik Geographical Institute, Ljubljana, Slovenia
[3]University of Nova Gorica, School for Viticulture and Enology, Nova Gorica, Slovenia

Key words: Doline, Ecology, Gradient, Plants, Vegetation

The object of the research were enclosed karst depressions, termed dolines, on Karst Plateau (SW Slovenia). We sampled vegetation in dolines of different depths (1–20 m) using the transect method, positioning vegetation plots in a south-north direction from one edge of doline through the bottom to the other edge. We sampled all vascular plants in the herb layer and estimating the cover of bare rock at the surface.

We used Detrended Correspondence Analysis (DCA) to detect the main floristic gradients. We determined species richness, bioindicator values, chorotypes and plant traits in vegetation plots.

The first DCA axis represents the gradient from the bottom of dolines to the top, while the second axis represents the cover of bare rock on the surface. We found that the highest number of plant species is found in the bottom of dolines, followed by the top, and the lowest number on the rocky slopes. The bioindicator values show the separation along the first axis, the highest number for moisture and nutrient values is at the bottom, while the highest number for light and temperature is at the top. The highest number of geophytes is found at the bottom. The slopes are dominated by scapose hemicryptophytes and terophytes, as well as by biennials and plants with rosettes adapted to the harsh rocky conditions and top positions are dominated by caespitose hemicryptophytes (grasses). Most species with Eurocaucasion distribution pattern are found in the bootom with deep soil layer, rocky places are dominated by Central European species, the highest number of Balkan species are found on slopes with deeper soils, while the top is dominated by Sub-Mediterranean and Euro-Asian species.

We can conclude that dolines contribute a lot to the plant diversity of karst landscapes.

Acknowledgements: This work was supported by the Slovenian Research Agency [grant numbers ARRS P1-0236; ARRS P6-0101; ARRS J6-2592].

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Spatio-temporal dynamics of meadow vegetation as an effect of precipitation deficit (Lake Gopło, central Poland)

Tomasz Załuski[2], Dariusz Kamiński[1], Dorota Gawenda-Kempczyńska[2]

[1]Nicolaus Copernicus University, Faculty of Biological and Veterinary Sciences, Department of Geobotany and Landscape Planning, Toruń, Poland daro@umk.pl
[2]Nicolaus Copernicus University, Collegium Medicum Faculty of Pharmacy, Department of Pharmaceutical Botany and Pharmacognosy, Bydgoszcz, Poland

Key words: Drought, *Mollinia* meadows, Spatial changes in meadow communities

Aim was describe changes in the proportion of different types of grassland communities on permanent plot in *Molinietalia* meadow vegetation during 10 year long period. Study site was complex of meadow vegetation on the Potrzymiech peninsula, on Gopło Lake (Great Poland – Kuyavia region, central Poland).

Permanent plot was established within the meadow complex, developed on organic-mineral soils on the bank of Goplo Lake. Detailed mapping of plant communities distribution was conducted in 2009, 2014 and 2019.

Changes in the spatial arrangement of the communities were recorded during the 10 years of observations. The composition and dominance structure of individual communities also changed. In the first research season, 6 plant communities were found. The largest area was occupied by patches of the *Galio veri-Molinietum* (54%) and *Violo-Cnidietum dubii* (33%) with a presence of *Arrhenatheretum elatioris* and community with *Calamagrosts epigeios* below 5%. In contrast, 8 communities were found in 2019. The proportion of *Violo-Cnidietum dubii* decreased to 2.4%, *Arrhenatheretum elatioris* occupied 20% and community with *C. epigeios* occupied 18.6%. A community of *Festuco-Brometea* also appeared occupying 15.6% of the area.

Vegetation cover responds dynamically to weather conditions. The observed changes are related to the prolonged drought that started in 2015. The natural dynamics of meadow communities related to weather conditions affects, among others, the management of environmentally valuable areas. Creating conservation plans often requires delimitation of vegetation patches and does not take into account their spatial dynamics.

Transitional plant communities of boreal mire complexes under climate change

Tiina H. M. Kolari, Teemu Tahvanainen

University of Eastern Finland, Department of Environmental and Biological Sciences, Joensuu, Finland, tiina.kolari@uef.fi

Key words: Aapa mire, Fen-bog transition, Hydroseral development, Spatial chronosequence, *Sphagnum*, Succession, Vegetation change

We explored how plant communities of boreal aapa mire complexes reflect recent expansion of bogs. We collected relevés and water samples from 23 undrained aapa mire complexes in Finland in 2019–2020. Sampling was focused on mires where *a priori* comparisons of archival (1940–1970) and new (2017–2019) aerial photographs indicated expansion of *Sphagnum*-dominated zones. Data was collected from aapa mire zones, transition zones where aerial image comparisons indicated *Sphagnum* increase, and bog zones. We ask 1) what are the main characteristics of transitional plant communities in aapa mire complexes, and 2) can key indicator species of modern fen-bog transitions be recognized. We found fen-bog transitions through an increase of *Sphagnum* sect. *Cuspidata* (mainly *S. majus* and *S. balticum*), indicating stable water-table levels. Indicator species of fen-bog transition that had preferred only transitional communities were not recognized, but *Sphagnum* expansion had favored some short-rooted vascular plants. Most importantly, *Scheuchzeria palustris* was particularly abundant in transitional flarks, suggesting that the increase of *S.* sect. *Cuspidata* had facilitated seed germination and growth of *S. palustris*. pH reflected the fen-transition-bog succession (4.2, 3.9, and 3.8, respectively), and concentrations of Ca and Mg were extremely low (<0.5 mg/l) in the studied mire complexes. *Sphagnum* mosses may have benefited from warming and longer growing seasons, but most importantly, weakly minerotrophic conditions have allowed the presence and the increase of *Cuspidata*. Boreal fens with only weak minerotrophy and poor mineral buffering capacity are sensitive to further acidification under present warming, together with surrounding landuse. Our study highlights the potential of boreal aapa mires to shift to *Sphagnum*-dominated bogs through a transitional phase with *S*. sect. *Cuspidata*, while maintaining high water table levels.

Acknowledgements: This research was supported by the Finnish Cultural Foundation, the Alfred Kordelin Foundation, and the Academy of Finland (SHIFTMIRE-project).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Half a century of changes in oak-hornbeam forest communities on volcanic bedrock of the Western Carphatians

Marek Kotrík[1], František Máliš[1], Mariana Ujházyová[2], Vlastimil Knopp[1], Karol Ujházy[1]

[1]Faculty of Forestry, Technical University in Zvolen, Zvolen, Slovakia, xkotrik@tuzvo.sk
[2]Faculty of Ecology and Enviromental Sciences, Technical University in Zvolen, Zvolen, Slovakia

Key words: Anthropogenic changes, Management, Species composition, Understorey vegetation, Vegetation dynamics

The species composition of European oak-hornbeam forests went through dramatic changes in the past century. These observed changes are mainly caused by anthropogenic changes that started processes like thermophilization, eutrophication or fragmentation of biotopes but also by change of management. Results of these ongoing processes are biodiversity decline, taxonomic homogenization and spread of invasive plant species. However, ecological processes behind these changes are poorly understood due to synergistic effect of mentioned processes and methodological difficulties.

To study the long-term changes in species composition, we analysed vegetation data obtained from resurveying 159 quasi-permanent plots, all established before 1980 in mesic *Quercus petraea* dominated forests on andesite bedrock of the Slovenské stredohorie Mts. in Slovakia.

Development trends of species composition change observed in the European level were confirmed. Lower canopy layer was occupied by more shade-casting and nutrient-demanding tree species. Dense canopy, accumulation of litter and moister microclimate in interaction with the anthropogenic eutrophication resulted to conditions more suitable for shade-tolerant and more nutrient-demanding herb species in understorey. Higher competition of these species in the understorey caused a biodiversity decline, but on the contrary, denser canopy led to a microclimate which mitigates the effects of thermophilization. At the same time, some species that were considered characteristic for these plant communities disappeared or survived in lower abundances in spatially limited areas with sufficient light transmission. Spread of the invasive species *Impatiens parviflora* is another negative feature of recent forests.

Acknowledgements: This research was supported by the Scientific Grant Agency of the Slovak Republic (VEGA 1/0624/21).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Changes in structure and dynamics of inland halophytic plant metacommunities

Marta Lis, Sandra Lubińska-Mielińska, Agnieszka Piernik

Nicolaus Copernicus University in Toruń, Faculty of Biology and Veterinary Sciences, Department of Geobotany and Landscape Planning, Toruń, Poland, martalis@umk.pl

Key words: Biodiversity, Halophytes, Natura 2000, Plant communities, Salinity

Inland salt marshes are considered as priority habitats in the European Union countries. Therefore, they are under legal protection, e.g. within the Natura 2000 network. Despite many years of conservation, this vegetation type is still assessed as endangered and have recently been included in the European Red List of Habitats. Our research concerns the halophytic vegetation in terms of the meta-community theory. Meta-community is a set of locally occurring communities, connected with each other by the possibility of spreading potentially interacting species.

The analyzes of vegetation concern three regions of Poland (Central Europe): Kujawy, Wielkopolska and Dolna Nida in the context of changes that have occurred over time. The salinity of the analyzed areas is related to the presence of salt stratums in the substrate, which were uplifted to the surface in the form of salt domes. Based on the already published data (294 vegetation sample plots), an analysis of changes in the structure and dynamics of halophytic vegetation patches over time was carried out. Individual periods and regions were characterized by calculation of α, β and γ-diversity, and the total halophytes number. As environmental parameters, we used weighted averages calculated on the basis of the Ellenberg indicator values (moisture, reaction, nitrogen content and salinity). The variability of meta-community species structure were analyzed by ordination methods, discriminant analysis and compared by basic statistics.

We found that the diversity indexes and number of halophytes diagnostic for vegetation changed over time. Vegetation indicated the highest changes in reaction, nitrogen and salinity. We hope that a better understanding of how salt marshes function in the long period of time will allow for their more effective protection.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Communities by *Botriochloa ischaemum* (L.) Keng, in natural and industrial landscapes of the Inhulets river basin (Steppe zone of Ukraine)

Liudmyla Lysohor[1], Olga Krasova[2]

[1]Kryvyi Rih State Pedagogical University, Kryvyi Rih, Ukraine, lisogor1981@gmail.com
[2]Kryvyi Rih Botanical Garden of the National Academy of Sciences of Ukraine Kryvyi Rih, Ukraine, kras.kbs.17@gmail.com

Key words: Gramineous communities, Natural and post-mining landscapes

The Inhulets River – a right tributary of the Dnieper River, crosses Dnieper Upland and Black Sea Lowland in the Submeridional direction. The area of the Inhulets River basin within the Steppe zone of Ukraine is 10000 km^2. The natural landscape – gully and banks slopes of small rivers are consist over 20% of territory Inhulets River basin. Communities dominated by *Bothriochlia ischaemum* (L.) Keng. in the territorial structure has a significant role. For example, these communities cover areas from a few square meters to 1–2 hectares and indicated soils erosion processes. If the substrate is stabilized*, B. ischaemum is replaced by species with higher competitiveness – Elytrigia* intermedia (Host) Nevski, *Stipa* sp. In floristic composition of communities by *B. ischaemum* identified rare species (Red book of Ukraine: *Adonis vernalis* L., *A. wolgensis* Steven, *Chamaecytisus graniticus* (Rehmann) Rothm., *Genista scythica* Pacz., *Ornithogalum boucheanum* (Kunth) Asch., *Pulsatilla pratensis* (L.) Mill. s.l., *Pseudoroegneria stipifolia* (Trautv.) Á.Löve, *Stipa asperella* Klokov & Ossycznjuk, *S. capillata* L., *S. lessingiana* Trin. & Rupr., *Stipa pulcherrima* K.Koch. The total number of species within the natural contours of the phytocenosis varies from 7 to 45; the average is 23.

On course of the Inhulets River, where it is located Kryvyi Rih Iron Ore Basin, natural landscape are higher transformed by iron ore mining. On this territory, there are more than 100 industrial dumps, which are used to accumulate rock formations, brought to the ground surface because of production of iron ore. Formation of plant communities on ore deposits is mostly spontaneous. Communities by *B. ischaemum* are formed in industrial landscapes, the age of which exceeds 50 years. *B. ischaemum* individuals in industrial habitats have an average clonal diameter of 15 × 11.4 cm and 17.0 × 16.8 cm, respectively. In the populations represented in natural biotopes, the size of the clones is twice as big – from 32.6 × 31.7 cm to 32.6 × 31.7 cm. In industrial habitats *B. ischaemum* produces more or less rounded clones, which are at a small distance from one another. Indicators of aboveground phytomass in natural habitats vary within the range – 45.9–166.6 g/m^2, and industrial – 11.6–66.2 g/m^2. *B. ischaemum* technological-changes environment does not realize its living strategy.

