



# European Vegetation Survey

## 23<sup>rd</sup> International Workshop of the European Vegetation Survey

Ljubljana 8–12 May 2014

*Book of Abstracts*



## 23<sup>rd</sup> International Workshop of the European Vegetation Survey – Book of Abstracts

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We are thankful for the support from the Research Centre of the Slovenian Academy of Sciences and Arts, Anton Melik Geographical Institute; University of Nova Gorica and Slovenian Tourist Information Centre.

## Welcome

*The annual meeting of the European Vegetation Survey is one of the most important meetings in the field of vegetation science in Europe, which offers to participants the possibility to get acquainted with the development of science in this field. This year the Workshop of the European Vegetation Survey is the first time organized by the Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU).*

*The Workshop will give opportunity for participants to present and discuss their recent achievements, to review the development of the science in the last period and to trace the development of the science in the future period.*

*Nowadays, with a full-grown community of scientists, conservation practitioners and volunteers working with vegetation science, and with a growing number of scientific studies, it is increasingly important to exchange ideas and to get acquainted with the development of science in this field.*

*The Workshop is organised in ten sessions along different themes. Together there are almost 80 oral presentations and more than 100 poster contributions. In addition you can enjoy the excursions prepared under this Workshop, join the meetings of the Red List of the European Habitats, the EVA & Braun-Blanquet projects teams, the IAVS working group for the Phytosociological Nomenclature.*

*With more than 200 participants from a great variety of nations, we hope you will have opportunity to present your research achievements, discuss various topics with the colleagues, build personal contacts and enjoy the excursions.*

*We wish you a very pleasant and stimulating Workshop!*

*Chairman of the Organization Committee,*

Andraž Čarni

## ***Organising Committee***

**Andraž Čarni**, Jovan Hadži Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, SI

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**Igor Zelnik**, Department of Biology, Biotechnical Faculty, University of Ljubljana, Ljubljana, SI

## ***Scientific Committee***

**Erwin Bergmeier**, Department for Vegetation and Phytodiversity Analysis, University of Göttingen, DE

**Milan Chytrý**, Department of Botany and Zoology, Masaryk University, Brno, CZ

**Andraž Čarni**, Jovan Hadži Institute of Biology, Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, SI

**Vlado Matevski**, Macedonian Academy of Sciences and Arts, Skopje, MK

**Ladislav Mucina**, School of Plant Biology, University of Western Australia, Crawley, AU

**John Rodwell**, Ecological Consultant, Lancaster, UK

**Joop Schaminée**, Nature Conservation and Plant Ecology Group, Wageningen University, NL

**Željko Škvorc**, Faculty of Forestry, University of Zagreb, Zagreb, HR

Wolfgang Willner, Vienna Institute for Nature Conservation and Analyses, Vienna, AT

# Program

## **WEDNESDAY 7. 5. 2014**

17:00–19:00 Early registration

19:00– Welcome reception

## **THURSDAY 8. 5. 2014**

8:00–9:00 Registration

9:00–9:30 Opening ceremony

9:30–9:45 Homage

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|----------|------------------|
| Kącki Z. | W. Matuszkiewicz |
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| Čarni A. | J. M. Géhu |
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### 9:45–11:00 SESSION 1: *Alpine vegetation* (Chair Čarni)

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|--------------------------|-----------------------------|
| Pignatti E., Pignatti S. | Plant life of the Dolomites |
|--------------------------|-----------------------------|

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| Wohlgemuth T., Moser B. | Species richness and dominance dynamics in the first 10 years after stand replacing burn in a central Alpine valley |
|-------------------------|---------------------------------------------------------------------------------------------------------------------|

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|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Pedashenko H., Apostolova I., Vassilev K., Sopotlieva D., Dajic Z., Radukova T., Oldeland J. | Vegetation diversity and dynamics on the highest part of the Balkan Range (Stara planina Mt.) |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|

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|                           |                                                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------|
| Koroleva N., Kulyugina E. | To syntaxonomy of <i>Dryas octopetala</i> L.-dominated communities in the eastern part of European Arctic |
|---------------------------|-----------------------------------------------------------------------------------------------------------|

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|---------------|----------------------------------------------------------------------------------------------------------|
| Krivobokov L. | Altitudinal differentiation of plant cover on the Barguzinskij Mountain Range (South of Eastern Siberia) |
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### 11:00–11:30 Coffee break

### 11:30–13:00 SESSION 2: *Methods and databases I* (Chair Schaminée)

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|------------------------|-----------------------------------------------------|
| Chytrý M., EVA Members | European Vegetation Archive: now EVA really starts! |
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|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Jiménez-Alfaro B., Chytrý M., Hennekens S., Knollová I., Schaminée J., the Braun-Blanquet project consortium | The Braun-Blanquet project: evaluating and characterizing European vegetation alliances |
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|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ewald J.                | Bimodal spectra of indicator plants for soil reaction in woody vegetation of the Calcareous Alps                                                                                   |
| Jansen F., Berg C.      | Does the drift of associated species compromise the characterization of supra-regional vegetation classifications – the example of <i>Sphagnum</i> rich habitats in Central Europe |
| Kamiński D., Piernik A. | At the ends of the ranges – syntaxonomy and phytogeographical differentiation of dry grasslands in Poland                                                                          |
| Kuzemko A.              | Geographical context of sociological species groups                                                                                                                                |

**13:00–14:00 Lunch**

**14:00–15:30 POSTER SESSION 1 (*Flora, Alpine, Forests*)**

**15:30–16:30 SESSION 3: *Methods and databases II* (Chair Schaminée)**

|                                                |                                                                                                               |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Hennekens S.                                   | Turboveg v.3 – A gateway to EVA                                                                               |
| Tichý L., Landucci F., Chytrý M.               | A formal language for expert systems for vegetation classification                                            |
| Landucci F., Tichý L., Šumberová K., Chytrý M. | Towards a consistent formalized classification of species-poor vegetation: a case study of aquatic vegetation |

**16:30–17:00 Coffee break**

**17:00–19:00 SESSION 4: *Methods and databases III* (Chair Chytrý)**

|                                                                                                                                   |                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Májeková M., Janeček Š., Mudrák O., de Bello F., Horník J., Bartoš M., Fajmon K., Janečková P., Jiráská Š., Lepš J., Klimešová J. | Plant functional traits as the predictors of species response to environmental changes on a productivity and soil moisture gradient |
| Monteiro-Henriques T., Bellu A.                                                                                                   | An optimization approach to the production of differentiated tables based on new differentiability measures                         |
| Jelaska S. D., Babić I., Škvorc Ž., Nikolić T.                                                                                    | 40 years of Ellenberg's indicator values – do we need another 40 to complete values for Croatian flora?                             |
| Tzonev R., Dimitrov M., Roussakova V.                                                                                             | The vegetation of Bulgaria – level of knowledge of the main types                                                                   |
| Kavgacı A., Yalçın E., Arslan M., Çoban S., Erdoğan N., Köse M., Öner H. H., Terzioğlu S.                                         | Towards a National Forest Vegetation Database of Turkey                                                                             |

|                                                            |                                                                                                                                                          |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">Çoban S.</a>                                   | Plant communities of Ayıkaya Region in Bolu/Turkey                                                                                                       |
| <a href="#">Capelo J.</a> , Espírito-Santo D., Costa J. C. | The Syntaxonomical Checklist of Portugal's vascular plant communities (continent and islands): 20 years of joint efforts by Portuguese phytosociologists |
| Čarni A., Kaligarič M., Škornik S., Zelnik I.              | Excursion briefing                                                                                                                                       |

**19:30–20:30** Zemljepisni muzej ZRC SAZU (optional)

Meeting of the EVA and Braun-Blanquet project teams

## **FRIDAY 9. 5. 2014**

**8:00–19:00** Mid-Workshop excursions

## **SATURDAY 10. 5. 2014**

**8:30–10:30** SESSION 5: *Patterns within forests in general* (Chair Willner)

|                                                                                                                                                                                     |                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">Rodwell J. S.</a> , Chytrý M., Evans D., Hennekens S., Schaminée J. H. J.                                                                                               | Integration of European forest classifications: the importance for vegetation science and environmental policy                                                                                   |
| <a href="#">Schaminée J. H. J.</a> , Chytrý M., Hennekens S. M., Jiménez-Alfaro B., Mucina L., Rodwell J. S.                                                                        | Review of EUNIS forest habitat classification – the importance of vegetation plot data                                                                                                           |
| <a href="#">Attorre F.</a> , Agrillo E., Alessi N., Cambria V. E., De Sanctis M., Fanelli G., Francesconi F., Guarino R., Marcenò C., Massimi M., Scarnati L., Spada F., Valenti R. | Classifying plant communities and mapping their potential distribution using very large, heterogeneous, georeferenced datasets: the case study of the forest vegetation in the Italian Peninsula |
| <a href="#">Chiarucci A.</a> , Giorgini D., Campetella G., Chelli S., Canullo R.                                                                                                    | The diversity of Italian forests: an interactive product of biogeography and ecology                                                                                                             |
| <a href="#">Somodi I.</a> , Czúcz B., Molnár Z., Zimmermann N.                                                                                                                      | Multiple Potential Natural Vegetation (PNV) assessment – an introduction through the modelling of the PNV of Hungary                                                                             |
| <a href="#">Ortmann-Ajkai A.</a> , Csicssek G., Lukács M., Horváth F.                                                                                                               | Drivers of spontaneous dynamics in a floodplain <i>Quercus robur</i> forest in the Pannonian ecoregion: field data support the Vera hypothesis                                                   |

|                      |                                                                                     |
|----------------------|-------------------------------------------------------------------------------------|
| Roleček J.           | Biogeography of Central European oak forests: stories for the appreciative audience |
| Berg C., Drescher A. | Why does ruderal woodland increase in Austria?                                      |

**10:30–11:00 Coffee break**

**11:00–13:00 SESSION 6: *Patterns within thermophilous and other forests* (Chair Bergmeier)**

|                                                                       |                                                                                                                                                                                        |
|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Di Pietro R., Fortini P.                                              | The intricate taxonomical vicissitudes of <i>Quercus dalechampii</i> and their consequences in the Vegetation Science field                                                            |
| Stupar V., Čarni A., Škvorc Ž., Brujić J.                             | Phytocoenological characteristics of the forests from the class <i>Quercetea pubescentis</i> in the continental Western Balkans (Bosnia and Hercegovina, Croatia, Slovenia and Serbia) |
| Šapić I., Baričević D., Alegro A., Vukelić J.                         | Silver lime ( <i>Tilia tomentosa</i> Moench) in forest vegetation of Zrinska Gora                                                                                                      |
| Demina O. N., Ogureeva G. N.                                          | The preservation of the relic xerophytic sub-mediterranean communities in the southern Russia                                                                                          |
| Baričević D., Bakšić D., Vukelić J., Perković I., Pernar N., Šapić I. | Vegetational-pedological relationships on Mount Medvednica (Croatia)                                                                                                                   |
| Neshatayev V., Golubev S.                                             | Biogeographical patterns of boreal forests of European Russia                                                                                                                          |
| Ulanova N.                                                            | Vegetation after bark beetle outbreak in Eastern European mixed spruce forests                                                                                                         |
| Mirin D.                                                              | Geographical differentiation of streamside forests in the North-West of Russia                                                                                                         |

**13:00–14:00 Lunch**

**14:00–15:30 POSTER SESSION 2 (*Grasslands, Aquatic and wetlands, Other*)**

**15:30–16:45 SESSION 7: *Patterns within beech forest* (Chair Rodwell)**

|                                                                                                                                                                                   |                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Willner W., Jiménez-Alfaro B., Agrillo E., Brisse H., Brunet J., Csiky J., Jandt U., Jansen F., Kącki Z., Rodwell J., Schaminée J., Šibík J., Škvorc Ž., Tsiripidis I., Chytrý M. | Classification of European beech forests: a Gordian Knot?                         |
| Hornstein D., Ewald J.                                                                                                                                                            | Characteristics of beech forests communities at their warm dry distribution limit |

|                                                                                                     |                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">Agrillo E.</a> , Alessi N., Angelini P., Attorre F., Casella L., Massimi M., Spada F.   | A tentative formalized classification of the Italian beech forests: an ecologically parameterized overview                        |
| <a href="#">Salamon-Albert É.</a> , Pauler G., Ortmann-Ajkai A., Lőrincz P., Borhidi A., Horváth F. | Functional differentiation and distribution of <i>Aremonio-Fagion</i> beech forests in a colline region of Central-Eastern Europe |
| <a href="#">Brujić J.</a> , Milanović Đ., Stupar V., Vojniković S.                                  | Vegetation characteristics of fir-beech communities in virgin forests on Dinarides                                                |

**16:45–17:15 Coffee break**

**17:15–18:00 Business meeting of EVS**

**18:00–19:00 Meeting of the IAVS working group for phytosociological nomenclature**

**20:00 Social dinner**

## **SUNDAY 11. 5. 2014**

**8:30–10:30 SESSION 8: *Grasslands I* (Chair Matevski)**

|                                                                                                                                                                                                                                                                    |                                                                                                                                          |
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| <a href="#">Dengler J.</a> , Chytrý M., Hennekens S., Jimenéz-Alfaro B., Apostolova I., Janišová M., Jansen F., Jentsch A., Knollová I., Kreyling J., Kuzemko A., Landucci F., Rusina S., Schaminée J., Vassilev K., Willner W., EVA Consortium, SIGNAL Consortium | Grasslands of Europe: an overview of available data in EVA and first approaches to analyse their diversity patterns at continental scale |
| <a href="#">Safronova I. N.</a>                                                                                                                                                                                                                                    | Some peculiar features of the desert steppes of European Russia                                                                          |
| <a href="#">Van Rooijen N. M.</a> , Keersmaecker W. de, Hennekens S. M., Ozinga W., Schaminée J. H. J., Honnay O.                                                                                                                                                  | Stability of ecosystem functioning in Dutch calcareous dune grasslands                                                                   |
| <a href="#">Rūsiņa S.</a> , Lakovskis P., Namatēva A., Rove I.                                                                                                                                                                                                     | The fate of semi-natural grasslands in Latvia in the era of rural development programme                                                  |
| <a href="#">Vojta J.</a> , Kubát M., Brůna J., Kovář P., Volařík D.                                                                                                                                                                                                | Shrubs in grasslands; unwanted invaders or biodiversity enhancers?                                                                       |
| <a href="#">Lengyel A.</a> , Bauer N., Chytrý M., Illyés E., Jandt U., Janišová M., Kącki Z., Krstonošić D., Purger D., Šilc U., Škodová I., Stančić Z., Willner W., Botta-Dukát Z.                                                                                | Spatial variation of the matching between regional and local classifications: an example of Central European grasslands                  |

|                                                                                                                                                                                                                                                                                            |                                                                                                                                                                              |
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| <a href="#">Turtureanu P. D.</a> , Palpurina S., Becker T., Dolnik C., Ruprecht E., Sutcliffe L. M. E., Szabó A., Dengler J.                                                                                                                                                               | Scale-dependent patterns of plant diversity in Transylvanian dry grasslands (Romania)                                                                                        |
| <a href="#">Janišová M.</a> , Bauer N., Botta-Dukát Z., Čarni A., Chytrý M., Coldea G., Csiky J., Dúbravková D., Fenesi A., Igic R., Kącki Z., Kish R., Korzeniak J., Krstivojevic M., Krstonošić D., Bitá-Nicolae C., Rédei T., Ruprecht E., Stančić Z., Škodová I., Tichý L., Willner W. | Rocky grassland vegetation ( <i>Stipo-Festucetalia</i> ) of the Pannonian Basin and the Carpathian Mts – biogeographical patterns revealed by semi-supervised classification |

### **10:30–11:00 Coffee break**

### **11.00–13.00 SESSION 9: *Grasslands II* (Chair Janišová)**

|                                                                                                                      |                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">Alegro A.</a> , Šegota V., Kabaš E., Lakušić D.                                                          | <i>Patzkea paniculata</i> grasslands from Velebit Mt (Croatia) in the Balkan-Alpine-Appennine context                                                              |
| <a href="#">Millaku F.</a> , Krasniqi E., Gashi B., Berisha N., Osmani M., Rexhepi F.                                | Some Balkan endemics in Kosovo's grasslands and their conservation status                                                                                          |
| <a href="#">Palpurina S.</a> , Chytrý M., Tzonev R., Axmanová I., Danihelka J., Merunková K., Duchoň M., Karakiev T. | Fine-scale species-richness patterns in dry grasslands across the Eastern Balkan Peninsula                                                                         |
| <a href="#">Pipenbaher N.</a> , Kaligarič M., Mason N. W. H., Škornik S.                                             | Ecologically similar meadows are not equally threatened: relationship between plant traits and rarity                                                              |
| <a href="#">Ambarlı D.</a> , Vural M., Adıgüzel N.                                                                   | How to group new releves? Halophytic plant communities of Central Anatolia revisited                                                                               |
| <a href="#">Slaviero A.</a> , Fantinato E., Del Vecchio S., Acosta A., Buffa G.                                      | Dry-meadow orchid richness and fitness: does flowering synchrony matter?                                                                                           |
| <a href="#">Arzac A.</a> , García-Cervigón A. I., Vicente-Serrano S. M., Loidi J., Olano J. M.                       | Exploring the double stress in Mediterranean mountain. Response of secondary growth and parenchyma amount on <i>Juniperus sabina</i> along an altitudinal gradient |
| <a href="#">Hájek M.</a> , Hájková P., Apostolova I., Mikulášková E., Plesková Z., Peterka T., Hájek T.              | Why vegetation of Balkan rich <i>Sphagnum-fens</i> differ from that of more northerly regions?                                                                     |

### **13:00–14:00 Lunch**

**14:00–16:00 SESSION 10: *Vegetation dynamics and conservation***  
**(Chair Kaligarič)**

|                                                                                                                |                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">Neshataeva V.</a> , Korablev A.,<br>Pesterov A.                                                    | Vegetation dynamics and plant cover structure on the volcanogenic substrata (in the Kamchatka Peninsula, Russian Far East)                      |
| <a href="#">Gashi B.</a> , Millaku F., Krasniqi E.,<br>Osmani M., Kongjika E.                                  | Phytodiversity and ecology of different populations of genus <i>Ramonda</i> in Kosovo                                                           |
| <a href="#">Škunca M.</a> , Đanić A., Peternel H.,<br>Mazija M., Kovač D., Patčev E.,<br>Kapelj S., Antonić O. | Different approaches to vegetation mapping during wind power plants impact assessment                                                           |
| <a href="#">Haveman R.</a> , de Ronde I.,<br>Bijlsma R.-J., Schaminée J. H. J.                                 | Phytogeographical and phytosociological patterns in <i>Rubus</i> L. subgenus <i>Rubus</i> in Northwest-Europe                                   |
| <a href="#">Lenker K. H.</a>                                                                                   | Mesoxeric perennial ruderal vegetation of the Rhine-Main-Area (Western Germany) and its contribution to an Eurasian View of Nature Conservation |
| <a href="#">Raman M.</a> , De Bie E.,<br>Wouters J., Hens M.                                                   | Quality assessment of Natura 2000 habitats – Approach in Flanders (northern Belgium)                                                            |
| <a href="#">Li C.-F.</a> , Zelený D.                                                                           | A supervised classification method – Cocktail Determination Key and CoDeK                                                                       |
| <a href="#">Zelený D.</a>                                                                                      | Use of mean Ellenberg indicator values revisited (again)                                                                                        |

**16:00–16:15 Closing ceremony**

**MONDAY 12. 5. 2014**

**8:00–19:00 Post-workshop excursion**

# Poster presentations

## THURSDAY 8. 5. 2014

### FLORA

Borsukevych L., Danylyuk K.

**Coenology and ecology of *Glyceria declinata* Bréb. – new species in flora of Ukraine**

Medvecká J., Jarolímek I., Zaliberová M., Májeková J., Senko D.

**Distribution of alien plants in the Tatra Mts and main factors affecting it**

Tóth Z., Nagy J. G., Fogarasi G., Endrédi A., Kissné Uzonyi A.

**Flora survey in Jászság micro region, Hungary**

Vuković N., Jelaska S. D.

**Variability of the CSR functional types among Croatian populations of the invasive *Erigeron annuus* (L.) Pers.**

Giovanetti M., Vuković N., Jelaska S. D.

**New data on alien *Acacia* species in Croatia**

Berisha N., Millaku F., Gashi B.

**Some rare and endangered geophytes in the serpentine of Kosovo**

Osmani M., Millaku F., Gashi B., Berisha N.

**Plant species of the genus *Paeonia* in Kosovo and their conservation status**

### ALPINE

Šibík J., Cooper D. J.

**The effects of domestic livestock grazing on alpine tundra vegetation in the western U. S.**

Zibzeev E.

**Alpine vegetation of the Western Sayan**

Kabaš E., Kuzmanović N., Vukojičić S., Lakušić D.

**Nomenclature and syntaxonomic notes on the alpine and subalpine calcareous grasslands from the class *Elyno-Seslerietea* BR.-BL. in Serbia**

Čušterevska R., Matevski V., Kostadinovski M., Čarni A.

**Phytosociological researches on the high-mountain grasslands of Galičica Mt. (Macedonian part)**

Vassilev K., Aneva I., Dimitrov D.

**Habitat diversity of the Bulgarian part of Vlahina Mt.**

Taffetani F., Avanzolini P., Zitti S.

**The environmental impact of ski tows in the Apennines (Central Italy)**

**FORESTS**

Çoban S., Akgül M.

**Change of main tree species composition change in Belgrade Forest, Istanbul: Its past and present status**

Agriolo E., Jiménez-Alfaro B., Alessi N., Argagnon O., Attorre F., Crespo J. G., Espírito-Santo D., Gonzalez F. F., Massimi M., Monteiro-Henriques T., Neto S. C.

**Floristic composition, ecology and distribution of *Quercus suber* L. forests**

Ottaviani C., Tesei G., Iorio G., Allegrezza M.

**On the *Pinus nigra* subsp. *nigra* reforestation in the central Apennines**

Čaković D., Stešević D., Martin M.

**Italian oak (*Quercus frainetto* Webb) forests in Montenegro**

Trenyik P., Borcsa-Bodolay J., Schellenberger J., Molnár M., Barczy A., Czöbel S.

**Comparative study of different-aged sessile oak stands in the Börzsöny Mountains, Hungary**

Zitti S., Biondi E., Taffetani F., Casavecchia S., Pesaresi S.

**The vegetation with *Taxus baccata* L. in an area of central Apennines, Adriatic coast**

Kutnar L., Eler K.

**Plant invaders and species diversity in (peri-)urban forests of Ljubljana, Slovenia**

Didukh Y.

**The patterns of altitudinal and regional vegetation distribution in the Crimean Mountains**

Tikhonova E., Zaugolnova L.

**Broad-leaved-spruce forest in European Russia: distribution, syntaxonomy and ecology**

Kadetov N.

**Diversity of fir-spruce and lime-fir-spruce forests of Priuralie (eastern part of European Russia)**

Mandžukovski D., Čušterevska R., Teofilovski A., Acevski J.

**Comparison of ecological and vegetation characteristics between *Pinus peuce* Grisb. forest communities**

Douda J., Nociar J., Boublík K., Drašnarová A., Biurrún I., Brisse H., Brunet J., Claessens H., Csiky J., Dullinger S., Fitzpatrick Ú., Gégout J.-C., Guisan A., Hennekens S., Horchler P. J., Hrivnák R., Chytrý M., Jandt U., Jansen F., Kącki Z., Landucci F., Lecomte H., Lenoir J., Michiels H. G., Paal J., Paternoster D., Pauli H., Rodwell J., Roelandt B., Svenning J.-C., Slezák M., Šibík J., Tzonev R. T., Vittoz P., Willner W., Wohlgemuth T., Zimmermann N. E.

**Formalized classification of floodplain forests, willow scrubs and alder carrs in Europe**

Kukurichkin G., Babyuk S.

**The distribution and dynamics of floodplain forests in West Siberia taiga zone**

**Pielech R.**, Anioł-Kwiatkowska J., Szczęśniak E.

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**Salamon-Albert É.**, Pauler G., Lőrincz P., Borhidi A., Horváth F.

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**Syntaxomical revision of coastal halophilic vegetation in Croatia**

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**Biogeographical peculiarities of communities of the *Thero-Salicornietea* class in Ukraine**

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**Classification and ecology of dry grasslands in Serbia**

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**Biogeographical processes of species-rich Mediterranean grasslands (*Scorzonero-Crypsopogonetalia*): case study of Čićarija (Croatia)**

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### Is the IBMR macrophytic index a reliable tool for water quality monitoring?

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**How many ordination axes should be interpreted?**

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**Kącki Z.**, Swacha G., Czarniecka M.

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**Habitat diversity within the agricultural landscapes of three neighbouring countries– a legacy of three political systems?**

**Wierzcholska S.**, Pielech R., Żarnowiec J.

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**Endresz G.**, Somodi I., Kalapos T.

**Invasive grasses reduce arbuscular mycorrhizal colonization of roots of resident species**

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**Škunca L.**, Đanić A., Peternel H., Antonić O.

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**Red List of European Habitats Project**



# Oral presentation – Abstracts

## Plant life of the Dolomites

Pignatti E.<sup>1</sup>, Pignatti S.<sup>2</sup>

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The Dolomites, in the Italian South-Eastern Alps, form a mountain system extending from the Piave Valley (Belluno province) to the Adige Valley (Trento province) and as far as the Puster Valley (South Tyrol), with a surface more than 6000 sq km.

In this territory three different languages are spoken: in the southern part Italian with dialects of the Venetian-Trento group, in the northern part German, while in some internal valleys (Livinallongo, Badia Valley) the Rhaetoromanic has been maintained. Therefore also the names of mountains sometimes are in Italian (Vette di Feltre, Civetta, Pale di S. Martino, Cristallo) or in German (Rosengarten, Plose, Duerrenstein), but more often the Rhaetoromanic root (Antelao, Antermoia, Marmarole, Nuvolau, Sorapis, Tofane, Vajolet and many more) remains.

The authors (Erika born in Austria and Sandro in Venice) know the Dolomites already since their childhood and later have returned as scientific experts. Their first visit in common is dated August 1, 1960. From that date onward they continued their studies in these mountains quite without interruption for about 50 years. The results of their research are exposed for the first time in the book 'Plant Life of the Dolomites', in English (about 800 pages with more than 500 figures), published by Springer at the beginning of 2014. Financial support for translation and publishing expenses has been provided by the Naturmuseum in Bolzano; the authors renounced all royalties for the sales of this book.

The Dolomites are calcareous mountains mainly consisting of sediments which originated during the Triassic Period from reefs, atolls and neighbouring basins that formed in a tropical sea over 200 million years ago and a coeval volcanic centre located in the area of Predazzo. Later (Miocene) those rocks were uplifted, forming a mountain chain, erosion shaped the spectacular peaks and vertical walls. During the last two million years they were covered by the ice sheets until their final retreat, about 20,000 years ago. With these characteristics the Dolomites form a unique mountain system in the world, well studied in regard to geology, but its flora and vegetation as a whole has been insufficiently known up to now.