Understanding patterns of secondary succession after land abandonment through the CSR approach

Anna Mastrogianni[1], Diogenis A. Kiziridis[1], Alexia Eleftheriadou[1], Margarita Paradisiotis[1], Magdalini Pleniou[2], Fotios Xystrakis[2], Spyridon Tsiftsis[3], Ioannis Tsiripidis[1]

[1]School of Biology, Aristotle University of Thessaloniki, Greece, amastroi@bio.auth.gr
[2]Forest Research Institute, Hellenic Agricultural Organization "Demeter", Greece
[3]Department of Forest and Natural Environment Sciences, International Hellenic University, Greece

Key words: Conservation, CSR strategy, Forest, Grassland, Hill's numbers, Land abandonment, Secondary succession

For more than a century, abandonment of agricultural land has been particularly prominent in marginal and mountainous areas of Europe, followed by passive recovery of natural vegetation through secondary succession. Previous work on the effects of land abandonment has revealed both positive and negative impacts on biodiversity patterns, depending on factors such as prioritization of conservation targets and spatiotemporal scale. High variability and complexity of potential diversity trajectories after abandonment requires complementary investigation of taxonomic and functional diversity aspects. This multifacet approach can contribute to the understanding and ecologically interpreting subsequent vegetation changes. Grime's CSR model has been considered as a valuable tool towards this direction, by allowing more meaningful comparisons among community types submitted to various levels of stress and/or disturbance during succession. Here, we studied the diversity patterns along a successional series of vegetation communities in a (sub-)mountainous area of northwestern Greece (northern Pindus), using the space-for-time substitution approach. Sampling of grassland and woodland vegetation types was conducted across five subregions of the study area, where high evidence of land abandonment during the last 70 years was previously identified through land cover mapping. We used the Grime's CSR model of plant strategies, to determine successional stages of vegetation, and highlight structural and functional differences among these stages. Additionally, Hill's numbers were employed for the investigation of taxonomic diversity across vegetation successional stages. The CSR approach was found to be particularly elucidating about ecology and differentiation of the community types of different successional stages. Consequently, our work has important implications regarding the conservation value of the studied semi-natural ecosystems.

Acknowledgements: The research project was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "1st Call for H.F.R.I. Research Projects to support Faculty Members & Researchers and the Procurement of High-and the procurement of high-cost research equipment grant" (Project Number: 2333).

The Size Matters. Comparison of spatial characteristics and herb synusia in differently sized forest fragments

Michaela Michalková, Mária Šibíková, Lucia Čahojová, Ivan Jarolímek

Plant Science and Biodiversity Center, Institute of Botany, Bratislava, Slovakia, michaela.michalkova@savba.sk

Keywords: Edge effect, Fragmentation process, Spatial indices, Vegetation

In the predominantly agricultural land in Slovakia with the islands of forest habitats, the occurrence, and composition of species groups of the plant community may be affected by the forest fragmentation process. Our study focuses on the question of how spatial characteristics such as patch area, shape index, perimeter and edge effect influence the species composition of forest fragments.

We examined variability in species richness and composition of the herbaceous layer in 76 plots located in 38 forest fragments (size from 1 to 30 ha) in different types of broadleaved deciduous forests (oak, oak-hornbeam, hardwood floodplain habitats) in the west, north-west, and south of Slovakia, with various spatial characteristics. Species composition of “core area” and “edge” was compared within paired plots of each fragment by the Wilcoxon test. The influence of the fragmentation process on the proportion of species groups is better described by fragmentation indices than by species number. The effect of spatial indices on the composition of vegetation in the herb layer of core and edge areas was evaluated using generalized linear models. The dissimilarities between each paired “edge” and “core” plots were computed. This dissimilarity was used as a dependent variable in a set of GLM models.

Our preliminary results showed in general that in the species-area relationship of forest fragments, those with larger areas are able to preserve species diversity. The larger the shape area/index and the perimeter, the more diverse the species layer is (in terms of functional group representation), and in smaller fragments, the differences between “core” and „edge“ areas are disappearing.

Acknowledgments: This research was supported by the grants VEGA 0119/19, APVV 16-0431.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Succession after removal of Pinus mugo above the tree line in Jeseníky Mountains

Linda Mikulenková

Charles University in Prague, Department of Botany, Prague, Czech Republic, mikul3af@natur.cuni.cz

Key words: Succession, Phytosociology, Plants, Vegetation

Pinus mugo was introduced in the Jeseníky Mts. during the 19th century in an attempt to shift the tree line to higher altitudes. This happened in the wider context of reforestation in order to increase timber yield as needed for the construction during the Industrial Revolution.

The goal of increasing timber production was not reached, what remained were growths of *Pinus mugo* which were left to its own devices and at the end, started to become somewhat invasive. In 2020, these growths were cut down in several localities and I am observing natural succession of the species-rich grasslands and I intend to gather grass seeds and try to aid renewal of the alpine grasslands.

The environment of the mountaintops is very fragile, it is one of rare glacial refugia with many rare plant species and the ecosystem is extremely fragmented. While the substrate is mostly acidic, there are many rivulets which carry calcium ions, there are microhabitats which may vary within a few metres, which makes this research particularly interesting. Before the expansion of *Pinus mugo*, the alpine meadows were very species-rich owning partly to the habitat mosaic and the general aim is to have the richly flowering meadows back. However, only time will show whether this goal can be reached by letting spontaneous succession happen or whether careful reintroduction from nearby habitats will be needed.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Long-term impact on weed vegetation changes (1994-2019) in two altitudinal zones

Urban Šilc[1], Sava Vrbničanin[2], Svetlana Aćić[2]

[1]ZRC SAZU, Institute of biology, Ljubljana, Slovenia, Urban.silc@zrc-sazu.si
[2]University of Belgrade, Faculty of Agriculture, Serbia

Key words: Classification, Phytosociology, Plants, Vegetation

Weed flora and vegetation has accompanied agriculture since its beginnings in Fertile Crest and is probably one of the most impacted ecosystems since. We made a re-survey of cereal weed vegetation in central Serbia at two elevations (lowlands from 195 to 530 m and highlands from 890 to 1270 m). The vegetation was sampled in 1994 and again in 2019. A comparison of α, β, and γ–diversity was made. We detected winners and losers among weed species, and NMDS was used to represent changes in vegetation species composition between two surveys.

Plant diversity in weed vegetation has declined in recent decades due to changes in agricultural practices. Although the surveyed area can be considered a remote area with preserved traditional agriculture compared to other parts of the Balkans and Europe with more intensive agriculture, we observed a decrease in the number of species per plot and in the total species pool. The number of species per plot decreased significantly in the lowlands (31.49 ± 7.78 i 24.57 ± 6.80) and at higher altitudes (38.15 ± 9.3 and 24.05 ± 6.9), while beta diversity increased. The number of ruderal species decreased in the lowlands and grasses in the highlands, while the number of weeds decreased in both regions.

Acknowledgements: This study was supported by the Slovenian Research Agency fund (ARRS) through the Program 0103-020 and bilateral grant SLO-SER.

Vegetation research for habitat conservation and restoration

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Conservation of natural habitats within the framework of RESEDA-Flore, a network of biodiversity stakeholders in the French Mediterranean

Olivier Argagnon[1], Clara Gritti[1,2], Louise Turpin[1], Katia Diadema[1]

[1]Conservatoire botanique national méditerranéen, Hyères, France, o.argagnon@cbnmed.fr
[2]Centre d'écologie fonctionelle et évolutive, Montpellier, France

Key words: Actions, Biogeographical conservation, Global change, Mediterranean ecosystems, Network

The French Mediterranean and its hinterland are part of a hotspot of biodiversty and home to several plants refugia. The socio-economics changes that occured in the last decades strongly modified the landscapes and ecosystems of this area. This, added to the on-going global changes, exerts a strong pressure on its specific biodiversity. Faced with this observation, plant biodiversity stakeholders from different backgrounds acknowledged common interests and objectives. In 2018, conservation organisms, natural area managers and research centers decided to join into a network called RESEDA-Flore.

The aims of RESEDA-Flore are centered around the idea of a biogeographical conservation strategy. They include: conservation stakeholders involvement, methods and tools for managers and decision-makers, monitoring and conservation action schemes, valorisation of knowledge and results and sharing issues with the general public. In addition to a traditional species-centered component, the network also consider higher levels of integration referred to as natural habitats.

The first steps of the network are framed through a funded program with several actions: (1) a survey of people involved in the Mediterranean flora conservation in order to better understand their expectations and needs, (2) a blueprint for a natural habitats conservation strategy, (3) a methodological framework for the priorisation of natural habitats, (4) a monitoring of the effects of global change on a wetland natural habitat.

First results show large knowledge gaps to be filled in order to consolidate the scientific relevance of current and future actions. In the meantime we have to develop ways to deal with missing data or unperfect expertise in order to prevent further degradation of Mediterranean ecosystems.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

PRéSur: a French national monitoring network and indicators for a better assessment of the conservation status of agro-pastoral habitats of community interest

Maxime Burst[1], Sylvain Abdulhak[2], Olivier Argagnon[1], Romain Bissot[3], Gaël Causse[4], François Dehondt[4], Rémi François[5], Elise Laurent[6], Anthony Le Fouler[3], Pierre-Marie Le Hénaff[7], Marc Mangeat[8], Gilles Pache[2], Julien Pottier[9], François Prud'homme[10], Kevin Romeyer[3], Jérôme Millet[11]

[1]Conservatoire Botanique National Méditerranéen de Porquerolles, Occitanie regional unit, Montferrier-sur-Lez, France, m.burst@cbnmed.fr
[2]Conservatoire Botanique National Alpin, Gap, France
[3]Conservatoire Botanique National Sud-Atlantique, Audenge, France
[4]Conservatoire Botanique National du Bassin Parisien, Paris, France
[5]Conservatoire Botanique National de Bailleul, Bailleul, France
[6]Conservatoire Botanique National de Brest, Brest, France
[7]Conservatoire Botanique National du Massif central, Chavaniac-Lafayette, France
[8]Conservatoire Botanique National de Franche-Comté – Observatoire régional des invertébrés, Besançon, France
[9]INRAE - UMR UREP Ecosystème prairial, Clermont-Ferrand, France
[10]Conservatoire Botanique National des Pyrénées et Midi-Pyrénées, Bagnères-de-Bigorre, France
[11]Office Français de la Biodiversité, Research and scientific support unit, Vincennes, France

Key words: Agro-pastoralism, Conservation status, Grassland, Habitats directive, Indicators, Monitoring network, Phytosociology, Vegetation

Within the framework of European reporting on the conservation status of habitats of Community interest (article 17 of the Habitats directive), many results are still today based on expert knowledge (for lack of anything better). Unfortunately, the assessments by expert knowledge have major weaknesses: (i) lack of objectivity, (ii) limitation of quantitative comparisons from one report to another, but also (iii) limitation of the precision of assessments (i.e. limitation in the detectable changes).

The agro-pastoral habitats of community interest (AP-HICs) have been identified in France, and more broadly in Europe, among the habitats most strongly threatened by global changes. To enable a better assessment of the conservation status of AP-HICs, it appears crucial to be able to acquire specific data (species occurence, abundance, etc.) within a monitoring network. These data, required for the construction of sets of indicators, should ultimately allow the production of objective, quantitatively comparable and precise results. Despite some local initiatives, this type of network does not currently exist in France for the AP-HICs, neither at the national scale, nor at that of biogeographical regions (i.e. the two scales necessary for reporting).

In order to improve future reporting, we propose in the "PRéSur" project a two-step approach based on (i) the creation of a unified database of phytosociological relevés for all the AP-HICs of mainland France, then (ii) the use of this database to design and size a plot monitoring network. The strategy adopted to design the monitoring network will involve the identification of the results to be produced for the reporting and the monitoring constraints, while the sizing of the network will depend on the minimum differences in the conservation status to detect.

Nature heritage of anthropogenic origin: conservation value of ancient settlements for steppe vegetation – case study from Lower Dnipro, Southern Ukraine

Polina Dayneko, Ivan Moysiyenko

Department of Botany, Kherson State University, Kherson, Ukraine, daynekopm@gmail.com

Key words: Ancient settlements, Nature conservation, Refugia of steppe flora

Ancient settlements, more widely recognized as archaeological monuments in Ukraine, are receiving increasing attention from botanist all over the world last years. Indeed, such objects of cultural origin, given the advantageous location on the river terrace between two gullies under steppe vegetation, may act as potential refuges of steppe flora. The aim of this study was to review the value of ancient settlements for nature conservation of steppe ecosystems, including the best way to preserve the natural and cultural heritage of them. In this paper conservation value of 18 ancient settlements within the Lower Dnipro (Southern Ukraine) was assessed in terms of their representativeness mostly by rare protected species, steppe species, rare plant communities and protected habitats. In addition, we compared ancient settlement`s flora to the flora of two different groups of objects within West Pontic grass steppe zone: objects of nature origin - reserves, protected by law (“Lesovyi Canyon”, “Askania-Nova”, “Yakovlivskyi” and “Staroshvedskyi” (projected)) and objects of cultural heritage (kurgans, old cemeteries and ancient forgotten parks of Kherson region), which also confirmed their potential for nature conservation. Thus, we recordered 33 protected species (6.3% of the total flora), 6 rare plants communities and 3 nature habitats within studied objects. In terms of the representation of ancient settlement`s flora, the highest similarity was shown to the ancient forgotten parks, behind only of qualities composition of habitats, while with respect to the government recognized nature reserves, the rare component of the ancient settlements flora was similar mostly for Yakovlivskyi reserve. Complete conservation of studied ancient monuments as well as others leading measures to minimize the anthropogenic impact are recommended. Until recently, the issue of nature reserves` establishment on the basin of archaeological monument was unclear. However, the creation of the landscape reserve “Ancient settlement with an embankment XI–XIV centuries” at the beginning of the year is given reason to futher studies and perspectives in development of a network of objects of the country's nature reserve fund.

Acknowledgements: This research is supported by the Swedish Science Council (Vetenskapsrådet) project N2012-06112.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Observation of a longtime unobserved positive establishment of European Habitat Type 6510-grasslands in North-Western Germany

Nina Fahs[1,2], Dietmar Zacharias[2], Burghard Wittig[3] and colleagues

[1]Department of Botany and Zoology, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic, nina@sci.muni.cz
[2]Applied and Ecological Botany, Faculty 5, University of Applied Sciences Bremen, Neustadtswall 30, 28199 Bremen, Germany
[3]Lower Saxony Water Management, Coastal Protection and Nature Conservation Agency, Betriebsstelle Lüneburg, Standort Verden, Bürgermeister Münchmeyer Str. 6, 27283 Verden, Germany

Key words: Classification, European Habitat Type 6510, Floodplain meadows, Regeneration

The conservation and restoration of semi-natural species-rich grasslands is one of the most challenging tasks in nature conservation. Even more remarkable in this context is the large increase of positively developing grasslands along a large stretch of the Wümme-river in North-Western Germany. In our study we now investigated those developing grasslands, their history and their perspectives for the future. We especially focussed on the apparent species community and attempted a first phytosociological and ecological classification.