\* \* \*

The study has been developed at three levels:

- *Flora*: about 2300 plant species have been identified, nearly 1/3 of the Flora of Italy.
- *Vegetation*: about 120 types of vegetation communities are described (stable

meadows, alpine pastures, shrubby vegetation, woodlands) – over 2000 plots of about 100 m<sup>2</sup> distributed over the whole surface, from the valley bottom to the mountain peaks, with a survey of all species present (from 10 to about 60, 84 to 100 m<sup>2</sup> at maximum).

- *Landscape*: more than 400 relevés of 1–5 hectares permit to individuate 30 different landscape units.

On the basis of this extensive test a strictly ecological indepth study has been performed, that is to say how such a rich plant life could be possible in a rather inhospitable environment like the compact rock, arid during summer and with glacial climate in winter.

### **A few examples:**

The “wake-up of a boulder” is described, how the first morning sunrays initiate the physiologic processes of the plants, well distinct adaptations, case by case, in order to warm up the leaf surface. The Edelweiss (*Leontopodium alpinum*) and its dense white hairiness, like a pullover: to protect from cold?

- The particular condition of alpine pastures with intense plant life, thanks to a heat island which develops at 2000–2400 m on calcareous slopes with southern exposition.
- The individualism of high mountain species, each one with its proper ecological adaptations.
- The postglacial repopulation which has permitted the flora to advance hundreds of kms northward.
- The “behaviour” of plant species to adapt adverse environment.

These and many other hints lead to an overtaking the interpretation based on classical physics (plant distribution regulated by temperature, warm environment at ground level and cold in upper belts) and lead to the interpretation that vegetation can be considered as a complex self-organising system and to an unedited definition of biodiversity. A new argument to consider the Dolomites as Heritage of the whole Humanity.

**Species richness and dominance dynamics in the first 10 years after stand replacing burn in a central Alpine valley****Wohlgemuth T., Moser B.**

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Frequency of forest fires in Central Alpine valleys is low if compared to regions south of the Alps and in the Mediterranean. Therefore, little is known on the succession patterns regarding species richness and dominance dynamics after stand-replacing fires. In this regard a 300 ha burn set by arson during the European heat wave 2003 in the Valais valley, central Alps served as case study for a fine-scale and 10 years lasting monitoring of re-vegetation. The burn destroyed a forest stripe along an elevation gradient ranging from the oak-pine belt at 850 m to the larch belt at the timberline at 2100 m a.s.l. (600–1100 mm precipitation sum). In this patch, 150 sample plots of 200 m<sup>2</sup> size each were permanently installed using a systematic grid with mesh size of 125 m. Vegetation was assessed in all plots annually from 2004 to 2007, and again in 2013. Expectedly, species richness increased during the first three years and exceeded richness of former forest vegetation already after two years. On shallow site conditions with incomplete vegetation cover, species richness has continued to increase even 10 years after the burn, and in average, species richness is on peak for 7 years. Nevertheless, early successional dominant forb species have been outcompeted by grasses that now increasingly prevail almost along the whole elevation gradient. Tree regeneration is more abundant towards higher elevations and consists to 90% of pioneer species.

## **Vegetation diversity and dynamics on the highest part of the Balkan Range (Stara planina Mt.)**

**Pedashenko H., Apostolova I., Vassilev K., Sopotlieva D., Dajic Z., Radukova T., Oldeland J.**

Stara Planina Mt. crosses Balkan Peninsula through Bulgaria and Serbia and plays significant role for climatic divergence of the areas on both its sides. As an old orographic system it is rich in habitats and is a centre of endemism. Since ancient historical times the mountain has been influenced by human activities so that over the last centuries upland grasslands were constantly used as pastures. As a result vast areas become covered by *Nardus stricta* communities. Common trend for the studied grasslands over the last decades is the continuous amendments of the territories occupied by *Juniperus communis* ssp. *alpina* due to the variations in management regimes after socio-economic changes during the 50s and 90s. This provides favourable conditions for recent expansion of the area covered by the alpine juniper which has high potential for quick spreading over the high mountain pastures. There is data that the species root system could grow with up to 20 cm per year.

The present study aims to reveal the syntaxonomical diversity and peculiarities of the vegetation developed on the mountain treeless zone and its succession. More than 600 relevés were analysed by numerical methods. The high mountain vegetation belongs to five classes (*Juncetea trifidi*, *Vaccinio-Picetea*, *Loiseleurio-Vaccinietea*, *Scheuchzerio-Caricetea nigrae*, *Mulgedio-Aconitetea*) which were further classified up to association level. Although the studied vegetation has many common elements with those from the European high mountains, the presence of numerous Balkan endemics retains some specificity for the region.

We also established successional processes related to *Juniperus* communities on a pilot area that demonstrate the changes of its presence during a period of 65 years. Four aero-photo images from different moments in the past (1947, 1969, 1989, 2012) were used for detecting vegetation changes.

## To syntaxonomy of *Dryas octopetala* L. -dominated communities in the eastern part of European Arctic

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The arctic-northern alpine circumpolar class *Carici rupestris-Kobresietea* Ohba 1974 was reported to comprise mainly cryo- and xerophytic communities on calcareous-basic soil with dominance of dwarf shrubs and low grasses and sedges. This conception of class was changed mainly on the account to alliance *Dryadion integrifoliae* Ohba ex Daniëls 1982, which comprises also communities in moist-wet substrata with high portion of hygrophytic-mesophytic grasses and mosses (Thannheiser, 1990; Lünterbusch, Daniëls, 2004). Alliance *Caricion nardinae* Nordh. 1935 comprises both xerophytic heath and mesophytic meadow-like communities in mountains and seashore terrains of northern Fennoscandia. Basing on 64 relevés of *Dryas octopetala*-dominated plant communities from eastern part of European Arctic (Malozemel'skaja Tundra, Bol'shezemel'skaja Tundra and Jugorskyi Peninsula, bioclimatic zones B and C, Circumpolar Arctic Vegetation Map) we propose alliance *Carici arctisibiricae-Dryadion octopetalae* Koroleva et Kulyugina ex Koroleva in Mucina et al. 2014, with diagnostic taxa *Dryas octopetala* (dominant), *Carex arctisibirica* (dominant), *Salix reticulata*, *Pedicularis oederi*, *Astragalus subpolaris* *Thalictrum alpinum*, *Saxifraga hieracifolia*, *S. hirculus*, *Eritrichium villosum*. Characteristic feature of communities of alliance is high coverage and constancy of dwarf shrubs (*Dryas octopetala*, *Salix reticulata*, *S. nummularia*), mesophytic low herbs and sedges (*Carex arctisibirica*, *Oxytropis sordida*, *Astragalus subpolaris*, *Pedicularis oederi*, *Petasites frigidus*, *Valeriana capitata*, *Myosotis asiatica*), and high abundance of mosses (*Aulacomnium turgidum*, *A. palustre*, *Tomenthypnum nitens*, *Hylocomium splendens*) and lichens (*Flavocetraria nivalis*, *F. cucullata*, *Ochrolechia frigida*, *Cladonia* spp.). Alliance includes three syntaxa of lower rank: ass. *Dryado octopetalae-Caricetum arctisibiricae* ass. nov. prov., acc. *Pediculari oederi-Dryadetum octopetalae* ass. nov. prov. and community type *Dryas octopetala* – *Salix reticulata*. Plant communities of alliance *Carici arctisibiricae-Dryadion octopetalae* are from small to medium size, and occupy clayey, sandy and gravelly well drained, warm and moderately snow protected habitats, sometimes with frost boiling patches, on hilltops and south- and west-exposed slopes of hills ('musyures') and low mountains. These plant communities are rather rare in the western part of this area (in the Malozemel'skaja Tundra) and get more widely distributed to the east of area (Pay-Khoy Mountains). These plant communities have high alpha-diversity and can be regarded as value natural habitat types.

Investigations were supported by funds from the projects 12-4-7-006-Arctica “Complex assessment of natural ecosystems of East-European Arctic sector for developing areas of high environmental value” and project RFBR 14-04-98810 r\_sever\_a “Composition and spatial structure of phytodiversity in mountain ecosystems of Euro-Arctic region”.

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## Altitudinal differentiation of plant cover on the Barguzinskij Mountain range (South of Eastern Siberia)

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Investigation of spatial organization of plant cover has a key meaning for detection of diversity and ecological features of functioning of plant communities and their territorial complexes. The aim of our study was to detect diversity of plant communities and their altitudinal differentiation on the western macroslope of Barguzinskij range in Eastern Siberia (based on the model transect in the Davshe river basin) using Braun-Blanquet approach and DCA-ordination. The study was performed in the Barguzinskij biosphere reserve territory, oldest reserve of Russia. It was founded in 1916.

Barrier location of the range relative to Atlantic air-mass transport in addition to hydrothermal influence (decrease of radiation balance) of Lake Baikal large water volume are basic macro ecological factors of vegetation's altitudinal belt spectrum. The belt of middle boreal waterlogged larch and larch-Siberian pine *Ledo palustris-Laricetalia gmelinii* (*Vaccinio-Piceetea*) forests in complex with open sedge-hypnum and sphagnum bogs *Sphagno warnstorffii-Tomentypneetalia* (*Scheuchzerio-Caricetea fuscae*) is basic for western macroslope of Barguzinskij range (450–500 m above sea level) due to influence of maritime cold and humid climate conditions. Hemiboreal *Carici macrourae-Pinetalia sylvestris* (*Brachypodio pinnate-Betuletea pendulae*) herbal forests on the steep southern slopes in aggregate with boreal *Lathyro humilis-Laricetalia cajanderi* (*Vaccinio-Piceetea*) moss-herbal forests on slopes of other aspects were found in the bottom part of range (500–750 m above sea level). Fir-Siberian pine *Piceetalia excelsae* (*Vaccinio-Piceetea*) forests with predominance of *Carex macroura* and *Vaccinium myrtillus* in herb-subshrub layer grow above 750 and up to 1000 m a.s.l. Sparse fir *Abieti-Piceetalia* (*Vaccinio-Piceetea*) forests of eastern Asian type form timberline at the 1300–1500 m a.s.l. Considerable participation of northeastern Asian species of trees and shrubs, such as *Rhododendron aureum*, *Pinus pumila* and *Betula ermanii*, in the floristic composition is a feature of these communities. Alpine vegetation is represented by tundra-high mountain communities of *Loiseleurio-Vaccinietea* (on the outcrops) in aggregate with alpine grass meadows *Schulzio crinitae-Aquilegietaalia glandulosae* (*Mulgedio-Aconitetea*) (on the concave landforms).

DCA-ordination indicated clear dependence of community's distribution on true altitude (axis 1). Crossing of *Trollio-Crepidetalia sibiricae* (*Mulgedio-Aconitetea*) subalpine meadows and *Abieti-Piceetalia* fir forests areas observed only at the range 1 to 3. These communities compose ecotone complex within 1000–1400 m true altitude. Axis 2 can be interpreted as complex gradient reflecting fertility of soils.

Defined altitudinal spectrum of plant communities we consider as an unique for South Siberian Mountains, which are located within ultra-continental sector of Eurasia, on the border of boreal (forest) and temperate (steppe) climatic zones, while forest-steppe altitudinal belt is a basic for vast territories of Lake Baikal region and Mongolia (Hilbig 1995; Ermakov, Dring and Rodwell 2000). This belt represent complex of Central Asian steppe communities of *Cleistogenetea squarrosae* and hemiboreal forest communities of *Rhytidio rugosi-Laricetea sibiricae*.

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## European Vegetation Archive: now EVA really starts!

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European Vegetation Archive (EVA) was announced as a new initiative of the European Vegetation Survey at the EVS Meeting in Vienna in 2012. The aim of EVA is to create a centralized database of European vegetation plots by storing copies of national and regional databases on a single software platform using a unified taxonomic reference database. EVA does not affect the ongoing independent developments of source databases and it guarantees that data property rights of the original contributors are respected. EVA Data Property and Governance Rules were approved and the EVA website ([www.euroveg.org/eva-database](http://www.euroveg.org/eva-database)) was established in 2012. Since then several European vegetation-plot databases joined EVA. In the framework of the parallel Braun-Blanquet project, we obtained experience with handling multiple databases based on different taxonomies, and a prototype of Turboveg 3 was developed as a software tool for joint management of multiple databases. This prototype has recently been accepted as the platform for technical management of EVA according to the approved Rules. A specific challenge for EVA is joining multiple species lists with different taxonomies used in national and regional databases. To solve this issue, EVA took over the SynBioSys Taxon Database, developed earlier for the SynBioSys Europe project, which is a system of taxon names and concepts used in the individual databases and their matches to a unified list of European flora. This taxon database is currently being extended to account for new vegetation-plot databases and revised by taxonomic experts working in a newly established EVA Taxonomic Advisory Board. These technical developments made it possible that after two years since its formal establishment, first data sets could be uploaded to EVA, forming a basis for large-scale analyses of European vegetation diversity for both scientific purposes and applications.

## **The Braun-Blanquet project: evaluating and characterizing European vegetation alliances**

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European tradition on vegetation classification provides an extraordinary legacy for understanding biodiversity. However, this classification lacks explicit data on vegetation attributes, especially if we extend national or regional concepts to a continental perspective. An additional effort for evaluating and characterizing European vegetation types is therefore needed, and the data contained in vegetation databases are probably the main tool for these purposes. The Braun-Blanquet project is an initiative of the European Vegetation Survey for characterizing vegetation alliances across Europe. By analyzing more than 500,000 vegetation plots from 22 European countries, we developed a framework consisting of: (1) evaluating the consistency and robustness of alliances using the information provided by vegetation plot databases, (2) calibrating assignment rules for classifying, at least partially, the plots not assigned to alliances and (3) characterizing vegetation types by providing lists of diagnostic species and major distributional patterns. The Braun-Blanquet project represents the first attempt for extrapolating European vegetation information into a comprehensive definition of vegetation types. Furthermore, the outputs of the project are expected to improve biodiversity assessment and the conservation management of natural habitats. As a study case, we illustrate how our framework can be used to characterize different forest types across Europe.

<sup>(\*)</sup> Agrillo E., Alessi N., Greve Alsos I., Apostolova I., Attorre F., Austrheim G., Bergmeier E., Biurrun I., Brisse H., Brunet J., Carlón L., Čarni A., Csiky J., Danihelka J., De Bie E., de Cáceres M., Dengler J., Didukh Y., Dimopoulos P., Ejrnaes R., Fernández González F., Fitzpatrick Ú., Font X., Golub V., Grytnes J.-A., Guarino R., Indreica A., Jandt U., Jansen F., Kącki Z., Krstonošić D., Landucci F., Lenoir J., Luoto M., Lysenko T., Martynenko V., Michalcová D., Novakovskiy A., Onyshchenko V., Rodríguez Rojo M. P., Rodwell J., Šibík J., Šilc U., Škvorc Ž., Sorokin A., Stančić Z., Suárez-Seoane S., Tichý L., Vandvik V., Venanzoni R., Virtanen R., Willner W., Yamalov S., Zobel M.

## **Bimodal spectra of indicator plants for soil reaction in woody vegetation of the Calcareous Alps**

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Plant communities are assemblages of species that respond similarly to environmental gradients. Plant stands are therefore expected to consist of species of similar physiological and ecological constitution. Certain communities may, however, combine species of opposing preferences on a certain gradient.

Frequency distributions of Ellenberg indicator values for soil reaction in mountain forests of the Calcareous Alps are often bimodal, combining acidophytes and calciphytes with few species of intermediate preference. This pattern requires an explanation that should have implications for processes, biodiversity, productivity and resilience of these ecosystems. Bimodality may be explained by microsite heterogeneity (soil mosaic within plots) or by overlapping successional stages (relics of high pH leptosols combined with species of mature histosols).

Among ca. 4000 plots in the BERGWALD vegetation database of Bavarian mountain forests, 3.7% showed bimodal distributions of reaction indicators. Correlations with nutrient and light values indicated that bimodality is typical for oligotrophic Piceion and Erico-Pinion forests and krummholz with open structure. A large group of coniferous forest, calciphytic grassland and rock-dwelling species, with numerous bryophytes among them, are positively associated with bimodality. In contrast, the majority of climax forest plants significantly avoid bimodal assemblages.

High incidence of positive indicators of bimodality supports the succession hypothesis. Bimodal communities are a characteristic feature of folic histosols on dolomite and limestone under the cold and humid climate of the front range of the Northern Alps. They represent very diverse, yet transient ecosystems that are highly susceptible to changes in climate and land-use, such as increased timber harvest for bioenergy. Their degradation would reduce carbon storage and reverse succession, leading to extremely infertile sites with strongly reduced protective functions.

## **Does the drift of associated species compromise the characterization of supra-regional vegetation classifications – the example of *Sphagnum* rich habitats in Central Europe**

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The increasing availability of vegetation plot data in Europe and around the globe is a great chance but also a challenge, producing new questions or invoking old ones. In chapter 8.6 of their famous book Mueller-Dombois and Ellenberg (1974) make some general assumptions upon vegetation (classification): (1) That similar combinations of species recur under similar habitat conditions, even in geographically quite separated locations. (2) That no two relevé analyses are exactly alike and that even stands in close proximity on seemingly equivalent habitats show certain deviations from one another. (3) That the species assemblage changes more or less continuously if one samples a geographically widespread, major community throughout its range of distribution.

Assumptions 1 & 3 open a question which has seldom been addressed and which can probably never be answered concluding, but which is elementary for all supra-regional vegetation classifications: the weighting between habitat influence and geographically induced differences in species assemblages.

We use vegetation plots containing *Sphagnum* species from Austria and North-Eastern Germany, two regions approximately 700 km apart from each other, located in the centre of Europe. *Sphagnum* species are typical elements of acidic wetland vegetation and have large, sometimes cosmopolitic distribution ranges. They are expected to be bound to clearly defined, azonal plant communities, i.e. their habitats should not substantially alter over long geographical distances. We can expect that they will build communities of stable character and recurring species association. However, the two regions are different in terms of species pool, climatic conditions, biodiversity measures and the distribution of habitats.

We seek for measurements to judge the suitability of species to characterise vegetation units across larger geographical distances and to separate the environmental influence on species composition from others like species dispersal or interspecific influences. a) We use the distance in multidimensional ordination space between regionalised species occurrences (calculated as weighted averages) to measure the sociological shift of associated species. b) We split the dataset into regions and plots with and without a specific *Sphagnum* species calculating the ratio of indicative species for that species versus region. c) We use available phytosociological classifications (alliances) of plots to calculate which observations of a species indicative for a unit in one region, lay outside the multidimensional convex hull of that unit in the other region.

All these methods suggest that the drift of associated species across regions may easily compromise our classification concepts for wider geographical areas even within azonal vegetation types, but that we can order species into those which are sociological more stable and those with great shifts in associated species.

## **At the ends of the ranges – syntaxonomy and phytogeographical differentiation of dry grasslands in Poland**

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Dry grasslands are rare habitats in humid climate and strongly anthropogenically changed landscape of Central Europe. Semi-natural dry grasslands (*Festuco-Brometea*) are included into Natura 2000 network with the code 6210. In Poland they belong to extrazonal vegetation – in some cases relic, which can develop and survive only due to human influence (deforestation, extensive haymaking and grazing). They lie in the transitional zone between temperate oceanic and continental climates, far away from Mediterranean Basin and Eurasian Steppes. Therefore they are poorer in species richness and in syntaxonomic diversity in comparison with the south-eastern and western European grasslands. Apart from semi-natural habitats on the slopes of river valleys and foothills rich in limestone, they also develop on anthropogenically disturbed habitats – e.g. former croplands converted into pastures. Syntaxonomical position of many patches is not clear. This study reviews the syntaxonomy of dry grasslands in Poland. Over 500 phytosociological relevés were collected based on the own research and literature. They were classified by hierarchical agglomerative and divisive (TWINSpan) classification methods. Indirect (CA, DCA) and partly direct (CCA) ordination were applied. Semi-natural dry grasslands in Poland are represented by four alliances: *Seslerio-Festucion duriusculae*, *Festucion valesiaceae* (*Festuco-Stipion*), *Cirsio-Brachypodium pinnati* and *Bromion erecti* (*Mesobromion erecti*). Some patches identified as *Festuco-Brometea* grasslands belong to *Agropyretalia repentis*. Abandonment of agro-pastoral activities and disturbance of soil structure related to its management in the past, are the factors most strongly interacting with the differentiation of dry grasslands in Poland.

## Geographical context of sociological species groups

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The sociological species groups (SSG) include species that are characterized by statistically confirmed tend to common occurrence in the relevés. These species usually have similar environmental requirements and probably should have common distributional properties. The aim of the study was to examine how SSG which were defined for grassland vegetation of the Forest and Forest-Steppe zones of Ukraine (Kuzemko 2012), are homogeneous in their areal types. In general the 43 SSG, which include 167 species, were analyzed. The areal types were analyzed by areal formulas of Meusel et al. (1965), taking into account the zonal and regional types that were analyzed separately, climate types were not taken into account. SSG was considered absolutely homogeneous if all the species that belong to it have the same type of areal; relatively homogeneous, if more than 50% of the species that belong to the group had the same type of the areal and heterogeneous if the all the species had a different type of areal, or if it coincided by less than 50% of the species. It was established that in the zonal types of the areal 9.3% SSG belong to absolutely homogeneous, 60.5% to a relatively homogeneous and 30.2% to heterogeneous; in regional types 16.3% of SSG are absolutely homogeneous, 74.4% are relatively homogeneous, 9.3% are heterogeneous. The largest number of absolutely homogeneous SSG for zonal types is typical for the Koelerio-Corynephoretea (25.0%) and Festuco-Brometea (22.2%) classes; number of heterogeneous SSG is the highest among groups typical for Festuco-Puccinellietea (50.0%) and Molinio-Arrhenatheretea (36.4%) classes. The majority of absolutely homogeneous SSG for regional types of areal was found within those that are diagnostic for several classes (50.0%) and also for the Festuco-Brometea class (33.3%); the largest number of heterogeneous groups (33.3%) was found among those that are diagnostic for several classes. In general, we consider differences in the types of areals, both zonal and regional within selected SSG as associated with different size of areals of the species that determines their belonging to different types of the areals, rather than geographical heterogeneity of the designated SSG.

## **Turboveg v.3 – A gateway to EVA**

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Although Turboveg v.2 is acceptable for many users, the call for a better database model has been growing over the last few years to overcome the current version's shortcomings. Since the Dutch National Vegetation Database provides information on the distribution and range of Natura 2000 habitats to report every 6 years to the EU, a 'quality status A' is nowadays required. Therefore a proper database model had to be set up. Because v.2 normally deals with multiple databases, and potentially different databases structures and different taxonomies, it was challenging to be able to deal with all these differences in a single SQL-based database (SQLite for locally stored databases).

A new Turboveg v.3 is now underway. The prototype not only is able to import Turboveg v.2 databases, but also contains basic functions to select data and to export selected plot observations to various formats for further processing with other programs. For example, plots observations can already be exported for use in JUICE, ArcGIS and MaxEnt for species distribution modelling. Moreover, editing of plot data is already built in, including sophisticated localisation by means of an integrated Google Map. Storage of metadata is also now integrated on almost every level in the database. Information on data providers (custodians), and the accessibility of data can be stored on the level of plot observation. A clear distinction between plots and plot observations is also supported in the model and the software. Versioning is also included, meaning that deleted data is never physically removed from the database, as is unfortunately the case with Turboveg v.2.

A prototype of the European Vegetation Archive (EVA) currently comprised of more than 700,000 plot observations and much different taxonomy. By integrating a crosswalk between the many different taxonomies (already more than 35), an analysis of such large heterogeneous data sets has now become feasible. For the dissemination of the data the EVA Data Property and Governance Rules will be followed (<http://euroveg.org/download/eva-rules.pdf>).

Though the current prototype can only access local SQLite databases, a future version of Turboveg v.3 will also be able to access centralised web based databases. This will allow vegetation scientists to access and share data in an easy way, and as such be a true gateway to vegetation data.

## **A formal language for expert systems for vegetation classification**

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An experience with an expert system of vegetation classification used in the four-volume compendium “Vegetation of the Czech Republic” resulted in proposals for several improvements in formal definitions of vegetation types. Based on this experience, we have recently developed a new structure and syntax of logical formulas for automatic identification of vegetation types such as associations or alliances. With this new approach, we can simplify and clearly organize logical formulas of vegetation units, which are more precise and better match the units of the traditional expert-based classification. New membership conditions and relational operators extended the possibilities of precise classification of relevés based on species composition and dominance. Even through this formal language enables combination of 28 membership conditions with 3 types of logical operators, logical formulas are more intuitive and visually understandable than the previous approach. We got a new scientific tool, which is highly efficient especially in species-poor vegetation types, where it provides consistent classification across all vegetation types. The new formal language has been included in the Expert System function of the JUICE program, although the functions for the previous version of the expert system have been preserved.

## **Towards a consistent formalized classification of species-poor vegetation: a case study of aquatic vegetation**

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Classification of vegetation is increasingly using supervised approaches that provide formal, unequivocal definitions of vegetation units. For example, vegetation of the Czech Republic has been recently classified and formalized using the Cocktail method in the four-volume monograph “Vegetation of the Czech Republic”. This supervised expert-based classification approach has several advantages compared with common unsupervised numerical approaches, first of all the possibility of reproducing the same classification on different datasets from the same geographical area. However, sociological species groups used in this method cannot be applied to species-poor vegetation types like aquatic vegetation and are difficult to use if the classification is transferred to other countries. Also, formal definitions of associations were made by experts and the general rules for constructing these definitions were not entirely consistent across different associations. To overcome these issues, we made a test of the efficiency of a new formal protocol (which is an extension of the Cocktail method) for the classification of species-poor vegetation, using a test dataset of Czech aquatic vegetation. We newly defined all associations classified by the previous version of Cocktail method using formal criteria and new functionalities of the program JUICE 7.0. A comparison between the old and new classifications was performed in order to test the efficiency of the new protocol. In conclusion the proposed protocol was able to provide a formalized, consistent and unequivocal classification of aquatic vegetation with several advantages in comparison with similar approaches. Main advantages are that (1) the new approach enables to classify more relevés in comparison with the older approach; (2) the proportion of overlapping (transitional) relevés is significantly smaller than in the older approach.

## **Plant functional traits as the predictors of species response to environmental changes on a productivity and soil moisture gradient**

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Plant functional traits have been recognized as a powerful tool for understanding and predicting species composition and diversity patterns and their underlying processes. This understanding is especially important in the face of ongoing environmental changes. Studies of the responses of plant communities to land use or climate change at a functional level have used species traits to enable generalization between different communities and biogeographical regions. This approach assumed that functional traits predict the response to the management and environmental changes similarly in different vegetation types with different pool of species. However, the extrapolation across different environmental conditions and vegetation types may not be an easy and straightforward process (de Bello et al. 2005). For many traits, either the rate or the direction of response to environmental change can be ruled by more complex, random, or context-specific responses across different gradients (Pakeman 2004).