In 2020 we recorded 197 vegetation plots along the whole stretch of the grasslands. We compared the apparent species composition to similar vegetation associations described in the European literature. Data available from biotope mappings from 1999, 2004 and 2018 and other records from the literature were used to trace the grasslands' development in the past.

The grassland community developing in the floodplain of the Wümme-river has not yet been described for Europe. The community is of a mesic character, uniting species indicative for the *Arrhenatheretalia elatioris* order (*Leucanthemum vulgare*, *Leontodon autumnalis*, *Galium album*) and the *Molinion caeruleae* order (*Filipendula ulmaria*, *Achillea ptarmica*, *Lotus pedunculatus*), while it is lacking diagnostic species for a specific association. Curious is also the appearance of species indicative for floodplain meadows (*Sanguisorba officinalis*, *Veronica longifolia*) and species known from nutrient-poor sandy grasslands (*Armeria maritima*, *Dianthus deltoides*). These species are rare in the area and some are red-listed. The area of value for nature conservation increased by about 100 ha during the past 10 years.

We concluded that a classification of the grassland community is best within the *Arrhenatheretalia elatioris* order. Due to missing of unambiguous diagnostic species we suggest a classification on the order-level. Especially in the context of the generally deficient development of lowland hay meadows in other regions of Germany, the here presented regeneration of large stretches of this protected European habitat type 6510 can be seen as a showcase project for successful applied nature conservation.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Coastal habitats in danger

Carsten Hobohm

University of Flensburg (EUF), Department of Ecology and Environmental Education, hobohm@uni-flensburg.de

Key words: Climate change, Land use change

Sea level rise, increasing storm disasters and human activities diminish coastal ecosystems. On the other hand, coastal management, nature conservation and natural processes such as land uplift or sedimentation can lower the effects, or even result in growth of coastal landscapes.

Is sea level rise a serious threat to coastal habitats in Europe? How important are wind and water dynamics for the survival of the nature there? How dangerous are disaster floods under conditions of artificially reduced dynamics? These are central questions in the field of coastal protection, economic development and nature conservation, and the answer often is ambiguous.

However, comparisons of satellite images, aerial photographs, expert knowledge and selected zonation and succession models can be used to draw the picture of a synthesis of current tendencies at the landscape level at European coasts. An attempt is made to rank the importance of different kinds of threat with respect to the occurrence of coastal habitats and their biocoenoses.

It can be shown that for environmental conditions and net range of marine neritic and coastal communities such as seagrass beds, saltmarshes and dunes at Black Sea, Mediterranean Sea, Atlantic Ocean, North Sea and Baltic Sea coasts land use and land use change including eutrophication, pollution, intensive agriculture and construction activities are much more relevant than anthropogenic climate change, rising sea level or severe weather.

This has to do with the fact that coastal habitats in general are adopted to dynamics such as streams, tides, storm, erosion and sedimentation.

Seagrass beds (*Zosteretea*, *Halodulo-Thalassietea*) and vegetation of brackish waters (*Ruppietalia*) lost large parts of their former range in the last century due to changes of physicochemical including light conditions.

In contrary, the whole range of saltmarshes (*Thero-Salicornietea*, *Juncetea maritimae*, *Spartinion*, *Bolboschoenion*, *Saginion*) increased at least during the last three decades, despite sea level rise. Land use and land use change, agricultural use and abandonment can be identified as most important drivers affecting the composition of saltmarsh communities and habitat types.

Dune areas on a large scale are managed with respect to tourism and urbanization including development of infrastructure. As a consequence, zonations and successions changed due to limitation of natural dynamics; migration of primary and secondary dunes and wet dune slacks is reduced, and late succession dunes with scrub and forest increased in size.

Thus, measures that reduce any kind of natural dynamics increase the likelyhood of further risks for the biodiversity at European coasts.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Wild plant species introduction in urban lawns: first results of the Latvian Fund for Nature campaign "Sow your own square meter"

M. Krūzmane[1], S. Rūsiņa[1], R. Sniedze-Kretalova[2], L. Brizga-Kalniņa[2], M.A. Župerka[1]

[1]University of Latvia, Riga, Latvia madarakruzmane2000@inbox.lv
[2]Latvian Fund for Nature, Riga, Latvia

Key words: Attitude, Community, Diversity, Grassland, Urban resident

Lawns are increasingly used to enhance biodiversity in urban environments. Previous research has mostly focused on public urban areas in Central and Western Europe but Eastern European and private lawn perspective has been scarcely studied. Our study focused on private lawns in Latvian towns. This campaign integrates environmental communication with defined action. We aimed to evaluate the interest and engagement of urban residents to increase biodiversity on their private land and to assess the success of wild plant species addition in their lawns. In September, 2020 Latvian residents were invited to express their interest in sowing one square meter of grassland flowers in their lawn. We received 1864 applications, 700 packages containing ca. 3 g seeds of 12 out of 20 wild plant species were sent. 238 applicants agreed to participate in the research. From those, 68 randomly chosen sites were sampled in summer, 2021. In each site, seeded $1m^2$ plot and typical lawn vegetation was sampled in $1m^2$ and $25m^2$ plots.

Cluster Analysis resulted in four plant communities corresponding to EUNIS habitats V35 Trampled mesophilous grassland, V31 Agriculturally-improved grassland, including sports fields and grass lawns, Mesic (V39) and dry (V38) perennial anthropogenic herbaceous vegetation. Sown plots contained significantly more species (19 versus 12) than existing lawns due to higher number of weeds. 4.3±1.6 out of 12 sown species were counted on average, while 18 out of 20 sown species occurred also naturally in sampled lawns. 7 species (*Galium verum*, *Trifolium montanum*, *Lychnis flos-cuculi* etc.) did not germinate while the most successful were *Leucanthemum vulgare*, *Prunella vulgaris*, *Galium album*, *Agrimonia eupatoria*, *Anthyllis vulneraria*. Considerable response to the campaign demonstrates that target audiences are responsive to specific, attainable call to action.

Acknowledgements: This research was supported by the EU LIFE Program project GrassLIFE LIFE16NAT/LV/262

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Artificial flooding as a conservation and restoration method of inland salt marsh habitats

Sandra Lubińska-Mielińska[1], Dariusz Kamiński[1], Piotr Hulisz[2], Arkadiusz Krawiec[3], Maciej Walczak[4], Marta Lis[1], Agnieszka Piernik[1]

[1]Nicolaus Copernicus University in Toruń, Faculty of Biology and Veterinary Sciences, Department of Geobotany and Landscape Planning, Toruń, Poland, sanlub@doktorant.umk.pl
[2]Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management, Department of Soil Science and Landscape Management, Toruń, Poland
[3]Nicolaus Copernicus University in Toruń, Faculty of Earth Sciences and Spatial Management, Department of Geology and Hydrogeology, Toruń, Poland
[4]Nicolaus Copernicus University in Toruń, Faculty of Biology and Veterinary Sciences, Department of Environmental Microbiology and Biotechnology, Toruń, Poland

Key words: Active protection, Degradation, Halophytic vegetation, Salinity

European inland salt marsh vegetation has been recognised as unique on a continental scale and is legally protected under the Natura 2000 network. Although it has been designated as priorities for the EU and has been protected for years, the area and number of this type of habitats have significantly decreased over the past century, even some reserves have been abolished because of the total degradation and desalinisation of their areas. There are still few studies on practical approaches and solutions regarding inland salt marsh protection and restoration. To fill this gap the aim of our study was to develop a restoration solution, on example of a halophyte reserve in Central Europe located in the spa town of Ciechocinek, north-central Poland. We performed multidisciplinary research including vegetation, soil seed bank, soils, water, land geology and microbiological safety. To reclaim the area, it was proposed using brine from a nearby health resort. The results showed that the use of health resort brine to regularly flood the reserve's meadow is microbiologically safe, will not affect neighbouring areas and should result in spontaneous restoration of the habitat rich in halophyte biodiversity. We hope that our research will inspire the international community to look for practical solutions in the restoration and active protection of halophytes and saline habitats using the methods of cooperation of various locally available sectors and in accordance with the principles of sustainable development.

Acknowledgements: This research was financially supported by the Ciechocinek Health Resort

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Phytogeographical division of the Czech Republic: statistical analysis of a large plant-distribution database

Martin Musil[1], Milan Chytrý[2], Jiří Danihelka[2,3], Zdeněk Kaplan[3], Jan Wild[3], Petr Novotný[3,4], Jan Divíšek[1,2]

[1]Department of Geography, Faculty of Science, Masaryk University, Kotlářská 2, 61137 Brno, Czech Republic, musil.martin@volny.cz
[2]Department of Botany and Zoology, Faculty of Science, Masaryk University, Kotlářská 2, 61137 Brno, Czech Republic
[3]Institute of Botany, Czech Academy of Sciences, Zámek 1, 252 43 Průhonice, Czech Republic
[4]Department of Biology Education, Faculty of Science, Charles University, Viničná 7, 128 00 Praha, Czech Republic

Key words: Beta diversity, Czech flora, Czech Vegetation, Pladias, Statistical analysis

The aim of this study is to analyse the distribution of vascular plant species in the Czech Republic and provide statistically based phytogeographical division of the country. The data on plant distribution come from the Pladias Database of Czech Flora and Vegetation. The Pladias database is the largest set of data on vascular plant occurrence in the country, which is subject to continuous quality control. We used information on presence/absence of 3139 vascular plant species in 2370 grid cells, each of them spanning 5' × 3' (~6 × 5.55 km at 50°N latitude). We calculated species turnover, using Sørensen and Simpson indices. While the Sørensen index also reflects differences in species richness, the Simpson index shows pure species turnover. Resulting dissimilarity matrices were then ordinated using principal coordinate analysis (PCoA) and clustered using Ward's algorithm. The environmental variables were projected onto ordination diagrams to show their relationship with species turnover.

The PCoA analysis showed that the highest species turnover in the country is related to elevation and associated climatic, geologic, and land-use gradients. The second highest turnover was indicated between the eastern and western part of the country. It corresponds with major geological units but also differences in soil moisture. Cluster analysis first divided the country to high-elevation and low-elevation areas, while finer divisions reflected different bedrock types, climatic and moisture regimes, as well as biogeographic differences between the Bohemian Massif and Western Carpathians. We also identified species most associated with individual phytogeographical regions and provided environmental characteristics of each region.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Contribution to the knowledge of chasmophytic vegetation in the Forebalkan, Central part of Northern Bulgaria

Momchil Nazarov[1], Gana Gecheva[2], Constantin Mardari[3], Beloslava Genova[2], Josef Šibík[4], Nikolay Velev[1], Kiril Vassilev[1]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev str. 23, 1113 Sofia, Bulgaria, mnazarov357@gmail.com
[2]University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Plovdiv, Bulgaria
[3]Anastasie Fătu Botanic Garden, Alexandru Ioan Cuza University, Dumbrava Roșie str. 7–9, 700487 Iași, Romania
[4]Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences

Key words: *Asplenietea trichomanis*, Calcareous rocky habitats, Classification, Vegetation

This work is focused on the syntaxonomy and ecology of plant communities within 8210 Calcareous rocky slopes with chasmophytic vegetation which belongs to class *Asplenietea trichomanis*. The study was carried out in Gabrovo municipality, which is characterized by semi-mountainous relief and widespread of calcareous bedrocks. The climate is temperate continental. The research territory has limited surface water resources represented by Yantra river and her tributaries, and a small karst lake.

During the field work were collected 19 phytocoenological relevés using the Braun-Blanquet approach. The used plot size was 4 m^2. In addition, we collected data for important abiotic factors such as slope, altitude, bedrock and inclination. All relevés are contributed to the Balkan Vegetation Database (EU-00-013). The nomenclature of species was standardized according to the Euro+Med PlantBase. The hierarchical clustering was performed in the PC-ORD software package using the Bray-Curtis dissimilarity and the flexible beta clustering algorithm. The species covers values were square root transformed and clusters were standardized to equal size. The diagnostic species were determined by calculating the Phi-coefficient and only the statistically significant values evaluated by Fisher's exact test ($P<0.05$) were considered. Detrended Correspondence Analysis was used to reveal the major environmental gradients.

The syntaxonomical diversity of chasmophytic vegeation is represented by 1 class (*Asplenietea trichomanes*), 1 order (*Potentilletalia caulescentis*), 1 alliance (*Cystopteridion*) and 2 associations (*Asplenietum rutae-murario-trichomanis*, *Cystopteridetum fragilis*).