Therefore we tested whether the relationship between traits and species response to an environmental change remains constant across different vegetation types. For this, we used data from 17 wet meadows along a productivity and soil moisture gradient in Železné hory Mts. (Czech Republic). In 2007 we established experimental plots on each of the sites with fertilization and mowing treatments in a full factorial design. Contrary to the other studies, we applied exactly the same management treatments in all sites. Species cover was then again recorded after two, four, and six years. We tested which traits could predict the response of individual species to the applied treatments and whether the trait-species response relationship changed along the assessed gradients. Our results confirm that plant traits can predict response of species to environmental changes. However, the predictive power of individual traits changes along the studied gradients. We hence conclude that at local scale plant functional traits represent a useful tool for prediction of the species responses to environmental and land-use changes. However,

one should be careful when extrapolating the trait-species response relationship from regions with a different pool of species and environmental conditions.

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## An optimization approach to the production of differentiated tables based on new differentiability measures

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**In a nutshell:** We propose two new measures, based on the notion of “differential species”: (i) the differentiability value of a taxon (*DiffVal*) and (ii) the total differentiability value of a phytosociological table (*TotDiffVal*). These two measures can be used to assist phytosociological tabulation and, thus, vegetation classification, simultaneously.

**Definitions:** Given a phytosociological table and a  $k$ -partition of its relevés (i.e. a classification of the relevés in  $k$  groups), *DiffVal* (varying from 0 to 1) expresses the ability of a taxon to differentiate one or some of the  $k$ -groups from the rest of the groups. *TotDiffVal* is calculated for the entire table, given a  $k$ -partition, considering the *DiffVal* of each species in the table; it consists on a global measure (from 0 to 1) of how well the  $k$  groups can be differentiated among each other. See formulae given below.

**Innovation:** When multiplied by the Pielou’s evenness index (*PEI*) of the  $k$ -partition, *TotDiffVal* can be used as the objective function in optimisation approaches, permitting, in this way, the search for the most interesting  $k$ -partitions, which present relatively even and most differentiable groups. We believe this approach comprises manual tabulation objectives, and can be used to find interesting differentiability patterns in the data, objectively. Nevertheless, expert intervention might be needed to validate such patterns from an environmental or biogeographical point of view.

**Examples:** We applied a simple hill climbing optimization method to the table provided by Mueller-Dombois & Ellenberg (1974, *Aims and Methods of Vegetation Ecology*) to illustrate manual tabulation. The method found easily a 3-partition with a value of *TotDiffVal* greater than the *TotDiffVal* for the 3-partition proposed by Mueller-Dombois & Ellenberg. In this new solution, which is possibly a global optimum, only one relevé was changed to a different group.

**Conclusions:** This method showed to be capable of producing differentiated tables, by searching, objectively, differentiability patterns in the phytosociological table. Optimal solutions of relevé clustering can thus be approximated, aiming to the maximization of groups’ differentiability, using appropriate optimization procedures. For large phytosociological tables, complexity might jeopardize this approach utility, although other optimization approaches seem promising, such as simulating annealing.

**Formulae:**

$$DiffVal_{s,p} = \sum_{g \ni s} \frac{\frac{\sum_{h \ni s} r_h}{r_{G \setminus g}}}{t_{\ni s}} \cdot \frac{r_{g \ni s}}{r_g}$$

$DiffVal_{s,p}$  – is the differentiability value of taxon  $s$ , given the partition  $p$ .

$G$  – is the set of all groups.

$\sum_{g \ni s}$  – intends a sum, where each term is obtained considering each of the groups  $g \in G$  containing species  $s$ .

$\sum_{h \ni s} r_h$  – is the sum of the number of relevés of each of the groups  $h \in G$  not containing species  $s$ .

$r_{G \setminus g}$  – is the total number of relevés of all groups except  $g$ .

$t_{\ni s}$  – is the number of groups containing species  $s$ .

$r_{g \ni s}$  – is the number of relevés in group  $g$  containing species  $s$ .

$r_g$  – is the number of relevés of group  $g$ .

We call  $\frac{\frac{\sum_{h \ni s} r_h}{r_{G \setminus g}}}{t_{\ni s}}$  the ‘adjusted differentiability proportion’ of species  $s$ , concerning group  $g$ .

Note that  $\frac{r_{g \ni s}}{r_g}$  is simply the ‘relative frequency’ of species in group  $g$ .

$$TotDiffVal_{T,p} = \frac{1}{n} \sum_{i=1}^n DiffVal_{i,p}$$

$TotDiffVal_{T,p}$  is the total differentiability value of the phytosociological table  $T$ , given the partition  $P$ .

$n$  is the total number of species present in  $T$ .

$DiffVal_{i,p}$  is the differentiability value of taxon  $i$ , given the partition  $P$ .

## **40 years of Ellenberg's indicator values – do we need another 40 to complete values for Croatian flora?**

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In 40 years of their existence (Ellenberg 1974), numerous criticism and approvals has been addressed to the Ellenberg's indicator values. Through that period authors has adjusted and/or expanded them to floras from the Faroe Islands to Romania. Despite the fact, that even the expanded Ellenberg list (Ellenberg et al. 1992), covers less than 30% of it, an attempt to expand and adjust the indicator values for Croatian flora has never been done. In a meantime, such efforts were done for Hungary (Borhidi 1995) and Italy (Pignatti et al. 2005), increasing the number of available indicator values to around 66% of Croatian flora. Out of this number, highest unique contribution was from Pignatti et al. (2005) ranging from 41.12% for light to 42.33% for soil reaction. Unique contribution of Ellenberg et al. (1992) and Borhidi (1995) lists were around 5% each, while overlap of available values from all three lists varied from 21.53% for temperature to 25.66% for light. For pairs of indicator lists, largest overlap were between Borhidi (1995) and Pignatti et al. (2005) ranging from 10.70% to 15.08% between environmental variables, while smallest was between Ellenberg et al. (1992) and Borhidi (1995) ranging from 4.82% to 6.18%. However, indicator values between lists were different for as much as 27.25% for continentality, followed by over 24% for soil reaction and moisture, 22.2% and 19.43% for temperature and light respectively, while difference for salinity was observed in just 4.86%. In case where differences between three lists of indicator values at level of just one value were neglected, the biggest discrepancy remains for continentality (15.16%), followed by soil reaction and moisture (12.56% and 11.31% respectively). Difference, equal to or bigger than two, for temperature was present in 7.04% and 6.23% for light, while 1.42% for salinity. All these differences, with still existing lack of data for 1/3 of Croatian flora, imply on necessity of thorough analyses of Croatian flora with respect to the Ellenberg's indicator values. This should include all available floristic and vegetation data that will enable calculation of adjusted and/or expanded list of indicator values, combining different appropriate approaches (e.g. weighted average values, HOF models, etc.).

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## The vegetation of Bulgaria – level of knowledge of the main types

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The Bulgarian vegetation is still not well studied according to the Braun-Blanquet's methodology, in spite of the significant progress during the last 15 years. According to the published overviews (Tzonev et al. 2009, Apostolova et al. 2012, Jimenez-Alfaro et al. 2013) the number of established and presumed classes in the Bulgarian vegetation varies between 49 and 53. The scope of this work is to evaluate the level of knowledge of main vegetation types in Bulgaria. It depends on the number of publications, the area investigated by scientists compared to the overall distribution of the vegetation types in the country, etc. The different vegetation classes were divided in five main groups: 1. Well studied classes (*Thero-Salicornietea strictae*; *Juncetea maritimi*, *Ammophiletea*, *Scheucerio-Caricetea nigrae*, etc), 2. Comparatively well studied classes (*Festuco-Puccinellietea*, *Quercus-Fagetetea*, *Festuco-Brometea*, *Juncetea trifidi*), 3. Comparatively poorly studied classes (*Crithmo-Staticetea*, *Lemnetea*, *Potametea*, *Quercetea pubescentis*, *Vaccinio-Piceetea*, etc.), 4. Poorly studied classes (*Asplenietea trichomanis*, *Thlaspietea rotundifolii*, *Bidentetea tripartiti*, *Isoeto-Nanojuncetea*, *Mulgedio-Aconitetea*, etc.) and 5. Not studied classes (*Zosteretea*, *Trifolio-Geranietea*, etc). The results of the current investigation are important for establishing the gaps in the vegetation science in Bulgaria and will be useful for defining the future prospects of its development.

## **Towards a National Forest Vegetation Database of Turkey**

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Turkey exhibits an interesting and rich floristic and vegetation diversity as a result of the many geographical, environmental and ecological reasons such as being a transition between Europe and Asia, last glacial effects, appearance of three main phytogeographical regions, geological differences, and topographical differences etc. Forests has special role in this richness. About 27% of all Turkey is covered by forests with the coverage of about 21 million hectares and they show differences by depending on the geographical and environmental variations. The Northern Turkey, where is under the effect of Euro-Siberian phytogeographical region, is mainly formed by deciduous forests at the lowlands and evergreen forests at the uplands while the Southern and Eastern Turkey is mainly represented by sclerophyllous forest and completely different evergreen forests due to the Mediterranean effects. On the other hand the inner and Eastern Anatolian forests are mainly dominated by drought resistant oak species because of the continental effects of climate (Irano-Turanian phytogeographical region). To understand the richness of those forests, phytosociological works are useful tools. The first essential studies in those forests were carried about fifty years ago and since then the researchers mainly in the science faculties, forestry faculties and forestry research institutes have been going on working the phytosociological structures of forests in Turkey. So those works include a large knowledge on the richness and diversity of forests. A compilation of those works as a database is important not only due to the nature conservation but also the sustainable forest management. For this goal, it is planned to carry out a project with the support of Forest General Directory of Ministry of Forest and Water Affairs of Turkey, which is the responsible of forest management in Turkey. With this project, it is planned to collect all published and unpublished relevés in a database and analyze them to understand the richness and diversity of forests and their geographical, environmental and ecological variations. Such a database would be very useful for a sustainable forest management in Turkey. With the latter studies, the database would also be easily enlarged.

## Plant Communities of Ayıkaya Region in Bolu/Turkey

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In this study plant communities of the Ayıkaya region (600–1780 m), which is situated in the northwest of Turkey, were classified. A total of 95 vegetation sample plots from the study area and 1042 relevés from the western part of Black Sea Region were stored in TURBOVEG. Vegetation analysis was carried out using Twinspan, Cluster analysis and indirect ordination (Detrended Correspondence Analysis, DCA). As a result of the classification 4 main forest communities and 11 sub-communities belonging to 2 higher syntaxonomic ranks and 2 grassland communities were determined. Main forest communities were determined as submontane *Erica arborea-Quercus petraea*, submontane/Montane *Vaccinium arctostaphylos-Fagus orientalis*, high mountain/sub-alpine *Abies bornmülleriana-Fagus orientalis* and high mountain *Physospermum cornubiense-Pinus sylvestris* communities. The southern part of the Ayıkaya Hill which has steep slopes, 60–100% inclination, is dominated by mesoxerophyte species. This community was determined as *Teucrium chamaedrys-Bromus riparius*. On northern slopes where mesophilic and forest transitional species occur, the community was determined as *Alchemilla pseudocartalinica-Astrantia maxima*.

In the north of Anatolia the mountain ranges running parallel to the Black Sea create a barrier for rain clouds moving inland, they cause abundant rainfall on the mountain slopes facing the coast. For this reason, while northern slopes dominated by *Fagus orientalis* and *Abies bornmülleriana* communities, southern exposures are mostly dominated by *Quercus petraea* in submontane and montane zones. However, through Karadere Valley humid air reaches most of the region and mixed *A. bornmülleriana* and *F. orientalis* forest cover wide areas in montane zone. *Physospermum cornubiense-Pinus sylvestris* community forms forest limit on clayey limestone of southern exposures of Ayıkaya Hill. On the northern part of the Ayıkaya ridge, *Abies bornmülleriana-Fagus orientalis* community appears on forest limit. The highest species diversity were found in *Physospermum cornubiense-Pinus sylvestris* community, whereas the lowest values were found in *Vaccinium arctostaphylos-Fagus orientalis* community which has a dense *Rhododendron ponticum* shrub layer.

Vegetation of Ayıkaya region, which is in the euxine part of Euro-Siberian phytogeographic region, have high similarities with Zonguldak-Çitdere and Karabük-Büyükdüz regions respectively but low similarities with Düzce-Elmacık mountain and southern part of Ilgaz mountain which are in the sub-euxine part of the region. In addition, *F. orientalis* and *Q. petraea* vegetation on northern part of Ilgaz mountain are close to those of Ayıkaya region. For description of ecological conditions, Pignatti's indicator values were assigned to vegetation data in JUICE and mean indicator values passively projected on DCA graph. Sample plots taken from sub-euxine region and southern slopes of the mountains have high continentality and temperature indicator values compared to the samples from euxine and northern slopes.

## **The Syntaxonomical Checklist of Portugal's vascular plant communities (continent and islands): 20 years of joint efforts by Portuguese phytosociologists.**

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Vegetation science on Portuguese territory started significantly with W. Rothmaler in the 40's, followed by the team of J. Braun-Blanquet, A. R. Pinto da Silva and A. Rozeira in the 50's and 60's. These botanists laid the foundations for further work by later generations of phytosociologists to this day. From both compilation and a big team effort of setting a stable and coherent syntaxonomical model for Portuguese vegetation, finally in 2012, a throughout checklist was completed, for both the continent and island territories (Madeira and Azores): Costa et al. (2012) Vascular Plant Communities in Portugal (Continent, Madeira & Azores). *Global Geobotany* 2: 1–180. Issuing from either 'classical' phytosociology or numerically-oriented papers, in a effort to fill the knowledge gaps on Portuguese vegetation, the Checklist follows strictly nomenclatural principles of the Code of Phytosociological Nomenclature and it's organized, from vegetation class to association levels, in ecological-physiognomical groups as the contemporary heir of the 'sociological progression' of Br.-Bl. Each syntaxon category is accompanied by a sufficient diagnosis: floristical, ecological, biogeographical, synchorological, physiognomical and bioclimatic. Some information regarding symphytosociology was included, as context for units. Only stable, well circumscribed vegetation types with repetitive combinations of: ecologically dominant and set of bioindicators were considered. The scheme encompasses 827 associations, 4 basal communities, 245 alliances, 116 orders and 64 vegetation classes. The 58 suballiances, 2 suborders and 4 subclasses as auxiliary ranks are also used. The floristic annex lists 2930 taxa and their phytosociological optima. The checklist is, by no means, a closed effort, but as a reference for further and continuous updating. Moreover, it sets a reference nomenclature and concept system that is paramount for other studies in vegetation science. Furthermore, it sets the reference scheme for habitat typologies, namely the institutionally-used NATURA 2000, as the syntax-habitat correspondence was also set earlier, in great extent, by the same authors in the frame of the former Portuguese Phytosociology Association (ALFA): a 600-page document of 2004: *Factsheets of Natura 2000 habitat-types in Portugal*. As a by-product, but not least important, we also produced a *Checklist of the Flora of Portugal* (Sequeira et al., 2009). The later document is nowadays the official reference for policies, planning and official issues on the NATURA 2000 implementation.

The Portuguese Checklist was produced always in scientific joint scientific coordination with other European countries, by far and in a spirit of brotherly friendship, with Spanish phytosociologists (the former AEFA), but also with intense and friendly interactions with other European groups and initiatives: FIP, IAVS, phytosociological societies of Europe and lately, by the co-authorship of Mucina *et al.* (submit.) *Vegetation of Europe: hierarchical floristic classification system of plant, lichen and algal communities. Applied Vegetation Science.*

## **Integration of European forest classifications: the importance for vegetation science and environmental policy**

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The European Forest Types (EFT) classification was produced to provide the Ministerial Conference on the Protection of Forests in Europe (MCPFE) with a user-friendly system within which indicators of sustainable forest management could be reported across the EU. For this purpose, both the EUNIS Habitat Classification and phytosociological syntaxa were considered inappropriate: both approaches were thought to offer an unfeasible number of forest types for MCPFE reporting and the latter to represent a methodological approach that was either inaccessible or unacceptable to MCPFE end-users. Proposed revisions to the EUNIS Forest classification developed through cross-walking with the latest version of the EuroVegChecklist have now produced a clearer equivalence between both these typologies and the EFT categories. Such clarification will have both scientific and policy benefits in bringing closer together different user communities, each with their own interest in forest classification and applications for the delivery of forest-related policies across Europe. This exercise highlights the way in which different scientific cultures and environmental policy frameworks develop or favour independent typologies to the detriment of common understanding and a shared commitment to ensure environmental protection and sustainable landscapes. For example, there is also a pressing need to address contrasting approaches to the definition of grasslands by the Environment and Agriculture Directorates of the European Commission whose differences are hindering coordinated habitat protection.

## **Review of EUNIS forest habitat classification – the importance of vegetation plot data**

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The EUNIS Habitat Classification is one of important tools in European nature policy, representing a pan-European reference set of habitat types. Links (crosswalks) between the habitat classification and the European vegetation syntaxa were first developed in 1998 and updated in 2012. The crosswalks concern Level 3 EUNIS habitat types and the vegetation types at the level of alliances, based on the latest versions of the European Vegetation Checklist (EuroVegChecklist, submitted for publication on 30 March 2013). The next challenge was and remains to determine the floristic composition of the EUNIS habitat types based on vegetation plot data. As a first group of ecosystems, forests were selected by the European Environmental Agency, and a team of EVS researchers and data contributors from the Braun-Blanquet Project and the European Vegetation Archive (EVA) was formed to carry out this research. In the new crosswalk, 156 forest alliances as defined by the EuroVegChecklist were assigned to one of the 36 EUNIS forest habitat types. At present, 32 EUNIS forest habitat types (89%) were covered by the data using information from 117 alliances. Based on an expert assessment of the crosswalks, two types of recommendations for improving the EUNIS forest habitat classification were made – one addressing the content of the habitat types and the other dealing with their naming. In future the new lines of development would include: (1) ecosystem and habitat mapping of the European forests, (2) application of the Red List assessment of the European forest types, and (3) development of indicator species for the European forests.

## **Classifying plant communities and mapping their potential distribution using very large, heterogeneous, georeferenced datasets: the case study of the forest vegetation in the Italian peninsula.**

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In recent years, the scientific community has made significant efforts in order to create geo-referenced vegetation databases (Global Index of Vegetation Plot Databases). These databases are useful to carry out assessments of the state of biodiversity, conservation of species and habitats, dispersion of alien species and as a support for the planning of land and protected areas. In this context, Italy has given birth to its own project called VegItaly, coordinated by the Italian Society of Vegetation Science and conducted by several research groups, in order to develop a uniform database for the entire country. Within this framework we have created a georeferenced database of phytosociological relevés of forest vegetation. This work was conducted in three main steps: digitalizing published phytosociological relevés, georeferencing them using indications on their location and topographical features, and updating species nomenclature according to the more recent checklist. In this way, we obtained a database of 5593 georeferenced relevés for insular and peninsular Italy. This database was then used to identify and map the main forest communities in the study area. For the classification process we used a finite mixture model that is particularly suitable to this purpose since it is able to integrate in the classificatory process species composition, environmental variables and the spatial distribution of the relevés. The application of this method led to the identification of 20 forest communities that represent the remarkable biological diversity in peninsular and insular Italy. This variability is characterized by the presence of central temperate European communities, sub-Mediterranean ones with marked Balkan influences and typically Mediterranean ones. The final step was mapping the potential distribution of these forest communities using only the environmental variables and validating the map by means of the georeferenced relevés. Results indicate the sub-Mediterranean forest communities being characterized by a lower classification accuracy with respect to the other two macro-typologies. Despite the intrinsic limitations of natural potential vegetation mapping, we believe that our approach can produce maps useful for small-scale landscape planning and nature conservation activities, being based on a replicable and standardized procedure that could be applied when georeferenced relevés are available.

## **The diversity of Italian forests: a interactive product of biogeography and ecology**

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Background: Italian forests contains a high total diversity of plants species and this is likely due to the huge biogeographical gradients covered by the country (from the Alps to the Mediterranean) as well as to the long lasting human exploitation and management practices.

This study aims to investigate the interactive effects of ecology and biogeography in determining the total plant diversity of Italian forests using a spatially representative sample of forests made of 201 plots sampled all over the country (CONECOFOR LI network).

The general hypothesis to be tested is that the effects of present day ecological factors are less important than biogeographical factors in determining the total diversity of forested areas.

The plant diversity of the sampled forest plan communities was divided into different spatial components, in particular: plot, site, forest type (used as a proxy for present day ecological conditions) and biogeographical region. Species presence\absence was only used. The three following hypotheses have then been tested:

Hypothesis 1: The diversity component accounted by the biogeographical region is higher than the diversity accounted by the lower scale components (plot, site, forest type).

Hypothesis 2: Distance decay rate across biogeographical regions is higher than distance decay rate within biogeographical regions (after correction for extent).

Hypothesis 3: Beta nestedness is higher within than across biogeographical regions (after correction for extent); on the other hand Beta complementarity is lower within than across biogeographical regions (after correction for extent).

Results encouraged to enlarge the study in order to consider a wider range of forest types and biogeographical features in determining the forest plant diversity patterns.

## **Multiple Potential Natural Vegetation (PNV) assessment – an introduction through the modelling of the PNV of Hungary**

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The concept of Potential Natural Vegetation (PNV) has a long history, benchmarked by heavy debates on the necessity of such research. Nonetheless, a need for the estimation of what vegetation could cover a currently unvegetated surface repeatedly arises. Somodi et al. (2012) argued for the usefulness of PNV estimations and introduced the concept of multiple Potential Natural Vegetation, which assesses PNV in a probabilistic setting, rather than providing a single estimate for one location. This multiple PNV reflects the uncertainty of our models and estimations regarding which vegetation entity could persist at the locality concerned. Such uncertainty arises from the overlap of environmental preferences of different mature vegetation types.

We introduce an example of such multiple probabilistic PNV assessment based on models of the PNV of Hungary. Our models are based on data of actual natural vegetation from the MÉTA (Landscape Ecological Vegetation Mapping of Hungary) database, which contains among others presence/absence observations for each vegetation type of Hungary at the scale of 35 ha. Biologically relevant explanatory variables (including climate and soil conditions) were calculated for the whole extent of Hungary. Models were built using the gradient boosting algorithm (GBM) and applied to the existing environmental conditions covering the full country.

Using these we present, how the multiple probabilistic assessment adds to the value of PNV, (1) by representing the potential variation within vegetation types in a single location, (2) by supporting an informed decision of nature conservation on which vegetation types are among the sustainable ones at a location and also (3) by supporting restoration with a range of potentially self-sustainable vegetation types, rather than representing the most probable one everywhere. The multiplicity also allows for representing rare or uncertain vegetation types, e.g. forest steppes in Hungary, the distribution of which is inherently dynamic and also difficult to estimate due to the low amount of stands left due to human transformation of the landscape.

### **Reference:**

Somodi I., Molnár Z., Ewald J. 2012: Towards a more transparent use of the potential natural vegetation concept – an answer to Chiarucci et al. *Journal of Vegetation Science* 23, 590–595.

## **Drivers of spontaneous dynamics in a floodplain *Quercus robur* forest in the Pannonian ecoregion: field data support the Vera hypothesis**

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Large river floodplains of Europe, most adequate places for human civilization, now practically deprived of their original vegetation, traditionally considered as forests with game populations too low to have any effect on forest dynamics. The alternative Vera hypothesis, less cited in botanical or forestry literature, states that prehuman floodplains were covered by a changing mosaic of forests, tree groups, open grasslands and thorny thickets, acting as shelters of regrowth of forest trees. Circular changes of these elements were driven by grazing and browsing of large game populations.

Proving or disproving a historical hypothesis with scientific methods is difficult, because of lack of sufficient objects and time; so we attempted to look for only four elements of the Vera cycle in the spontaneous dynamics of an abandoned floodplain oak forest in Southern Hungary. Study questions are: a. Does gap formation is followed by the spread of *Crataegus monogyna* in the lower canopy? b. Does browsing damage *Crataegus* less than other woody species? c. Is browsing an important factor effecting regeneration patterns? d. Do thorny plants (*Crataegus*, *Rubus*) facilitate regeneration of woody species?

In Bükkhát Forest Reserve (southern Hungary) browsing damage is high (60% on average), and almost no regeneration of *Quercus robur* can be observed. In 120 years old stands, where gap forming has just began, the occurrence of *Crataegus monogyna* in the second canopy has risen to 24% from 6% in 1995. *Crataegus* is the only species which has significant negative correlation in A2 and B1 with A1 coverage, a proxy for light availability in lower layers. Evaluation of browsing rate of apical shoots of 1973 individuals of *C. monogyna*, *Q. robur*, and five other woody species in the shrub layer revealed that *Crataegus* is damaged less than all of the other ones. Multivariate analysis (RDA) of regrowth patterns revealed that most important determinants of regrowth patterns include *Rubus* and *Crataegus* coverage and game damage. Only very weak correlations have been found between cover of thorny species and regrowth of woody ones.

Contrary to wide-spread opinions, the apparent unability of *Quercus robur* to regenerate in closed stands and besides high game pressure, does not necessarily lead to permanent disappearance of this species, if we regard the current situation only as a stage of a hypothetical natural cycle, which – on a longer time-scale – may secure the survival of this species in frames of a diverse and changing landscape mosaic. Spatial and time scales of this mosaic are difficult to estimate. As the quantity of *Quercus robur* strongly decreases, and today's closed high forests seems to disappear together with their inevitable economic and conservational values, the judgment of letting these processes go may be very controversial.

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## **Biogeography of Central European oak forests: stories for the appreciative audience**

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Thermophilous oak forests of *Quercetea pubescentis* class and mesophilous oak forests of *Carpinion* alliance (*Carpino-Fagetea* class) dominate the natural vegetation on moderately-rich to rich, mesic to dry soils in lower altitudes of Central Europe. Based on published information, field experience and results of phytosociological data analysis, I discuss differences in the geographical variation in species composition and richness of these two oak forest types and their possible causes. The main patterns are the following: Species richness is on average about 50% higher in thermophilous oak forests than in mesophilous oak forests and it increases from north-west to south-east in both forest types. Amount of coarse-scale geographical variation in species composition is similar in both forest types; while latitudinal variation is somewhat stronger in thermophilous oak forests, longitudinal variation is much stronger in mesophilous oak forests. Geographically most distinctive oak forest types and their best diagnostic species will be presented.

## Why does ruderal woodland increase in Austria?

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In eastern Austria, a strong increase of vegetation with neophytic woody species like *Robinia pseudacacia*, *Acer negundo*, *Ailanthus altissima*, *Juglans nigra*, *Fraxinus pennsylvanica*, *Paulownia tomentosa* and *Aesculus hippocastanum*, called “ruderal woodland” here, is observed. The Austrian Vegetation database contains 918 relevés from all over Austria since 1957 with at least one of these species in any layer. The dataset can be assigned to two large groups: floodplain vegetation and mesophilous stands. We search for the main drivers for the increase of ruderal woodland in Austria using indicator values and various plant traits extracted from the BIOLFLOR database in temporal and spatial series.

The cover of neophytic species overall significantly increased over time. Indicators of “synanthropization” such as the mean values of hemeroby and urbanophily show the same tendency. Another fact is the decrease of these values with increasing distance from any sealed area. In the triangle of Grime’s C-S-R-strategy types the decrease of stress tolerant specialists characterizes this development but not the increase of ruderals.