Association *Asplenietum rutae-murario-trichomanis* Kuhn 1937 is found on sunny or semi-shaded places on cliffs, scarps and ridges or on rocky walls usually in not very urbanized villages on northern, eastern, northeastern, northwestern or western slopes. It includes species-poor communities (average species number per relevé is 7) with open to semi-open horizontal structure and total cover of 35–80%, from which the mosses and lichens dominating with cover between 10% and 70%. The diagnostic and dominant species is *Asplenium ruta-muraria.*

Association *Cystopteridetum fragilis* Oberdorfer 1938 is found on shady places on cliffs, scarps and ridges on northern, northeastern or northwestern slopes. It differs ecologically from ass. *Asplenietum rutae-murario-trichomanis*, being identified on sites characterized by more mesic conditions. Its phytocoenoses are also species-poor (average species number per relevé is 10) and has semi-opened horizontal structure with total cover 70–85% from which mosses and lichens have 40–85%. Diagnostic and dominant species is *Cystopteris fragilis.*

The central parts of the Forebalkan area preserve unique calcareous rocky habitats and chasmophytic vegetation. Totally, two associations (*Cystopteridetum fragilis, Asplenietum rutae-murario-trichomanis)* were registered for the first time for vegetation diversity of Bulgaria.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Potential of accidentally collected seed material for city grasslands restoration: A case study from Sudety foothills, Central Europe

Peliyagodage Chathura Dineth Perera[1], Zofia Nocoń[2], Tomasz H. Szymura[2], Magdalena Szymura[1], Hassanali Mollashahi[1] and Malwina Wierzbicka[1]

[1]Institute of Agroecology and Plant Production, Wrocław University of Environmental and Life Sciences, Wrocław, Poland, chathura.perera@upwr.edu.pl
[2]Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław, Wrocław, Poland

Key words: Biodiversity, Grassland vegetation, Semi-natural meadows, Seeds transfer

Sustainable urban areas with species-rich grasslands support biodiversity conservation with native species and provide numerous ecosystem services. There is a problem in establishing species-rich urban grasslands due to difficulties in the availability of seeds of regional origin and the high cost of imported seeds mixtures. Here, we assess the quality of seeds obtained accidentally from a mower machine working in species-rich semi-natural grasslands for establishing city grasslands with rich plant diversity. The seed composition, seed germination, and species transfer rate were evaluated under laboratory and field conditions and compared with commercial seed mixtures. The seed sample consisted of 90% pure seeds of numerous grasslands species. However, the germination capacity was relatively low (42%). There were significant differences in seed germination depending on the storage period and pretreatments. However, the species richness of the tested seed mixture did not differ significantly from the species richness of commercial seed mixtures. Despite the relatively low germination rate of the tested seeds, the typical seed mass per square meter used for restoration was sufficient for successful grassland establishment. Cumulatively of all the species during any of the three main trials, the transfer ratio was 42%. However, the average transfer rate in the field was low (22–29%), obtaining 94.6% total coverage. The low amount of seed material and the inability to plan seed harvest time are disadvantages, while the advantages of low cost and seed content of local species represented local ecosystems. Consequently, the use of randomly collected seeds can be considered as an effective but temporary solution.

Acknowledgements: This research was supported by "UPWR 2.0:international and interdisciplinary programme of development of Wrocław University of Environmental and Life Sciences" ,co-financed by the European Social Fund under the Operational Program Knowledge Education Development, under contract No. POWR.03.05.00-00-Z062 / 18 of June 4, 2019.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Macrophyte monitoring of the reconstruction sites of the Lake Kolon, Hungary

Eszter Saláta-Falusi[1], Aranka Hollósi[2], Ildikó Turcsányi-Járdi[1], Csaba Bíró[3], Károly Penksza[1]

[1]Hungarian University of Agriculture and Life Sciences, IOA Department of Botany, Gödöllő, Hungary, salata-falusi.eszter@uni-mate.hu
[2]Kiskunság Bird Protection Society. Izsák, Hungary
[3]Kiskunság National Park Directorate, Kecskemét, Hungary

Key words: Macrophyte, recolonization, Monitoring, Restoration

The primary objective of the conservation interventions in the Lake Kolon, core area of the Kiskunság National Park, was to create marginal and open water habitats to support nesting birds in accordance with the management plans for the area.

In the northern part of Lake Kolon, in a 40 ha area of former peatland 12 small open water patches and their connecting canals were created to increase mosaic appearance of homogeneous reed habitat where the sludge depots were placed on two sides of each little patch. In the case of the „Great Water“, the second to be developed, 20 ha of open water of varying depth (1–1.8 m) with islands was constructed with depots far from the wetland area. In this case an existing canal flows through it.

Monitoring of the development of aquatic macrophytes in these areas was carried out from the first year on a yearly basis ("Patchy" area 2011–17 and the "Big Water" 2014–18). The Kohler transect mapping method, commonly used in aquatic vegetation mapping was applied to the linear habitats, while the patches and borderlines (depots and non-depots) were surveyed with cover estimation used mainly in coenological surveys and evaluated with hierarchical clustering and principal component analysis.

Pioneer species as *Utricularia vulgaris* were quickly introduced into the connecting canals of Patchy area. Competitor plant species indicating stabilized situation, showed a very slow but steadily increasing trend till 2017. We can state that the appearance of macrophytes already present in the flora of Lake Kolon, based on literature data and former field surveys, started in 2015 only four years after the reconstruction, so recolonization was a slower process due to the wedged reed stands. The long-term study of the depots in the borderline found that by 2017 they had vegetation similar to the non-deposited borders. In the case of the Great Water the dominance of competitor plant species such as *Nymphaea alba* had already been established and showed a slight increase in 2015, two years after the reconstruction. Our results understated that the natural meso- and eutrophic macrophyte vegetation has good regeneration potential in presence of propagules.

Acknowledgements: This research was supported by The Kiskunság National Park Directorate and the KEOP-3.1.2/2F/09-2009-0014 and KEOP-7.3.1.2/09-2009-0009 proposals.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Factors influencing for the steppe flora and recommendation for subsequent protecting and conservation in old cemeteries of Kherson province (Southern Ukraine)

Nadiia Skobel[1], Ivan Moysiyenko[1], Barbara Sudnik-Wójcikowska[2], Iwona Dembicz[2], Maria Zachwatowicz[3]

[1]Kherson state university, Department of Botany, Kherson, Ukraine, skobel2015@gmail.com
[2]University of Warsaw, Department of Ecology and Environmental Conservation, Warsaw, Poland
[3]University of Warsaw, Department of Geoecology, Warsaw, Poland

Key words: Old cemeteries, Plants, Vegetation

In recent years, research has been developed on the biodiversity of sites such as old cemeteries. Today, old cemeteries are surrounded on all sides by anthropogenic landscapes: residential, or located on the border of residential and segetal landscapes, sometimes - among segetal, so the steppe vegetation in old cemeteries is isolated. Changes in natural landscapes lead to the loss of a large proportion of the steppes. The purpose of our study was to identify factors influencing the conservation of steppe flora and provide recommendations for conservation in village and urban cemeteries, for the example of Kherson province. Kherson province is determined by its geographical location within the proper steppe zone of the Eastern European Plain. The area of the 13 old cemeteries (10 village and 3 urban (there are only 3 old cemeteries in the city) of the Kherson province varies from 0.43 ha to 10.45 ha. The total area of all old cemeteries is 51.2752 ha. The presence of sozophytes, typical steppe species, both in urban and village cemeteries, *Agropyron pectinatum* (M.Bieb.) P.Beauv, *Festuca valesiaca* Gaudin, *Koeleria cristata* (L.) Pers, *Stipa capillata* L. and a large proportion of native non-synanthropic species, indicates about the relatively good state of conservation of steppe vegetation in old cemeteries *in situ*. Conservation of steppe vegetation in old cemeteries of villages and towns varies according to location (city, village), size, date of foundation, cultural care for graves, availability of mowing or grazing, controlled burning) and the condition of the cemetery (abandoned / abandoned, which the graves are tende / used). Abandoned cemeteries have the most positive effect on the conservation of flora, because they don`t have the graves are tended: planting, littering and vandalism. Although urban cemeteries are characterized by less conservation of steppe flora compared to village ones, their role in conservation steppe flora in the urban environment undeniably. Old cemeteries could play an important role in steppe phytodiversity conservation and give perspective for future steppe restoration actions.

Old cemeteries are known as cultural heritage sites and have potential for conservation of steppe flora. Old cemeteries should be integrated sites of historical and natural heritage conservation. Our recomendation: creating a register of old cemeteries and recognizing them in the State Register of Monuments, recognizing of old cemeteries as natural monuments (Ukrainian: “Pamiatky pryrody" – protected by adequate environmental regulations including in its description “unique structures with exceptional natural, scientific, educational, and esthetic values that should remain intact’”), introduction of management (mowing, grazing, controlled fires), uprooting adventitious shrubs, or preventing their spread and emergence.

Acknowledgements: This research was supported by the Swedish Science Council (Vetenskapsrådet) project N 2012-06112 and by National Research Foundation of Ukraine «Grass habitats of Ukraine of European importance: current status, the extent of losses and the conservation strategy in the context of global climate change and anthropogenic transformation of the environment» (registration № 0120U104763).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The effect of former ploughing on grassland species composition in the Hutě Nature Reserve (White Carpathians)

Karolína Slachová, Michal Hájek

Department of Botany and Zoology, Faculty of Science, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic, slachova.kaja@centrum.cz

Key Words: Above-ground biomass, Bílé Karpaty Mts, Convergence, Former fields, Grasslands, Nutrients, Productivity, Species richness, Species-rich, succession, The Hutě Nature Reserve

As in other parts of the Bílé Karpaty Mts, we can come across a mosaic of differently species-rich grasslands with many rare and endangered plant species in the Hutě Nature Reserve nearby the village of Žítková. A part of this mosaic is formed by grasslands which used to be ploughed and used as fields during the second half of the twentieth century. However, they were subsequently abandoned and their contemporary vegetation is being formed by the processes of succession. In the last few decades the same type of management, especially scything, has been applied on both the former fields and the continuous grasslands that have never been ploughed. Ecological theory predicts a gradual convergence of species composition between the former fields and continuous grasslands that are currently species-rich and of high conservation value. This convergence has not been yet tested, either it has not been tested which species are associated with continuous grasslands or former fields, respectively.

Paired design of data sampling has been used in this study. Each pair comprised a vegetation-plot record of the segment from a continuous grassland and a vegetation-plot record from a former field. Within a pair, plots were located in a way they were as close to each other as possible with respect to environmental conditions such as slope degrees and exposition. Former fields were identified according to the archival aerial photographs, terrain indications and information from the cadastre of real estate and witnesses. Twelve pairs of vegetation-plot record (24 sites in total) were recorded, digitalised using the Turboveg database and processed using numerical methods, together with measurements of soil moisture and chemistry.

Segments of continual grasslands are still more species-rich, however, the convergence of species composition of these two types is taking place at some plots. Nevertheless, environmental factors have a considerable effect on such processes, especially higher nutrient content on the fields that had been fertilized in the past and then abandoned. Vegetation of the fields continues to be more productive and it tends to harbour a lower number of rare and endangered species. Average number of species per plot (area 16 m^2) was 79 for continuous grasslands, 62 for former fields respectively.

Although former fields show quite high species richness as compared to conventional agricultural landscape, their diversity and conservation value is still lower than that of adjacent continuous grasslands despite the long-term conservation management. They represent modern *Arrhenatherion* communities with high proportion of expansive species such as *Chaerophyllum aromaticum*, *Anthriscus sylvestris* or *Calamagrostis epigejos*, especially in places where nutrients accumulate. Nature conservancy should protect continual grasslands of any undesired effects that may lower their diversity. For former fields the measures leading to lowering nutrient levels, supressing dominants, and eventually efforts to increase flow of propagules from ancient grasslands should be adopted.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Vegetation research helps in sustainable grassland management in the face of global changes

Magdalena Szymura[1], Tomasz H. Szymura[2], Chathura Perera[1], Michał Feliniak[1]

[1]Institute of Agroecology and Plant Production, Wrocław University of Environmental and Life Sciences, Wrocław, Poland, magdalena.szymura@upwr.edu.pl
[2]Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław, Wrocław, Poland

Keywords: Biodiversity, Ecosystem services, Environmental conditions, Mountain pastures, Productivity

Grasslands provide a wide range of ecosystem services, including biodiversity maintenance, forage production, carbon sequestration and water retention. In the face of global changes, both climate and socio-economic, it is necessary to adapt the methods of grassland management to the new realities. In livestock production, the quality of products is nowadays attributed to the animal husbandry methods as well as fodder quality. Extensive pasturage of animals is in a line with the principles of sustainable development, but its new rules should be developed taking into account the climate and economic changes.

The aim of the study was to create models of productivity and biodiversity patterns of mountain pastures, which helps establish an optimal method of management that guarantees a stable nutritional base for animals in changing climatic and socio-economic conditions.

A vegetation analysis was the basis for the model, and sampling plots were established according to the gradient of moisture. Additionally, the productivity and quality of the hay were assessed and correlated with biodiversity and environmental data. The study was conducted in two localities in the Lower Silesia region, SW Poland. The study sites were located in sub-mountain and mountain areas, containing both meadows and pastures.

The studied grasslands have a relatively high level of biodiversity - both in the number of species and species composition. A positive correlation was found between the number of species and the content of ash in plants, calcium in plants and magnesium in soil.

No negative correlation was found between the species richness and productivity (biomass). Biodiversity and species composition were shaped mostly by soil moisture and reaction. Extensive grazing promotes high biodiversity, and high biodiversity guarantees high fodder quality and stable yield even under drought conditions.

Acknowledgements: This research was financed under the Leading Research Groups support project from the subsidy increased for the period 2020–2025 in the amount of 2% of the subsidy referred to Art. 387 (3) of the Law of 20 July 2018 on Higher Education and Science, obtained in 2019.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Species diversity indices and community completeness index as indicators of short-term success of semi-natural grassland restoration

Martina Marei Viti[1], Solvita Rūsiņa[2], Līga Gavare[2], Madara Krūzmane[2], Marks Arnolds Župerka[2] , Baiba Strazdiņa[3]

[1]University of Bologna, Department of Biological, Geological and Environmental Sciences, Bologna, Italy, martinamarei.viti@studio.unibo.it
[2]University of Latvia, Department of Geography, Rīga, Latvia
[3]Latvian Fund for Nature, Rīga, Latvia

Key words: Community completeness, Indicators, Restoration, Short-term, Semi-natural grassland, Species diversity

In real-life restoration projects, there is the need to define suitable ecological indicators that evaluate the restoration success in a short timeframe. Furthermore, in large-scale studies, it is necessary to characterize different restoration treatments according to the intensity of disturbance introduced. By comparing grassland vegetation before and 2–3 years after restoration, we evaluated the changes in plant species diversity and community completeness in four categories of restoration intensity.