Some traits show different results in mesophilous and floodplain stands. The proportion of indigenous species decreased in mesophilous stands over time, but remained unchanged in floodplains. The Ellenberg indicator values for nutrients increased in mesophilous stands, while no trend in floodplains is noticeable.

Is there also an impact of global warming to these changes? Searching for phenomena like “thermophilization” and “laurophyllization”, different trends in the two subsets are visible. In mesophilous stands the Ellenberg indicator values for temperature remain more or less unchanged, but increased in riverine stands. This corresponds with a strong decrease of the Ellenberg indicator values for moisture in the floodplain stands and reflects more the impact by river regulation and drainage than effects of global warming. The data presented here do not support “laurophyllization” to be a trend in Austrian ruderal woodland at all.

Our analysis shows that direct human impact is the driving factor for changes in mesophilous ruderal woodlands especially in the vicinity of settlements. The “newcomers” on this stage, *Paulownia tomentosa* and *Aesculus hippocastanum*, give a current example that urban environment is a vantage ground for dispersal and invasion. In floodplains, natural dynamics still play a certain role, but regulation and forest management accelerated the transformation into ruderal woodland.

## **The intricate taxonomical vicissitudes of *Quercus dalechampii* and their consequences in the Vegetation Science field**

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The potential vegetation landscape of central and southern Europe is largely marked by the presence of deciduous oak forests. The majority of these forests are characterized by the dominance of the so called “white oaks” (*Quercus* subgen. *Quercus*) such as *Q. robur*, *Q. petraea*, *Q. pubescens*, *Q. frainetto*. Nevertheless the taxonomy of the European white oaks represents a critical point for botanists and the main European floras and checklists are only partially in agreement concerning both the number of taxa included in this *Quercus* group and their nomenclatural status. *Quercus dalechampii* Ten. has been for a long time one of the most controversial taxonomical issues. Its intricate history had its origin in the Kingdom of Naples in 1830 and for many decades its taxonomy was debated among Italian botanists. It was only in the last century, that its problematic taxonomical status crossed the Italian border to become a Europe-wide problem. The problem was that there were two positions amongst European botanists on the taxonomic relationships of *Q. dalechampii*; the first, whose main proponent was Schwarz (1936–39; 1964), saw *Q. dalechampii* as a species belonging to *Q. petraea* species complex and the second, advocated by Camus (1936–54) and, more recently, by Brullo & al. (1999), considered *Q. dalechampii* as falling within the *Q. pubescens* species complex. The recent lectotypification of this taxon (Di Pietro et al. 2012) has definitively established it to be assigned to the group of *Quercus pubescens*. Being the problems of *Q. dalechampii* not just limited to taxonomical aspects, but also impinging upon other fields of research, such as phytogeography, forestry, vegetation science and conservation, this lectotypification has opened the door to a revisional phase which will require an updating of information-data, diagnosis and directives. One of these updating will involve the necessary redraw of the distributional area of this species which will turn out to be significantly reduced (...at least in this first step of revision...) when compared to what is reported in the current maps. Another changing will concern the phytosociological features of *Q. dalechampii* together with the coenological diagnosis of its woods and their position in the European syntaxonomical framework.

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## **Phytocoenological characteristics of the forests from the class *Quercetea pubescentis* in the continental Western Balkans (Bosnia and Hercegovina, Croatia, Slovenia and Serbia)**

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This paper deals with thermophilous deciduous forests of the class *Quercetea pubescentis* in continental (northern dinaric and peripannonic) part of the Western Balkans and low hills of southern fringes of Pannonian plain (Slovenia, Croatia, Bosnia and Hercegovina and Serbia). This area comprises great variety of ecological conditions. Due to different bedrock, clear east-west climatic gradient, climatic influence from the south (montane, mediterannean), forest vegetation is a mixture of thermophilous, mesophilous and thermo-acidophilous oak forests. Because of this complexity the classification of these forests was confusing and very often same forests were classified within different orders. Around 1500 relevés of forests traditionally assigned to *Quercetalia pubescentis*, *Quercetalia robori-petraeae* and partially to *Erythronio-Carpinion* (thermophilous variants) were collected from the literature and in the field. Using classification and ordination methods the main groups of communities were established. Anylisis revealed a clear ecological and floristic separation and definition of different syntaxa within the *Quercetea pubescentis* class. The research showed that the forests traditionally assigned to the acidophilous order *Quercetalia robori-petraeae* (e.g. *Quercetum montanum* s. lato) for the major part belong to thermophilous class *Quercetea pubescentis* (*Quercion pubescenti-petraeae* and *Quercion petraeae*). This is valid also for some forests classified within *Querco-Carpinetum illyricum* (*Erythronio-Carpinion*).

## **Silver lime (*Tilia tomentosa* Moench) in forest vegetation of Zrinska Gora**

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The research of forest vegetation was performed in the area of Zrinska Gora Mt (Central Croatia) by the principles of the standard Braun-Blanquet approach. Zrinska Gora Mt is situated on the south edge of the Pannonian plain, phytogeographically it has weak Dinaric influence, and furthermore it is south-west edge of distribution of *Tilia tomentosa* in natural forest communities. From a total of ten forest associations recognized in Zrinska Gora Mt silver lime is present with varying abundance in 7 of them. The highest abundance *Tilia tomentosa* has in specific ditches and ravines, where as dominant species forms the community of noble hardwoods.

Silver lime stands are distributed in altitudinal belt from 270–360 meters and they are developed fragmentary in specific habitats. They are generally characterized by large ravines with inclination of 20–40°, often a high percentage of rockiness, springs and constant moisture. Rockiness percentage ranges from 10 to 35%, with the bedrock made mostly of carbonate flysch, calcareous clastic sediments and blocks with colluvial material. Colluvial soil is deep, with less prominent layers as a result of unequal deposition of materials. Above the ravines with silver lime usually follow stands of beech or sweet chestnut, and on the higher slopes and southern exposures sessile oak forest, with much smaller proportion of silver lime. In comparison to the surrounding beech forests of all. *Fagion sylvaticae* and suball. *Luzulo-Fagenion*, they are characterized floristically by share of the Illyrian elements. *Tilia tomentosa* stands are affiliated within the alliance *Tilio-Acerion* and its suballiance *Lamio orvalae-Acerenion*.

## **The preservation of the relic xerophytic submediterranean communities in the southern Russia**

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In the south of the European part of Russia there are the unique natural ecosystems dry subtropical of the Black Sea coast, that have conserve the biological diversity of natural ecosystems of the northeastern Mediterranean. For their protection in the spurs of the Western Caucasus (Abrau Peninsula) the Utrish reserve, was created which is the member of in the World Natural Heritage Site “Western Caucasus”. Within the reserve the whole number of priority areas for habitat protection EUNIS is singled out.

The zone of the Mediterranean formations of xerophytic woodlands and shrub is situated at altitudes up to 150–250 m above sea level. On the southern seaside slopes the lowest zone up to 150 m is occupied with pistachio-juniper, juniper forests and woodlands, xerophytic shrubland communities with juniper like a shibliak-type.

These communities were identified in association *Pistacio mutica–Juniperetum excelsae* Grebenshchikov et al. 1990, referred at this level of analysis to the alliance *Lonicero etruscae–Quercion pubescentis* Arrigoni et Foggi 1988. Diagnostic species: *Juniperus excelsa*, *J. oxycedrus*, *J. foetidissima*, *Pistacia mutica*, *Jasminum fruticans*, *Asparagus verticillatus*, *Paliurus spina-christi*, *Teucrium polium*, *Melica transilvanica*, *Ephedra distachya*, *Alyssum obtusifolium*, *Colutea cilicica*, *Lactuca saligna*, *Hypericum perforatum*, *Sideritis euxina*.

Within the association united in to the a new subassociation *P. m.–J. e. pine-tosum pityusae* is considered variants with *Cotinus coggygia*, *Salvia ringens*, *Stipa lessingiana* are distinguished.

A significant forest forming belonging to role *Paliurus spina-christi*, and sometimes *Colutea cilicica*, *Rhus coriaria* are present.

The communities of Mediterranean and Persian *Pistacia mutica* unique for the territory are located in Russia from Anapa to Novorossiysk on the area of 232 ha.

Juniper forests form a peculiar combination with juniper (*Juniperus excelsa*, *J. oxycedrus*, *J. foetidissima*), oak (*Quercus pubescens*) and pistachio (*Pistacia mutica*) woodlands and have high environmental value. The average age of juniper ranges within 120–140 years, some individuals reach the age of 200 years and more.

The peninsula Abrau refers to Crimean- Novorossiysk province Mediterranean floristic region (Takhtajan, 1978). Juniper woodland flora includes 933 species of vascular plants belonging to 396 genera and 76 families. In the flora of the Mediterranean juniper woodlands Asteraceae (151 species), Fabaceae (93) and

Poaceae (76) occupy the first places. Three leading family add up more than a third (34, 3%) of the total number of species. Mediterranean species share is about 50%.

The richest floristic formation juniper (71%), including Mediterranean and steppe species. 41 species are endemic for the Caucasus (*Potentilla caucasica*, *Rubus caucasicus*, *Lathyrus miniatus*, *Pastinaca pimpinellifolia* etc.). The IUCN list includes eight species, of which *Veronica filifolia*, *Campanula komarovii* are endemic juniper woodlands. *Juniperus excelsa* and *Juniperus foetidissima* are included in the Red Book of the Russian Federation and the IUCN Red List (status LR / lc); *Juniperus oxycedrus* is listed in the IUCN Red List (status LR / lc).

## **Vegetational-pedological relationships on Mount Medvednica (Croatia)**

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The paper presents the results of vegetational-pedological research in the area of Mt. Medvednica, the most urban nature park in the Republic of Croatia. Medvednica Nature Park is situated in the immediate vicinity of the City of Zagreb and covers an area of 17 938 ha. Extending between 120 and 1033 m above sea level, it represents an outstanding example of vertical zonation of vegetation upon highly diverse geological parent material and soil types. Of the overall Park area, forest ecosystems account for 64%. Vegetational-pedological research was conducted in 181 localities in a regular 1×1 km grid. In each of the localities an adequate type of forest vegetation (association) was determined following classical phytocoenological principles (Braun-Blanquet 1964). Composite topsoil samples to a 5 cm depth were taken for further pedological analyses. Soil pH values and organic carbon content were measured in topsoil samples and so was the content of the elements P, K, Ca, and Mg after extraction with *aqua regia* (HRN ISO 11466: 2004). The basic synecological indicators (elevation, exposition, inclination, bed-rock and soil type) were also determined in each locality.

The goal of this research was to determine synecological conditions of the occurrence of each identified forest community with particular emphasis on vegetational-pedological relationships.

The results of vegetation research in the studied localities reveal the occurrence of beech-fir forests, different types of beech and sessile oak forests, and forests of sweet chestnut and black alder (asoc. *Festuco drymeiae-Abietetum* Vukelić et Baričević 2007; *Lamio orvalae-Fagetum sylvaticae* (Horvat 1938) Borhidi 1963; *Cephalanthero longifoliae-Fagetum sylvaticae* Vukelić, Baričević et Šapić 2012; *Luzulo luzuloidis-Fagetum sylvaticae* Meusel 1937; *Castaneo sativae-Fagetum* Marinček et Zupančič (1979) 1995; *Festuco drymeiae-Carpinetum betuli* Vukelić 1991 ex Marinček 1994; *Epimedio-Carpinetum betuli* (Horvat 1938) Borhidi 1963; *Quercu-Castaneetum sativae* Horvat 1938; *Potentillo micranthae-Quercetum petraeae* (Vukelić 1991) Vukelić, Baričević et Šapić 2010; *Stellario nemorum-Alnetum glutinosae* Lohmayer 1957). These associations were formed into units for the statistical analysis of correlations between forest communities and soil pH values, the content of P, K, Ca, Mg and the organic carbon content. Statistical analysis was performed in Statistica 7 software package. Descriptive statistics was made for all the analyzed variables. In order to eliminate the effect of outliers and extreme values, the median was taken as the mean value. Mutual differences between the analyzed variables per

association were tested using the Kruskal-Wallis non-parametric test. The following was determined for each identified forest community: ranges and mean values of the elevations, expositions and inclinations of forest occurrence, dominant geological bedrocks and soil types, as well as correlations with pedological properties (pH values and element concentrations), including statistical differences between individual forest communities in terms of the investigated characteristics. Beech-fir stands developed on the soils above basic igneous rocks are characterized by a higher Ca, Mg, and K content, and consequently higher pH values. As a result, the best represented species in these forests are neutrophilic species.