Study was located in abandoned or degraded semi-natural grasslands subjected to restoration in Latvia.

We sampled 69 grassland vegetation plots of 5x5m in 2018–2019 before restoration and in 2021 after restoration. For assessing changes in species diversity in each restoration intensity category, we analysed species richness, Shannon, Simpson diversity indices and Pielou's evenness index, as well as species-area relationship and ecological indicator values. In addition, we performed temporal beta analysis. Whereas, for detecting changes in community completeness, we compared Community completeness indices derived from local and regional species pool.

We found that all restoration sites are undergoing positive changes in species diversity. However, it still lacks clear patterns of changes in relation to mild, medium and high restoration intensity, whereas the main gradient of differences is observed when comparing reference communities with restored ones. Reference communities were observed to change the most in terms of species richness and community completeness of specialist species, whereas restored sites showed an increase in evenness due to generalist species cover gain and a decrease of expansive species cover. Both reference and restored sites lack a significant recruitment of specialist species.

Species diversity and community completeness index are complementary indicators of short-term restoration success, and we suggest that they are used in a concert. Moreover, we suggest that reference communities are also monitored, because under a climate change their ecological state is subjected to variability.

Acknowledgements: This research was supported by the LIFE programme project GrassLIFE LIFE16NAT/LV/262.

Plant invasions in the context of climate change

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Geographical patterns of neophyte invasions in European vegetation

Irena Axmanová[1], Martin Večeřa[1], Jan Divíšek[1,2], Petr Pyšek[3,4], Veronika Kalusová[1], EVA data contributors and Milan Chytrý[1]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, axmanova@sci.muni.cz
[2]Department of Geography, Faculty of Science, Masaryk University, Brno, Czech Republic
3 Department of Invasion Ecology, Institute of Botany, Czech Academy of Sciences, Průhonice, Czech Republic
[4] Department of Ecology, Faculty of Science, Charles University, Prague, Czech Republic

Key words: Aliens, Anthropogenic habitats, Distribution, Europe, Forests, Grasslands, Habitats, Neophytes, Shrubs, Wetlands

The human-driven spread of alien plants has serious environmental and socioeconomic consequences. However, the numbers of alien species and their impacts differ among regions and habitats. Here we focus on extra-European neophytes, i.e. alien plants introduced to Europe after 1500 AD. We use the most comprehensive dataset of vegetation plots available in the European Vegetation Archive to study patterns of neophyte invasion in a wide range of European habitats (forests, shrublands, grasslands, wetlands including mires, coastal and man-made habitats according to the EUNIS-ESy expert system).

We mapped neophyte invasion levels across regions and habitat types, and identified regions and habitats with the highest and lowest concentrations of neophytes. We compared different measures of invasion levels (absolute neophyte richness, relative neophyte richness, absolute neophyte cover, and relative neophyte cover), both at the level of habitat species pools and vegetation plots. To interpret the current distribution of neophytes in Europe we also analyzed relationships with broad-scale environmental and human-linked factors. In addition, we assessed the habitat-specificity of the most frequent neophytes, and compared their life forms and regions of origin.

Acknowledgements: This research was supported by the Czech Science Foundation (EXPRO grant no. 19-28491X).

Overview of European alien plant checklists

Veronika Kalusová[1], Natálie Čeplová[1], Milan Chytrý[1], Jiří Danihelka[1], Petr Pyšek[2,3], Idoia Biurrun[4], Steffen Boch[5], Franz Essl[6], Emmanuel Garbolino[7], Anna Kuzemko[8], Jana Medvecká[9], Vira V. Protopopova[10], Myroslav Shevera[8], Jens-Christian Svenning[11], Erik Welk[12], Irena Axmanová[1]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, ceplova@ped.muni.cz
[2]Czech Academy of Sciences, Institute of Botany, Department of Invasion Ecology, Průhonice, Czech Republic
[3]Department of Ecology, Faculty of Science, Charles University, Prague, Czech Republic
[4]Department of Plant Biology and Ecology, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Bilbao, Spain
[5]WSL Swiss Federal Research Institute, Birmensdorf, Switzerland
[6]Bioinvasions, Global Change, Macroecology-Group, Department of Botany and Biodiversity Research, University of Vienna, Vienna, Austria
[7]Crisis and Risk Research Centre, MINES ParisTech, Paris, France
[8]M.G. Kholodny Institute of Botany of the National Academy of Sciences of Ukraine, Kyiv, Ukraine
[9]Institute of Botany, Plant Science and Biodiversity Centre, Slovak Academy of Sciences, Bratislava, Slovakia
[10]Ferenc Rákóczi II Transcarpathian Hungarian College of Higher Education, Berehove, Ukraine
[11]Department of Biology, Center for Biodiversity Dynamics in a Changing World (BIOCHANGE) and Section for Ecoinformatics and Biodiversity, Aarhus University, Aarhus, Denmark
[12]Institute of Biology/Geobotany and Botanical Garden, Martin Luther University Halle, Halle/Saale, Germany

Key words: Alien species, Database, Europe, Invasion status, Plant invasions, Vascular plants

Macroecological research in invasion ecology depends on evaluation and assignment of the alien status of plant species in different regions of Europe. The development of national checklists of alien floras in many countries started in the 1990s based on the collation and expert evaluation of available floristic records for particular countries. Subsequently, continental-scale databases containing regional data on alien plants, such as DAISIE, GloNAF and Euro+Med PlantBase were developed. However, there are still gaps and inconsistencies among existing checklists and databases of alien plant species in terms of their up-to-dateness, completeness, comparability, data quality and consistency of species categorizations. Moreover, information on alien plants is insufficient for some European regions.

The aim of this project is to compile an overview of recently published national and regional alien checklists across European countries. We aim at unifying the taxonomy and nomenclature, invasion and residence time status categories and other information provided for their species using a common methodological approach. Based on the unified species lists, we will compare alien floras across Europe and identify main gaps in data availability and quality. So far, we have digitized complete or partial alien checklists for 50 European territories (countries or bigger islands and archipelagos with distinct history and biogeography). We continue searching for available checklists and evaluating them. Species-status data obtained from published checklists will become part of the recently developed online database FloraVeg.EU.

Acknowledgements: This research was supported by the Czech Science Foundation (EXPRO grant no. 19-28491X).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Examining the association between alien species and community species richness across habitat types

Josep Padullés Cubino[1], Jakub Těšitel[1], Pavel Fibich[2], Jan Lepš[2], Milan Chytrý[1]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, padullesj@gmail.com
[2]Department of Botany, Faculty of Science, University of South Bohemia, České Budějovice, Czech Republic

Key words: Biotic resistance, Biotic acceptance, Community ecology, Czech Republic, Plant invasion, Species richness

The effects of invasive species manifest across spatial scales but can be particularly pronounced within ecological communities, where they can alter species composition and drive local extinctions. However, it is unclear whether individual alien species consistently occur in species-poor or species-rich communities across broad geographical scales and whether this pattern differs among habitat types. We examined the association between the incidence of 73 alien species and species richness in ~17,000 invaded and non-invaded terrestrial plant communities in the Czech Republic. We calculated the median, range, and skewness of the distribution in community species richness associated to the 73 alien species. Then, we compared the observed values with those obtained under a null expectation to test whether alien species occurred at random in relation to species richness in forest and grassland communities. We demonstrate that the relationship between the occurrence of alien species and the diversity of local plant communities is species-dependent and varies across habitats. However, when considered together, alien species occur more often in species-poor communities than would be expected by chance. Alien species are also associated with more species-poor vegetation than the rest of the flora in the Czech Republic. These patterns are more pronounced in grasslands, where alien species also occur in communities with a more similar number of species than would be expected by chance. We conclude that multi-species studies are needed for understanding community assembly processes and assessing the impact of alien plant invasions on native diversity.

Acknowledgements: This research was supported by the Czech Science Foundation (projects 19-28491X and 20-02901S).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Levels of invasion in European dwarf shrub and scrub vegetation

Veronika Kalusová[1], Irena Axmanová[1], Milan Chytrý[1], Martin Večeřa[1], Emiliano Agrillo[2], Idoia Biurrun[3], Christian Berg[4], Emanuela Carli[5], Klaus Ecker[6], Emmanuel Garbolino[7], Jens-Christian Svenning[8], Maria Šibíková[9], Urban Šilc[10]

[1]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic, corresponding author's email: kalveron@tiscali.cz
[2]Department of Environmental surveillance and monitoring, Institute for Environmental Protection and Research (ISPRA), Roma, Italy
[3]Department of Plant Biology and Ecology, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Bilbao, Spain
[4]Institut for Biology, University Graz, Graz, Austria
[5]Department for the Monitoring and Protection of the Environment and for Biodiversity Conservation, Institute for Environmental Protection and Research (ISPRA), Roma, Italy
[6]Biodiversity and Conservation Biology Research Unit, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland
[7]Crisis and Risk Research Centre, MINES ParisTech, Paris, France
[8]Department of Biology, Center for Biodiversity Dynamics in a Changing World (BIOCHANGE) and Section for Ecoinformatics and Biodiversity, Aarhus University, Aarhus, Denmark
[9]Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences, Bratislava, Slovak Republic
[10]Jovan Hadži Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia

Keywords: Continental scale, EUNIS habitats, Europe, Neophytes, Plant invasions, Shrublands

Human-assisted introduction of alien plant species is one of the main drivers of biodiversity loss; therefore, identifying vulnerable habitats and their successful invaders is crucial for risk assessments and alien plant management. The establishment of the vegetation-plot data repositories such as the European Vegetation Archive (EVA) enabled new studies of invasion levels at the fine-scale resolution of individual habitats across Europe. Our study focused on the European habitats of dwarf-shrub and scrub vegetation (EUNIS habitat group S and a subset of group N). As highly dynamic, heterogeneous vegetation that often forms transitions to other habitat types, shrublands can be important in terms of alien plants' establishment.

We analyzed a geographically stratified dataset of 24,220 shrubland vegetation plots provided by EVA. We compared several measures of neophytes' invasion levels across i) EUNIS habitats, ii) broad habitat groups and iii) biogeographical regions of Europe. In total, we identified 311 taxa (i.e., 4.8% of all taxa) considered as neophytes in Europe. The most frequent neophytes were *Prunus serotina*, *Robinia pseudoacacia* and *Vaccinium macrocarpon* among woody taxa and *Impatiens parviflora*, *Erigeron canadensis*, and *Solidago gigantea* among herbaceous taxa. The most invaded habitats included lowland scrub vegetation of the Macaronesian region, followed by riparian scrub, *Rubus* scrub and forest clearings scrub of temperate Europe, and coastal dune scrub of the Atlantic region. The levels of invasion were low in dwarf shrub and scrub vegetation of the Arctic and the Mediterranean region and decreased with the elevation in Alpine regions. This indicates the importance of insularity, frequent disturbances, and resource-rich or resource-fluctuating environments for promoting plant invasions.

Acknowledgments: This research was supported by the Czech Science Foundation (EXPRO grant no. 19-28491X).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Is vulnerable vegetation of cold environments threatened by plant invasions as a result of global changes?

Michaela Vítková[1], Josef Kutlvašr[1,2], Lenka Moravcová[1], Irena Perglová[1], Jiří Sádlo[1], Hana Skálová[1], Petr Pyšek[1,3], Jan Pergl[1] and SEED-ASICS partners

1Institute of Botany CAS, Průhonice, Czech Republic, michaela.vitkova@ibot.cas.cz
2Faculty of Environmental Sciences CULS, Praha, Czech Republic
[3]Faculty of Science, Charles University, Prague, Czech Republic

Key words: Alpine ecosystem, Climate change, Distributional shift, Non-native Species, Plant invasion, Polar tundra, Tolerance limits

Cold environments, both in high latitudes and altitudes, and their endemic plant diversity were often regarded as resistant to plant invasions due to the harsh climate and a low human footprint. However, globalization, climate change, atmospheric nitrogen deposition, and land-use changes with the increasing development of human infrastructure amplify the invasion pressure even in these Earth's most remote areas. Disturbed roadsides and hiking trails are major pathways for the migration of alien species from the hotspots in harbors, cities, and other hubs, into pristine alpine and polar environments.

The presented research combines experimental and observational approaches to study the distributional shifts of selected alien and native plant species along altitudinal and latitudinal gradients, their tolerance limits, and occupied ecological niches. This will help us to better predict invasion pressure on pristine vegetation under the conditions of future climatic and land-use changes to develop sound mitigation and management measures.
We use 50 study sites worldwide in polar (Arctic, Antarctic, and Subantarctic Islands) and alpine (tundra; Oceanic, Hemiboreal, Continental, and Subtropical climatic groups) regions to explore the effect of climate on species altitudinal migrations. Within each site, plots were established at three altitudes along one road or hiking trail along the elevation gradient. In addition, to study the effect of land use and human pressure, each site contains one pair of permanent plots located at the roadside and in the undisturbed vegetation further from the road, giving six plots per site in total.

We study the patterns in soil temperatures and humidity over years and soil nutrient availability over vegetation season associated with vegetation composition. A subset of most frequent alien and native plants are used as model species in chamber experiments to study their plasticity and reaction to different temperature regimes. This methodology was tested along eight roads leading from the Czech and Polish sides to the arctic-alpine tundra of the Krkonoše Mts.

Acknowledgements: This research is a part of the ongoing global project ASICS (Assessing and mitigating the effects of climate change and biological Invasions on the spatial redistribution of biodiversity in Cold environmentS; https://www.coldregioninvasives.com/) supported within BiodivERsA in 2021-2024 (TAČR SS70010001), Center for Landscape and Biodiversity (TAČR SS02030018), and long-term research development project RVO 67985939. We gratefully acknowledge the immense effort and time that numerous SEED-ASICS partners contribute to the collection of field data.

Forest vegetation and forestry

Multifaceted analysis to evaluate the forest structure on understories biodiversity in European beech forests

Alessandro Bricca[1,2], Gianmaria Bonari[2], Maurizio Cutini[3]

[1]School of Biosciences and Veterinary Medicine, University of Camerino, via Pontoni 5, 62032 Camerino, Italy, *Alessandro.Bricca@unibz.it*
[2]Faculty of Science and Technology, Free University of Bozen-Bolzano, Piazza Università 5, Bolzano, Italy
[3]Department of Science, University of Roma Tre, viale G. Marconi 446, 00146 Roma, Italy

Key words: Coppices, *Fagus sylvatica*, Functional diversity, Habitat filtering, Pphylogenetic diversity, Taxonomic diversity

Forest management alters the structure of forest stands causing cascading effect on understory plant diversity. Because of the multidimentsional nature of biodiversity, the role of management practices in driving community assembly should be evaluated on different diversity facets, that are, taxonomic, functional and phylogenetic. Here, we investigated the role of structural parameters on each of the three diversity facets in 56 beech forest understories plots located in central Italy subjected in the past to two different forest management, coppice-with-standard and high forest. We expected that (i) structural parameters related to stand maturity, namely basal area, stand density, mean tree height, will act as filters in reducing the overall diversity; (ii) structural parameters related to stand heterogeneity, namely vertical and horizontal stratification of tree, amount of lying deadwood enhance the overall diversity. We run separate multiple-linear models on taxonomic diversity, standardized effect size of functional diversity for single plan trait, and of phylogenetic diversity, considering also the two management practices and their interactions with the structural parameters. We found that each facet of diversity responded differently to structural parameters, highlighting the co-occurrence of multiple community assembly processes. Increasing lying deadwood enhances functional divergence of specific leaf area, hinting at the role of micro-environmental soil heterogeneity, while basal area acts to increase functional convergence for seed mass, suggesting filtering effect exerted by wetter and colder condition. Stand density increased taxonomic diversity and decreased phylogenetic diversity. Our study suggests that forest management has contrasting effects on biodiversity facets. We suggest a multifaceted approach evaluating the effect of structural features on different facets of diversity represents a promising framework for understanding and predicting plant response to management practices. Such kind of studies can help in taking more informed decisions about management and conservation practices.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Impact of experimental interventions inspired by historical management and environmental changes on thermophilization of temperate oak forest understorey

Linda Csölleová[1], Karol Ujházy[2], Mariana Ujházyová[3], Marek Čiliak[3], Judita Kochjarová[2], Vlastimil Knopp[2], František Máliš[2]

[1]Department of Phytology, Faculty of Forestry, Technical University in Zvolen, Slovakia, csollelinda@gmail.com
[2]Department of Phytology, Faculty of Forestry, Technical University in Zvolen, Slovakia
[3]Department of Applied Ecology, Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, Slovakia

Key words: Climate change, Environmental changes, Forest vegetation changes, Forest management, Historical land-use, Thermophilization

During global warming and other environmental changes, vegetation of lowland temperate forests undergoes changes in species composition resulting into loss of biodiversity. Increasing nitrogen depositions, abandonment of historical forms of forest management combined with climate change are the main drivers inducing processes of eutrophication or thermophilization of vegetation. Since changes in canopy openness are linked to thermphilization due to the loss of microclimate buffering effect, historical human activities altering forest structure were significantly affecting forest microclimate and thus life conditions of understorey vegetation for centuries. Therefore, to set appropriate forest management providing the most optimal conditions for conservation and restoration of biodiversity, it is very important to quantify relationships between the structure of the tree layer and microclimatic conditions as well as to quantify their influence on understorey composition in the context of historical management practices.

For these purposes, we set up a field experiment at Central European oak dominated forests where we analysed the response of understorey vegetation to three treatments that simulate historical management and increasing nitrogen depositions: i) reduction of canopy closure, ii) litter raking and iii) fertilization. Experiment was established in 2017 in five replications. At each of five sites the rectangle of 40 x 80 m was set and subdivided into eight subplots with a unique combination of treatments including control without any intervention. To measure microclimate, we installed data loggers at the centre of each subplot where they continuously recorded the temperature and soil moisture. Also, at each subplot, there was vegetation composition repeatedly recorded every year. The degree of thermophilization was determined by usual method using Ellenberg Indicator Values and with novel approach using the ClimPlant database, which quantifies the realized climatic niches of the forest vascular species. The early 3-year response of understorey vegetation does not indicate any significant directional shifts towards more thermophilus plants after reduction of canopy closure. Vegetation of fertilized plots exhibited a slight shift towards more cold-adapted species in general, but particularly on the plots where no other treatment except increasing of nitrogen has been applied. Importantly, combination of litter raking and reduction of canopy closure has induced shifts of species composition towards more drought-tolerant plants suggesting increased drying out of soil due to the loss of litter layer and increased direct sun radiation. Most of the specialized studies in topic of vegetation changes due to climate change were so far with emphasis on raising temperatures, however, these findings underline the importance of amount of precipitation as well. It is possible that in many cases the water availability rather than changing temperature is a limiting factor in species survival.

Acknowledgements: Research was supported by Slovak Research and Development Agency by project No. APVV-19-0319.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Structure and species composition of Scots pine (*Pinus sylvestris* L.) stands in Tervete Nature Park in Latvia

Aigars Indriksons, Inga Straupe, Anna Duvina

Latvia University of Life Sciences and Technologies, Forest faculty, Department of Silviculture, Jelgava, Latvia, aigars.indriksons@llu.lv

Key words: Scots pine, Species composition, Tervete Nature Park, Tree stand structure

The research was carried out in 2020 in the area of unique old Scots pine (*Pinus sylvestris* L.) stands in Tervete Nature Park in Latvia. A complex assessment of forest stand parameters – the tree stand dendrometric indices, soil and ground vegetation description was performed. The oldest tree stands in Tervete reaches age of 180 till 260 years. These are the oldest pine stands in Latvia and in Baltic countries still growing nowadays. The stands are characterized by the structure of natural forests that need to be preserved for the future development of biodiversity. An unresolved issue is the origin of these stands, as the local conditions are not typical for pine growth. The potentially rich, carbonate saturated sediments of moraine would be more favourable for establishment of stands of nutrient demanding broadleaves species. In generally, Scots pine has a wide ecological range; it grows in both poor sandy soils and wet peat soils. In fertile soils pine grows branched with wide annual rings and is therefore of low timber value. Pine grows best in slightly clayey sandy soil, where it can reach a height of up to 40 meters. The rich understorey of common hazel (*Corylus avellana* L.), rowan (*Sorbus aucuparia* L.) and other shrub species provides the necessary nutrients to the soil. Pine grows in both pure and mixed stands together with the Norway spruce (*Picea abies* (L.) H.Karst.), birch (*Betula* sp.), less often with the common oak (*Quercus robur* L.), common aspen (*Populus tremula* L.) and other deciduous tree species. The stands are composite having a well expressed second floor which consists of common oak, small-leaved linden (*Tilia cordata* Mill.), Norway maple (*Acer platanoides* L.) and common ash (*Fraxinus excelsior* L.). The most characteristic species of understorey are the alder buckthorn (*Frangula alnus* Mill.), rowan and the guelder-rose (*Viburnum opulus* L.).

In generally, the regeneration of Scots pine is difficult in sites rich of nutrients because of competition by herbaceous vegetation and fast-growing deciduous trees. Therefore a special interest of forest managers and scientists concerns to further development of Scots pine stands in Tervete Nature Park.

Acknowledgements: The study was supported by the grant of project of Latvia University of Life Sciences and Technologies “Implementation of LLU research program”.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The temperate deciduous forests of western Eurasia: plant diversity, biogeographic relationships and climatic drivers

Loidi Javier [1], Marcenò Corrado [2], Chytrý Milan[3], Jiménez-Alfaro Borja[4] & data contributors

[1]Department of Plant Biology and Ecology, University of the Basque Country (UPV/EHU), Bilbao, Spain, javier.loidi@ehu.eus
[2]Department of Chemistry, Biology and Biotechnology, University of Perugia, Italy
[3] Department of Botany and Zoology, Masaryk University, Brno, Czech Republic
[4] Research Unit of Biodiversity - CSIC/UO/PA, Universidad de Oviedo, Mieres, Spain

Key words: Forest diversity, Forest floor, Life form, Shrub layer, Tree layer

Temperate deciduous forest biome occupies a large area in temperate western Eurasia. The vast territory it occupies suggests a common origin as it formed a continuous and much broader area during the late Tertiary. The Pleistocene climatic oscillations caused successive reductions and expansions with differential impact on floristic extinctions in the different parts of this biome. This could be reflected in the diversity of vascular plants in the separate subregions of the total area and in their biogeographic relationships. We try to understand the main drivers of the diversity patterns of the three different elements of the forest community: trees, shrubs and forest-floor plants. Nine subregions have been selected for the survey encompassing the area and variability of western Eurasian temperate deciduous forests, and 1,000 vegetation plots were selected within each of them from the EVA database, making a total of 9,000 plots. The dataset was homogenized and standardized, and the species were classified into the following life forms: For ligneous species, trees, shrubs or dwarf-srubs, either perennial or deciduous, and conifers or non-conifers. For herbs, hemicryptophytes, geophytes or therophytes. Lianas and epiphytes were also considered as well as ferns. For the analyses, the plant communities were deconstructed into three layers: tree, shrub and floor. Generalized linear mixed models (GLMM) were used to analyse the influence of current climate, historical climate and topography on species richness by accounting for regional effects. Redundancy analysis (RDA) with variance partitioning was used to describe the variation in life forms along abiotic gradients. The three forest layers were analysed jointly and separately in order to find out whether their variation patterns were similar or different. The Balkans, Alps and Carpathians appeared to be the richest in plant species, whereas the British Isles and the Hyrcanian region were the poorest. Annual temperature range and annual mean temperature were the best predictors of species richness for the whole dataset and for the shrub layer. The tree layer richness was mainly explained by the annual temperature range and elevation. The current climate was the main predictor of the composition of the whole community, the tree layer and the floor layer, while the shrub layer was also influenced by historical climate.

Our overview of the diversity of temperate deciduous forests in western Eurasia demonstrates different patterns and drivers across life-forms and forest layers. The diversity of trees is mainly linked to current climatic conditions, while the shrub layer is also driven by postglacial-glacial climatic stability, suggesting a different origin from forest trees.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Multi-taxa diversity response to experimental treatments aiming to restore biodiversity of temperate oak forests

František Máliš[1], Marek Čiliak[2], Mariana Ujházyová[2], Erika Gömöryová[1], Pavel Širka[1], Judita Kochjarová[1], Vlastimil Knopp[1], Blažena Benčaťová[1], Linda Csölleová[1], Mikuláš Kočiš[1], Juraj Cipa[1], Danica Krupová[3], Karol Ujházy[1]

[1]Faculty of Forestry, Technical University in Zvolen, Slovakia, malis@tuzvo.sk
[2]Faculty of Ecology and Environmental Sciences, Technical University in Zvolen, Slovakia
[3]Forest Research Institute in Zvolen, National Forest Centre, Zvolen, Slovakia

Key words: Biodiversity restoration, Environmental changes, Historical management, Land-use change, Nitrogen deposition, Soil microbiota, Temperate oak forests, Vegetation diversity, Western Carpathian Mts.

Biodiversity of oak temperate forests in Europe seriously declined due to environmental changes, particularly land-use changes and nitrogen deposition. Restoration of historical management which typically maintained high light levels at the herb layer is a promising approach to recover diversity of oak forest vegetation. However, positive effects could be vanished by climate warming and associated thermophilization process due to the loss of microclimate buffering effect of forest canopies or by eutrophication triggered by increased light at the understorey and consequent rapid decomposition of litter. Therefore, it is essential for nature conservation practice to develop suitable management strategies for recovery of oak forest biodiversity.

We established the field experiment to test effects of three treatments: canopy reduction, litter raking and fertilizing on changes in multi-taxa biodiversity. Early response of vascular plant, bryophyte and soil microbiota richness was assessed during 3 consecutive years on 10 × 10 m plots organized in eight unique treatment combinations within a 40 × 80 m experimental site established in five replicates. Number of vascular plants rapidly and gradually increased particularly on plots with a combination of canopy reduction and litter raking. While single canopy reduction and litter raking had a slightly positive effect, the fertilization did not affect plant richness. Richness of soil microbial functional groups slightly increased, however not due to the treatment application as the same trend was observed at the control plots. Bryophytes were assessed only in the third year after the establishment of the experiment, thus without possibility to evaluate the temporal trajectories, but comparison of different plots also revealed the most significant effect of combination of canopy reduction and litter raking.

Our results indicate that restoration of historical management with limited intensity of cutting interventions have great potential to safeguard and support vegetation diversity despite high levels of nitrogen deposition and climate change.

Acknowledgements: Research was supported by the Slovak Research and Development Agency by project No. APVV-19-0319

Importance of forest characteritics in rare epiphytic bryophyte and lichen occurrence within boreo-nemoral landscape

Anna Mežaka, Rolands Moisejevs, Māris Nitcis

Institute of Life Sciences and Technology, Daugavpils University, Daugavpils, Latvia, anna.mezaka@du.lv

Key words: Bryophytes, Boreo-nemoral forests, Conservation, Epiphytes, Lichens

Epiphytic bryophytes and lichens contribute significantly to global forest diversity. However, due to the intensive forestry, rare epiphytic bryophytes and lichens face challanges in their long-term existence in boreo-nemoral forests. The aim of our study was to understand rare epiphytic bryophyte and lichen model species demands for long-term existence in boreo-nemoral forest landscape. We used Nature Data Management System OZOLS that is a national information system of rare taxa in Latvia. We selected rare epiphytic bryophyte and lichen occurrence core areas in different parts of Latvia and analyzed them in relation to forest characteristics. The study results showed that most of rare epiphytic bryophyte model species records were found in dry deciduous forests, while rare epiphytic lichen model species prefer both dry deciduous and dry mixed tree forests. Forest stand age was significant predictor in all rare epiphytic bryophyte and lichen model species occurrence, but forest stand area was significant in two rare epiphytic bryophyte and one rare epiphytic lichen species occurrence. Tree bark pH class was significant only in rare epiphytic bryophyte species occurrence. Surprisingly that forest stand heterogeneity did not show significant relationship with any of studied model species. Our results show the importance of forest characteristics in rare epiphytic bryophyte and lichen sppecies occurrence. Especially forests older than 100 years have high contribution in rare epiphytic bryophyte and lichen conservation in long-term.

Acknowledgements: This study was supported by the project: „Epiphyte metapopulation dynamics in boreo-nemoral forest landscape“ Nr. 1.1.1.2/VIAA/3/19/469. We are grateful to Stock Company „Latvia’s State Forests“ for the co-operation.

Evaluation of abiotic controls on forest damage after the Elisabeth windstorm in central Low Tatras, Slovakia, using logistic regression

Vladimír Šagát

Department of Physical Geography and Geoinformatics, Faculty of Natural Sciences, Comenius University in Bratislava, Slovakia, sagat13@uniba.sk

Key words: Abiotic drivers, Deforestation, Logistic regression model, Low Tatras, Mountain forests, Windstorm

For thousands of years, windstorms have been modifying land cover of mountain ranges. The distribution of deforested areas is not random, yet reflects the influence of numerous abiotic and biotic drivers on the vulnerability of forests.

Our study focuses on deforestation after the Elisabeth windstorm (November 2004) in surroundings of Čertovica saddle in the central part of Low Tatras, Slovakia. Using logistic regression model, we evaluated the impact of selected abiotic factors on the vulnerability of stand with a high proportion of Norway spruce. The presence of deforestation was identified using large-scale mapping based on high-resolution aerial imagery, while abiotic variables were obtained from the digital elevation model and forestry maps.

The best-performing model suggests that elevation, slope, exposition, and distance from non-forested areas are the most important abiotic controls. On the contrary, curvature, Topography Position Index, soil type, soil size, and soil depth seem to pose no significant contribution to the model prediction ability. Stands growing at higher elevations, on moderate slopes, not exposed to southeast and south, in the neighborhood of non-forested areas, appear to be the most sensitive to wind-driven damage.

After parameter removal using AIC, the resulting model reached AUC=0.72, correct classification of both response states=0.65 (cutoff value=0.23), and MacFadden's R-squared=0.11. Outputs of this research are applicable mostly in the decision-making of local forest management.

Acknowledgements: This research was supported by the Scientific Grant Agency of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences, the grant VEGA 1/0247/19 "Assessment of land-use dynamics and land cover changes".

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Ecological diversity and overview of pedunculate oak (*Quercus robur*) floodplain forests in Vojvodina (Serbia)

Tijana Šikuljak, Mirjana Ćuk, Miloš Ilić, Dragana Vukov, Ružica Igić

Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, Serbia, tijana.sikuljak@dbe.uns.ac.rs

Keywords: Classification, Foodplain forests, Pedunculate oak, Vojvodina

Floodplain forests are one of the most endangered treatable ecosystem, they are acting as interfaces between terrestrial and freshwater ecosystems and providing some of the most diverse and species-rich habitats in the world (Jolley, 2010). Therefore, they need to be provided with adequate protection, because these forests are increasingly endangered, both due to climatic factors and mostly due to devastation by anthropogenic factors.

As for the lowland forests in Serbia, they are connected to the alluvial soil. The communities that occur here are mainly poplar (*Populus* ssp.) forest formations and pedunculate oak (*Quercus robur*) forests. Communities with pedunculate oak are especially important for the yield, but in this part of history the great threat to them is the human factor, mostly for economic reasons.

The object of research is the pedunculate oak floodplain forests in the Vojvodina region (northern part of Serbia), in three different provinces that belong to Vojvodina: Srem, Banat and Backa. These three provinces are separated from each other by the rivers Sava, Tisza and Danube. Most often on the plain of rivers, these communities occur.

The aim of this paper is to present the plant communities in which the pedunculate oak appears. With the help of ecological diversity, we will see to what extent communities in different provinces discern from each other. An overview of the associations and their classification will be shown.

The most stable formation of pedunculate oak forest associations is present in the province of Srem in the valley of the Sava River.

The field research covered the period of summer and autumn of 2020 and spring, summer and autumn in 2021.

Phytocoenological relevés were collected using a Braun-Blanquet (1972) abundance scale. They are stored in the TURBOVEG database (Hennekens & Schaminée 2001) and further analyses were done in the JUICE 7.1 software package (Tichý 2002). The classification of the data set was completed by TWINSPAN (Hill 1979). The results are visualised using CANOCO 5.12 package (ter Braak & Šmilauer 2012).

Braun-Blanquet, J. (1972). Plant sociology: The study of plant communities (Facsimile of the edition of the 1932, translated by Fuller G.D. and Conard H.S.) Hafner publishing company, New York.

Jolley, R.L., Lockaby, B.G., & Cavalcanti, G. G. (2010). Changes in riparian forest composition along a sedimentation rate gradient. Plant Ecol. 210:317-330.

Hennekens, S.M., & Schaminée, J.H. (2001). TURBOVEG, a comprehensive data base management system for vegetation data. J Veg Sci 12:589-591.

Hill, M.O. (1979). A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. TWINSPAN.

ter Braak, C.J., & Šmilauer, P. (2012). Canoco reference manual and user's guide: software for ordination, version 5.0.

Tichý, L. (2002). JUICE, software for vegetation classification. J Veg Sci 13:451-453.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Forest floor bryophytes in Central European forest habitats

Ewa Stefańska-Krzaczek[1], Grzegorz Swacha[1], Jan Żarnowiec[2], Małgorzata W. Raduła[3], Zygmunt Kącki[1], Monika Staniaszek-Kik[4]

[1]Botanical Garden, University of Wrocław, Wrocław, Poland, ewa.stefanska-krzaczek@uwr.edu.pl
[2]Institute of Environmental Protection and Engineering, University of Bielsko-Biała, Bielsko-Biała, Poland
[3]Department of Ecology, Biogeochemistry and Environmental Protection, University of Wrocław, Wrocław, Poland
[4]Department of Geobotany and Plant Ecology, Faculty of Biology and Environmental Protection, University of Łódź, Łódź, Poland

Key words: Bryophyte indicators, EUNIS habitats, Liverworts, Mosses

Bryophytes are sensitive to environmental gradients and may be used as indicators of forest habitats. Their distribution may improve the classification of forests and also be helpful in understanding dynamic tendencies and disturbances of forests. However, so far bryophyte species have been little used on a wide scale when investigating the diversity of forest types. In our study, we assessed the diversity and distribution of forest floor bryophytes across a wide gradient of Central European forests. We used vegetation plots from the Polish Vegetation Database (PVD). We selected plots of 100–1000 m^2, with a tree layer cover of at least 20%, and classified them as EUNIS habitats. Our final dataset consisted of 9,258 vegetation plots containing bryophytes. We assessed the number and cover of bryophyte species, composition of bryophyte layer, species tendency for coexistence, and bryophyte diagnostic value for forest habitats. We used boosted regression tree (BRT) models, species frequency and fidelity in the EUNIS habitats, ordination methods, and interspecific associations of bryophyte species.

Bryophyte number and cover were high in moist habitats both with deciduous and coniferous tree stands. The species richness and abundance of bryophytes, as well as the species composition of the bryophyte layer depended mainly on substrate conditions and a tree stand type (coniferous or deciduous). Moreover, the environmental factors and the tree stand type filtered bryophyte species traits. Bryophyte species showed a clear preference for EUNIS habitats, but their fidelity was usually not high. We also identified groups of coexisting species. The groups showed a connection with a tree stand type, which was related to other environmental variables.

Forest floor bryophytes respond to environmental gradients by species number, cover, species traits and composition. Our research shows the importance of databases in learning about bryophyte ecology, however the use of vegetation data has some limitations.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Plant communities of Slovakia. 6. Forest and shrub vegetation

Milan Valachovič[1], Ján Kliment[2], Katarína Hegedüšová Vantarová[1] (eds), Dana Bernátová[2], Richard Hrivnák[1], Ivan Jarolímek[1], Róbert Kanka[3], Jozef Kollár[3], František Máliš[4], Jan Roleček[5, 6], Michal Slezák[1], Jozef Šibík[1], Mária Šibíková[1], Jana Uhlířová[7], Karol Ujházy[4], Mariana Ujházyová[8], Hubert Žarnovičan[9]

[1]Plant Science and Biodiversity Center, Institute of Botany, Slovak Academy of Sciences, Bratislava, Slovakia, milan.valachovic@savba.sk
[2]Botanical Garden of Comenius University in Bratislava, Blatnica, Slovakia
[3]Institute of Landscape Ecology, Slovak Academy of Sciences, Bratislava, Slovakia
[4]Faculty of Forestry, Technical University in Zvolen, Zvolen, Slovakia
[5]Department of Botany and Zoology, Faculty of Science, Masaryk University, Brno, Czech Republic
[6]Department of Paleoecology, Institute of Botany of the Czech Academy of Sciences, Brno, Czech Republic
[7]Bezručova 6, Bratislava, Slovakia
[8]Faculty of Ecology and Environmental Science, Technical University in Zvolen, Zvolen, Slovakia
[9]Faculty of Natural Science, Comenius University in Bratislava, Department of Environmental Ecology and Landscape Management, Bratislava, Slovakia

Key words: Classification, Phytosociology, Plant communities, Vegetation

The book represents the sixth volume of the edition of Plant communities of Slovakia. It summarizes the results of the phytosociological forest and shrub vegetation, which includes that on lowland forest vegetation on alluvia of large rivers and streams (*Alnetea glutinosae*, *Alno glutinosae-Populetea albae*, *Salicetea purpureae*), natural and also secondary vegetation of the shrub and anthropogenic forests (*Franguletea*, *Crataego-Prunetea*, *Robinietea pseudoacaciae*), oak forests on basic and acidic substrates (*Quercetea pubescentis*, *Quercetea robori-petraeae*), deciduous and mixed forests (*Carpino-Fagetea sylvaticae*), coniferous forests (*Dicrano-Pinetea*, *Erico-Pinetea sylvestris*, *Vaccinio-Piceetea*, *Vaccinio uliginosae-Pinetea sylvestris*) and subalpine dwarf pine communities (*Roso pendulinae-Pinetea mugo*). The present publication comprises a total of 128 associations and other rank-less syntaxa, classified into 38 alliances, 22 orders and 14 classes. The dataset used in the syntaxonomical revision contained 15 714 relevés. Synoptic tables for the classes and alliances were generated from a non-stratified data set to contain all accessible phytosociological relevés. Syntaxa are traditionally arranged from the level of class to orders, alliances, and associations. The subassociations and variants have also been distinguished in some instances. The text on unit description is divided into sub-sections with information on species composition and structure, phenology, dynamics, ecology, syntaxonomy, distribution in Slovakia and level of threat. The distribution of the communities is expressed by scoring the occurrence in orographic units as defined by the map of the Database of the Fauna of Slovakia. Where necessary, notes on the syntaxonomy and/or nomenclature of the units are given. The presented results are essential for scientists (botanists, zoologists, and ecologists), nature conservation institutions and policy.

Patterns and processes in a riparian zone

The vegetation of small French Mediterranean rivers, witnesses of the functioning of the turquoise network

Karine Faure

Conservatoire botanique national méditerranéen de Porquerolles (CBNMed), Montpellier, France, k.faure@cbnmed.fr

Key words: France, Functioning indicators, Mediterranean, Recommendations for action, Riparian vegetation, Turquoise network

Riparian vegetation is a privileged area for many species in the Mediterranean, acting as a refuge, reproduction area and ecological corridor for specific fauna and flora. They make up the turquoise network defined by the Rhone Mediterranean Corsica Water Agency as "the space where the green network and the blue network interact very strongly" and are witnesses to the dynamic balance and proper functioning of rivers. However, this vegetation has been subject to strong anthropic disturbances for the last two centuries.

This project (2020-2022) consists of developing a methodology for characterising the functioning of the turquoise network through its plant component in order to implement preservation and restoration actions. It concerns six Mediterranean coastal rivers and has four objectives:

1) Characterise the turquoise network through its vegetation component. The study allows for a better definition of the concept of the turquoise network and the identification of the vegetation that makes it up at the landscape and plant community level. Connectivity, ecopotentiality and biodiversity variables are studied.

2) Identify the influencing factors. The diachronic analysis of the landscape allows us to understand the evolutionary dynamics of the vegetation. In addition, a detailed analysis of the effects of environmental variables, landscape structure and anthropic pressures on plant communities is carried out.

3) Assessing the state of the turquoise network. The assessment method draws on bibliographical knowledge and the results of this study. It identifies the relevant indicators and proposes a scoring system to assess the functioning of the network.

4) Drawing up recommendations for action. A consultation process is implemented with the stakeholders of the catchment areas concerned to locate sectors for action and recommend preservation, management or restoration actions.

Acknowledgements: This study is supported by the Rhone Mediterranean Corsica Water Agency.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The effect of Poplar plantations on undergrowth diversity and neophyte distribution

Beloslava Genova[1], Ivan Jarolímek[3], Karolína Gelatičová[5], Simona Klačanová[3], Momchil Nazarov[2], Denisa Slabejová[3], Michal Slezák[3,4], Kiril Vassilev[2], Jozef Šibík[3], Mária Šibíková[3]

[1]University of Plovdiv "Paisii Hilendarski", Faculty of Biology, Department of Ecology and environmental protection, Todor Samodumov st. 2, 4000 Plovdiv, Bulgaria, beloslava111@abv.bg
[2]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev str. 23, 1113 Sofia, Bulgaria
[3]Plant Science and Biodiversity Center, Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, 845 23 Bratislava, Slovakia
[4]Institute of Forest Ecology, Slovak Academy of Sciences, Ľ: Štúra 2, 960 53 Zvolen, Slovakia
[5]Geobotany research company, Karpatské námestie 10/A, Bratislava, Slovakia

Key words: Danube, Floodplain forests, Neophytes, *Populus ×canadensis* ,Twin-plots

This research compares natural floodplain forests and artificial plantations of *Populus ×canadensis* in terms of ecological conditions, species composition, number, and cover of neophyte species. We hypothesized that the plantations would have poorer species composition with higher neophyte species with higher cover in the undergrowth.

The study was conducted along the Danube River and some of its tributaries on the territory of 6 countries – Austria, Slovakia, Hungary, Serbia, Bulgaria, and Romania. The twin-plot method was used to sample one relevé in a plantation and one in a natural forest nearby. A total of 232 relevés, or 116 twin-plots, were collected, following the Braun-Blanquet approach. They were then stored in the TURBOVEG database. Ellenberg values, number, and cover of neophyte and diagnostic species for three natural floodplain forest alliances (*Alnion incanae*, *Salicion albae*, and *Fraxino-Quercion roboris* (all names follow broadly accepted names (Mucina et al. 2016), as well as Shannon-Wiener index, were calculated in the JUICE software. Climatic data for the study areas was extracted from raster files of bioclimatic variables from the WorldClim database using ArcGIS Pro. A paired T-test was performed in the R software to determine the difference in the values between the natural forests and the plantations. Dissimilarity indices inside the natural and artificial forests were calculated in R, and generalized linear models were applied to check the factors responsible for the dissimilarity values.

The results show that plantations have a significantly lower number and cover of diagnostic species of the natural floodplain forest alliances, *Alnion incanae*, *Salicion albae,* and *Fraxino-Quercion roboris* and a higher number and cover of neophytes in the undergrowth. Natural forests have more hygrophytic species, while in plantations, more sunlight is available to the undergrowth. Plantations are located in significantly more nutrient-richer places than natural forests. The species diversity is higher in natural forests. When the soil is richer in nutrients and more alkaline, the difference between the plots in a pair is more negligible. The higher average temperature during spring has a similar effect.

Remote sensing for vegetation and habitat monitoring

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Earth Observation and Biodiversity Big Data for Forest Habitat Types Classification and Mapping

Emiliano Agrillo[1],Federico Filipponi[1], Alice Pezzarossa[1], Laura Casella[1], Daniela Smiraglia[1], Fabio Attorre[2], Andrea Taramelli[1,3]

[1]Italian National Institute for Environmental Protection and Research (ISPRA), Via Vitaliano Brancati 48, 00144 Roma, Italy
[2]Department of Environmental Biology, University of Roma "La Sapienza", Piazzale Aldo Moro 5, 00185 Roma, Italy, fabio.attorre@uniroma1.it
[3]IUSS-Istituto Universitario di Studi Superiori di Pavia, Palazzo del Broletto-Piazza della Vittoria 15, 27100 Pavia, Italy

Key words: Copernicus Progamme, Eunis Habitat Classification, Forest Habitat, Habitat Classification, Habitat Mapping, Supervised Machine Learning Modelling

In the light of the "Biological Diversity" concept, habitats are cardinal pieces for biodiversity quantitative estimation at a local and global scale. In Europe EUNIS (European Nature Information System) is a system tool for habitat identification and assessment. Earth Observation (EO) data, which are acquired by satellite sensors, offer new opportunities for environmental sciences and they are revolutionizing the methodologies applied. This paper shows the results of a novel approach for a spatially explicit habitat mapping in Italy at a national scale, using a supervised machine learning model (SMLM), through the combination of vegetation plot database (as response variable), and both spectral and environmental predictors. The procedure integrates forest habitat data in Italy from the European Vegetation Archive (EVA), with Sentinel-2 imagery processing (vegetation indices time series, spectral indices, and single bands spectral signals) and environmental data variables (i.e., climatic and topographic), to parameterize a Random Forests (RF) classifier. The obtained results classify 24 forest habitats according to the EUNIS III level: 12 broadleaved deciduous (T1), 4 broadleaved evergreen (T2) and eight needleleaved forest habitats (T3), and achieved an overall accuracy of overall accuracy of 76.14%. The results of the proposed methodology open the way to increase the EUNIS habitat categories to be mapped together with their geographical extent, and to test different semi-supervised machine learning algorithms and ensemble modelling methods.

Acknowledgments: This research was supported by the. Italian Institute for Environmental Protection and Research (ISPRA) and the Italian Space Agency (ASI) "Habitat Mapping project". The authors are also grateful to the support by: Arianna Orasi and Roberto Inghilesi on the methodological and analytical framework of this research.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

Exploring Natura 2000 Habitats by Satellite Image Segmentation: a case study from Čierny Balog (Central Slovakia)

Lucia Čahojová[1], Martin Ambróz[2], Ivan Jarolímek[1], Michal Kollár[2], Michaela Michalková[1], Karol Mikula[2], Jozef Šibík[1], Mária Šibíková[1]

[1]Institute of Botany, Plant Science and Biodiversity Center, Slovak Academy of Sciences, Bratislava, Slovakia, lucia.cahojova@savba.sk
[2]Department of Mathematics, Slovak University of Technology, Radlinského 11, 810 05 Bratislava, Slovakia

Key words: Earth observation, ecosystem mapping; forest type, remote sensing, Sentinel-2

Natura 2000 is a network of protected areas covering Europe's most valuable and threatened species and habitats. To set up the proper management of these areas, to monitor habitat´s changes and thus have the opportunity to intervene quickly, we need to obtain information about habitats and their surroundings more often and more regularly. This cannot be achieved by a field approach, but remote sensing could play an important role. Its advantage is also the ability to provide data from vast and remote areas, where research is difficult to achieve. New approaches and studies with different focus and results are being developed. Our approach includes point data from phytosociological databases as a starting point for automatic segmentation, which is a novel method that could help to connect ground-based and remote sensing data.

The main aim of our case study is to apply advanced remotely sensed techniques on mapping the area and condition of vegetation units. We focus on forest habitats belonging mainly to the Natura 2000 network in the area of Čierny Balog village (Central Slovakia). We concentrated on the verification of the possibilities of differentiation of various habitats using only multispectral Sentinel-2 satellite data.

New software created by our team called NaturaSat was used to reach our goals. In the identified areas, spectral characteristics were calculated using software tools, which were subsequently processed and tested statistically. We obtained significant differences between forest habitat types that provided promising results and verification of the methods used. The results of this study have the potential to be used in a wider area to map the occurrence and quality of Natura 2000 habitats.

Acknowledgements: This research was financially supported by projects APVV16-0432, APVV-19-0460, and VEGA 2/0119/19.

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

The first vegetation map of Kunashir (the Kurils Islands): An ecotone between boreal and temperate forests

Kirill Korznikov

Department of Functional Ecology, Institute of Botany of the Czech Academy of Sciences, Třeboň, Czech Republic, korzkir@gmail.com

Key words: Machine learning, Sattelite images, Vegetation mapping

Kunashir is the southernmost volcanic island of the Kuril Islands (44.11°N, 145.85°E). The total area is 1,490 km²; the avg. annual temperature is +5.1°C, the avg. annual precipitation is 1253 mm. The zonal vegetation consists of south boreal dark coniferous and northern temperate broad-leaved or *mixed* forests. The field research was conducted in July-August of 2019 and 2020.

Satellite data: five cloud-free Sentinel-2 20m resolution images (September 2019, October 2020, May, June, and July 2021); calculated spectral indices NDVI, NDWI, and BSI (barren soil index). We used the Random forest algorithm (scikit-learn, Python) with a recursive feature elimination procedure. The algorithm was trained on more than 2,500 pixels, 25% of them went to test.

We recognized 11 main vegetation units. The vegetation unit #1 is forests dominated by birches (*Betula ermanii*, *B. platyphylla*), alders (*Alnus japonica*, *A. hirsuta*), and willows (*Salix cardiophylla*, *S. schwerinii*, *S. udensis*) which covers 32% of the whole island area. #2 dark coniferous (*Abies sachalinensis*, *Picea jezoensis*, *P. glehnii*) forests – 29%. #3 sparse *Picea glehnii* boggy forests – 0.5%. #4 broad-leaved temperate (*Kalopanax septemlobus*, *Magnolia hypoleuca*, *Phellodendron sachalinense*, *Quercus dentata*, *Q. crispula*, *Ulmus japonica*, *U. laciniata*) forests – 1.5%. #5 mixed dark coniferous-birch and dark coniferous-broad-leaved forests – 9%. #6 oak (*Quercus crispula*) coppice forests – 2.5%. #7 Siberian dwarf pine (*Pinus pumila*) thickets – 3.5%. #8 windthrows and dead forest patches influenced by the bark beetles – 2%. #9 dwarf bamboo (*Sasa* spp.) thickets – 12.5%. #10 wetlands – 1.5%. #11 other non-forest vegetation (agriculture fields, meadows, sand, rocky, tephra deposits, and ruderal plant communities) – 6%.

Vegetation mapping prospects: the future version of the map would contain more detailed separated units of riparian alder-willow forests and stands dominated by birches; separate vegetation units of mixed dark coniferous-broad-leaved and dark coniferous-birch forests.

Acknowledgments: research supported by the “Mobility 2020“ project (No. CZ.02.2.69/0.0/0.0/18_053/0017850); fieldwork and mapping process were provided with the participation of D. Kislov, T. Petrenko, V. Dzizyurova, A. Vozmishcheva, P. Krestov (Botanical Garden-Institute, Vladivostok, Russia).

30th Conference of the European Vegetation Survey: Plant communities in changing environment. May 9–13, 2022, Slovakia. Plant Science and Biodiversity Center SAS, Bratislava, Hrivnák R. & Slezák M. (eds)

How field knowledge can improve remote-sensing vegetation mapping? Feedback on three Natura 2000 sites in southern France

Laure Sirvent[1], Clara Gritti[1], Olivier Argagnon[2]

[1]Conservatoire botanique national méditerranéen de Porquerolles (CBNMed) & Centre d'Ecologie Fonctionelle et Evolutive (CEFE-CNRS), Montpellier, France, l.sirvent@cbnmed.fr
[2]Conservatoire botanique national méditerranéen de Porquerolles (CBNMed)

Key words: Coastal vegetation, France, Mapping Natura 2000, Mediterranean, Pleiades imagery, Remote sensing

Natura 2000 sites are partly designated to ensure the long-term survival of Europe's most valuable and threatened habitats, listed under the Habitats Directive (Council Directive 92/43/EEC). Recent and accurate Habitats Directive mapping is a key tool to properly manage Natura 2000 sites. In order to update Habitats Directive mapping of three coastal Natura 2000 sites, a remote-sensing mapping method has been applied in in southern France between 2019 and 2021. These projects involved three partners with complementary skills: i-Sea company, specialized in remote-sensing; Conservatoire botanique national méditerranéen de Porquerolles, specialized in vegetation science and each Natura 2000 site manager. This mapping method is based on: a local, precise and most comprehensive vegetation typology; a time series of very high resolution Pleiades imagery and a robust georeferenced training dataset recently collected on the field, to run remote-sensing classification.

The analysis of mapping iterations of each site has revealed two facts: modelling at pixel scale is source of noises at site scale and false positive predictions remain even after improving the training dataset. Field knowledge has been integrated through some correction solutions to reduce both pixel noises and false-positive predictions: (1) Prediction minimum surfaces, for each type of vegetation (e.g. 250 m² minimum for forest polygons); (2) Cover layer to hide urbanized zones and roads; (3) Zonations within the site, with a restricted typology adapted to ecological conditions (e.g. dunar zonation where a resricted list of vegetation can be encountered); (4) Decisions rules to automatically change polygons vegetation assignment; (5) Usual cartography polygons integration for rare or surface restricted vegetations which can not be predicted by the model; and (6) Manual corrections. In addition, the relevance of mapping several sites at the same time to lower cost is also addressed.

This type of multidisciplinary project requires not only a strong vegetation and modelisation knowledge but also a well-planned schedule, a strong communication and teamwork to deliver a representative map of the field and above all a relevant one for site management.

Acknowledgements: These studies were supported by the DREAL Occitanie.

Compared GHC based habitat mapping with satellite data in Ipoly-Valley

Ildikó Turcsányi-Járdi, Eszter S.-Falusi, Károly Penksza

Magyar Agrár- és Élettudományi Egyetem Növénytermesztés Tudományok Intézete, Növénytan Tanszék, ildikojardi@gmail.com

Keywords: Climate change, Habitat maps, Vegetation indexes

Ipoly River in Hungary is slightly used by water management therefore it is prominent site in Europe that is formed variable habitats. The precipitation trend changed in the last few years.

The General Habitat Category protocol was used for the habitat mapping, furthermore based on the Sentinel-2A satellite imagines were made vegetation indexes (NDVI, GNDVI) and different water indexes (NDWI, MNDWI) in for 2 years. GHC category system was used as a control by field sampling using hand-held GPS equipment. The habitat mapping and the results of the satellite were compared and evaluation was the multivariate statistical method.

The habitat categories separated well from each other, in the grass vegetations were significant different. The anthropogenic and the *Phragmites australis* dominant vegetation showed negative NDVI value. The actual vegetation activities showed better quality with the GNDVI.

Acknowledgements: Supported by the ÚNKP-21-4 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National research, development and innovation fund.

Author index

Sponsors

The conference under the auspices of Mayor of Bratislava

Implemented with the financial support of the Ministry of Transport and Construction of the Slovak Republic

Mgr. Art. Matej Kováč

Brano Molnar

Slovak Environment Agency

Jozef Melečke

ISBN 978-80-974243-0-5
EAN 9788097424305