## Biogeographical patterns of boreal forests of European Russia

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The aim of research was to show the diversity of boreal vegetation of the European part of Russia on the Circumboreal Vegetation Map (CBVM) at scale 1 : 7500000. We put more than 2000 relevés into geoinformation system and analyzed them. In the Boreal Region of the European part of Russia there are five subzones: Forest-tundra, Northern taiga (NT), Middle taiga (VT), Southern taiga (ST), Sub-taiga or Hemi-boreal subzone (HB) and two provinces: 1) North European, 2) Ural – West Siberia. Zonal vegetation (ZV) in the forest-tundra is woodlands with *Betula cherepanovii* and *Picea obovata*. Each boreal subzone has its own characteristic spruce association of ZV with their differential species and dominants (used in their names). NT ZV is ***Piceetum empetroso-myrtillosum*** Zinzerling, 1932 (*Empetrum hermaproditum*, *Ledum palustre*, *Vaccinium uliginosum*). MT ZV is ***Piceetum vacciniosum myrtilli*** Sukachev, 1927 (*Dryopteris carthusiana*, *Gymnocarpium dryopteris*, *Linnaea borealis*, *Luzula pilosa*, *Lycopodium annotinum*, *Maianthemum bifolium*, *Orthylia secunda*, *Oxalis acetosella*, *Trientalis europaea*). ST ZV is ***Piceetum oxalidosum*** Sukachev, 1927 (*Aegopodium podagraria*, *Carex digitata*, *Melica nutans*, *Milium effusum*, *Paris quadrifolia*, *Pyrola rotundifolia*). HB differs by ***Piceetum nemoriherbosum*** Zinzerling, 1932 (*Asarum europaeum*, *Actaea spicata*, *Lathyrus vernus*, *Myosotis sylvatica*, *Galium odoratum*, *Pulmonaria obscura*, *Ranunculus cassubicus*, *Stellaria holostea*, *Viola mirabilis*), frequently with broadleaved trees (*Acer platanoides*, *Quercus robur*, *Tilia cordata*, *Ulmus glabra*) and hazel (*Corylus avellana*). Surface fires periodically damage pine forests on well-drained sands preventing their change by ZV. Lichen-rich pine forests occurring on sands in the NT differ by *Empetrum hermaproditum*, *Ledum palustre*, *Vaccinium uliginosum*. Taking into account topological factors, on the territory of boreal zone of European part of Russia there are two orographic parts: Fennoscandia and Russian plain. Fennoscandia differs by the presence of specific forest types on shallow soils on rocks rich with *Cladonia* and some epilithic lichens. Swamp and bog forests also differ in different subzones. Differentiation of boreal vegetation from West to East was caused not only by topography and climate but also by last glaciation and/or marine transgression that took place during the last years of Pleistocene. It severely impoverished flora in the North-Western part of Russia, reduced and disjointed areas of coniferous forest dominants (*Picea obovata* – *P. abies*, *Pinus cembra*–*P. sibirica*, *Larix decidua* – *L. sibirica*, *Abies alba* – *A. sibirica*) and some herb species.

## **Vegetation after bark beetles outbreak in Eastern European mixed spruce forests**

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Bark beetle (*Ips typographus* (L.)) outbreaks together with storm events are the most important natural disturbances determining the dynamics of the forests in Eastern European spruce (*Picea abies*) forests. A bark beetle outbreak affected Russian spruce forests in the 1999–2003 and 2011–2013 years. The beetle population rise to epidemic levels was caused by extreme weather conditions (drought) and catastrophic windthrows disturbances. In addition, the main management technique during outbreaks is the sanitation felling of infested standing trees but salvage logging in reality, which usually results in complete clearcutting.

We performed our studies in mixed spruce forests affected by bark beetle outbreak with and without forestry interventions. The results suggested that natural disturbance had a smaller effect on forest regeneration and ground layer vegetation than additional anthropogenic disturbance in the form of salvage logging.

The pathways of tree regeneration were essentially different in two case studies. Changes in stands with dead canopy were determined by the survival patterns of the understorey of the original stand, mainly by *Sorbus aucuparia*, *Tilia cordata* and *Corylus avellana*. There was no new regeneration of *Picea abies*, *Betula pendula*, *Populus tremula* and *Pinus sylvestris* during 10 years after bark beetle outbreak. The regeneration was carried out only by spruce saplings appeared under stand canopy before the disturbance.

Specific site conditions of dead canopy stand differ from cutting area that is why the course and outcome of the succession will be another. Fast renewal by pioneer species such as *Betula pendula* and *Populus tremula* formed close canopy on 3–7 year after disturbance in cutting areas. The course of succession with forestry intervention, therefore, is a classical pioneer stage of secondary succession.

Most forest herb species survived quite well after bark beetle outbreak under dead canopy if it remained, with pioneer species rarely colonizing these areas. There was only the change of dominance position of species. In clearcuts, pioneer species like *Rubus idaeus* and *Calamagrostis epigeios* expanded, while forest herbs decreased or even disappeared.

The preservation of species composition and restoration of spruce forests attacked by bark beetle are affective only with saving dead stand without salvage logging.

## **Geographical differentiation of streamside forests in the North-West of Russia**

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Streamside forests belong to intrazonal vegetation. They are typologically very diverse and high species richness is peculiar for them. Numerous factors determine composition and structure of streamside forests. This plant communities were investigated on sample plots in the territory of Leningrad, Tver', Pskov, Arkhangelsk regions (NW Russia) in the north, middle, south taiga and mixed forests subzones. Vegetation of Arkhangelsk region has a lot of signs of Siberian taiga, forests in the south part of Pskov and Tver' regions are enriched with nemoral species. I analyzed species composition, species correlation and lists of types and group of types on geographical gradients. Besides expected decreasing frequency and elimination species with a border of distribution in or near the region of observation there were found changing correlation some species with other species and soil conditions. Seems it is caused by substitution of different ecotypes of some species. Also the list of streamside forest types and type groups are not similar in different regions. Valleys of streams are the ways for distribution such nemoral species to the north as Siberian species to the west in Arkhangelsk region. Large ferns (*Athyrium filix-femina*, *Dryopteris expansa*, *D. carthusiana*, *Matteuccia struthiopteris*) are the dominants of streamside forests' field layer in southern and middle taiga very often, in northern taiga they turn out dominants significantly rarer.

## Classification of European beech forests: a Gordian Knot?

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The high-rank classification of European beech forests has been a matter of controversy for many decades. For the purpose of the new EuroVegChecklist (EVC1) and the related Braun-Blanquet project, we elaborated a revised classification of beech forests at the alliance level based on a large set of plot data covering the whole range of this vegetation type in Europe. From the database of the Braun-Blanquet project, we selected all relevés with a cover of *Fagus sylvatica* > 50% and plot sizes between 100 m<sup>2</sup> and 1000 m<sup>2</sup> which resulted in a data set of 22 496 plots and 2154 taxa. This data set was numerically classified using the TWINSPLAN algorithm. The first division largely corresponded with the border between acidic and basiphilous beech forests (*Luzulo-Fagetalia* and *Fagetalia sylvaticae*). Within the *Luzulo-Fagetalia*, the Western European *Ilici-Fagion* was clearly separated from the Central and South-eastern European *Luzulo-Fagion*. Within the *Fagetalia sylvaticae*, temperature was the strongest gradient, with the montane fir-beech forests of the Alps and adjacent mountain ranges at the one end of the gradient (mainly corresponding to the *Lonicero alpigenae-Fagenion*, all. *Aremonio-Fagion*) and the thermophilous beech forests of southern Italy and the southern Balkan Peninsula (corresponding to the *Doronicus orientalis-Fagenion*, all. *Geranio versicoloris-Fagion*) at the other end. These two extremes have also a distinct biogeographical character with many narrow-range species, which are linked to the two main glacial refuge areas of European beech forests. The bulk of basiphilous beech forests, however, lack such distinct floristic features, and differences in species composition reflecting the current ecological conditions (mainly temperature and soil pH) are much stronger than the historic biogeographical signals related to the various micro-refugia in Western, Central and South-eastern Europe.

## **Characteristics of beech forests communities at their warm dry distribution limit**

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This research it is focused on forests with beech as dominant tree species at its warm and dry range limit (margin, distribution edge). The search and detection of a species at its range limit is not a trivial task, due to different niche concepts, forestry practices, taxonomy, margin definitions and subjective expert knowledge. Nevertheless an approach is presented that allows general conclusions. In 2013 there have been sampled beech forest plots in Bulgaria, Romania, Slovenia and Italy, that were not planted, showing long term halt of silvicultural intervention and showed a stand age that is at least over 80 years. The plots have been ranked according to the results of an ensemble of three different species distribution models. They show different distances (probabilities of occurrence) to the niche margin which is used as gradient. Vegetation relevés, forestry parameters, dendroecological measurements, leaf traits, soils, and field observations were used to characterise these beech forests. There is evidence that Ellenberg indicator values could be a tool for a coarse discrimination between marginal and central beech forest communities. The vegetation composition is rather similar to the centre of the distribution range, beside there seem to be differences in the vegetation structure. Furthermore, site factors that influence micro climate conditions seem to play a major role within the interplay of macro climatic drivers at the xeric edge of beech.

## **A tentative formalized classification of the Italian beech forests: an ecologically parameterized overview**

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The coenology of the beech forests in Italy has been extensively investigated by classic phytosociology. However this valuable effort produced a huge amount of syntaxonomical units, displaying complex patterns of cross-similarities in the hierarchy, which hardly match the limited stand variability observed in the field.

Besides this, most of the basic studies have been traditionally focused on the local scale, due to the unavailability of larger archives of sample-plots. Hitherto, this lack hindered any consistent approach to a comprehensive typological classification of the zonal *Fagus* dominated or *Fagus* mixed forest belts in Italy.

Here we present some preliminary results of a coenological overview of late successional beech forest stands, applying a formal classification approach to all available data for Italy appeared to date in the phytosociological literature.

The data have been extracted from the EU-IT-011 “Georeferenced Vegetation Database of Sapienza University of Rome” (13,552 plots) and the EU-IT-010 “Italian National Vegetation Database of BVN / ISPRA” (4400 plots). From these we gathered an initial data set of 2123 relevés with occurrence of *Fagus sylvatica* L., selected with an operational criteria and subsequently submitted to classification.

The analyses were performed using the JUICE package, running the functions of resampling, classification, assignment of relevés and evaluation of the performed classifications. After this stepwise process, the evaluation of the groups obtained has been based on the biome affinities of diagnostic and dominating species. The environmental parameterization emphasizes the topographical and geographical displacement of the groups throughout the study area from the Alpine region to the Mediterranean islands.

The aim of this research is to stress the importance of large and geographically comprehensive databases combined with this type of formal classification, which enhances the detection of relevé clusters corresponding to forest types based on chorological and ecologically consistent indicator species, still badly needed by end-users in nature conservation issues and landscape planning.

## **Functional differentiation and distribution of *Aremonio-Fagion* beech forests in a colline region of Central-Eastern Europe**

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Our research is focusing on functional classification of lowland beech forests in the South-Western region of Hungary under contrasted climatic and edaphic conditions, existing in the vegetation zone of oak-hornbeam woodlands at the European scale. The climate is moderately warm and wet, as the annual precipitation is about 650 mm, mean annual temperature is 10.9 °C and mean elevation is 150 m. Soils are composed with sand, loam and clay fraction, having various amount of organic matter and clay minerals, causing a high range in soil water management parameters. Among climatic variables, temperature varies in a quite narrow range but in contrast, precipitation shows a wider range for function and differentiation (e.g. annual or seasonal). Climatic trichotomy, edaphic pentotomy and five associated functional units as ecological communities have been revealed computed by a three-level statistical analysis. Winter temperature, summer precipitation, ratio of loam fraction, organic matter and clay minerals of the soil are extracted as principal predictors for differentiation. Associating results of functional units, the mechanism of climatic-edaphic interactions as environmental counterbalances are detected to facilitate long term adaptation of beech woodlands. In addition, interrelations among functional and syntaxonomic communities are also presented, containing in *Helleboro odori-Fagetum*, *Vicio oroboidi-Fagetum*, *Doronic austriaci-Fagetum* and *Leucojo verni-Fagetum* forests. Analysis was supported by “TÁMOP 4.2.2.A-11/1/ KONV-2012-0004” research grant.

## **Vegetation characteristics of fir-beech communities in virgin forests on Dinarides**

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This research regards to virgin forest reserves of mixed forests of fir and beech (with or without spruce) in Dinaric Alps (Slovenia, Croatia, Bosnia and Herzegovina and Montenegro), which are verified by national legislatives. Phytocoenological relèves from literature were supplemented by new relèves, collected in the field in virgin forests of Bosnia and Herzegovina. Floristic and ecological analysis of the virgin forests showed differentiation of these forests along NW–SE climatic and biogeographical gradient through Dinarides, as well as differentiation based on development phases in virgin forests, substrates and other.

## **Grasslands of Europe: an overview of available data in EVA and first approaches to analyse their diversity patterns at continental scale**

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After two preparatory years, the European Vegetation Archive (EVA; <http://euroveg.org/eva-database>) actually started to become functional in 2014 (see talk by Chytrý et al.). This community-owned continental vegetation-plot database is the largest database of that type in the world and aims to be comprehensive with regard to countries and vegetation types. It is coordinated by the European Vegetation Survey (EVS; <http://euroveg.org/>) with responsibilities for the grassland vegetation by the BiodivERsA project SIGNAL (<http://www.bayceer.uni-bayreuth.de/signal/>) and the European Dry Grassland Group (EDGG; <http://www.edgg.org>).

In this talk, I will present an overview of the plot data of grassland syntaxa available in EVA at the point of time of the conference, with an outlook on additional data that are currently being processed, and highlight data gaps for certain grassland types or regions. We understand grasslands in a wide sense, including the following major groups: (1) Temperate grasslands (*Koelerio-Corynephoretea*, *Festuco-Brometea*, *Molinio-Arrhenatheretea*, *Nardetea strictae*), (2) Mediterranean grasslands (*Poetea bulbosae*, *Lygeo-Stipetea*, *Stipo-Agrostietea*, *Stipo-Trachynietea*, *Helianthemetea guttati*, *Tolpido-Holcetea*, *Helichryso-Crucianelletea*, *Astragalo-Bro-*

*metea*); (3) Arctic-alpine grasslands (*Carici-Kobresietea*, *Elyno-Seslerietea*, *Juncetea trifidi*); (4) Oro-Mediterranean grasslands (*Festucetea indigestae*, *Festuco-Ononidetea*, *Carici-Genistetea*, *Rumici-Astragaletea*, *Daphno-Festucetea*, *Diantho-Teucrietea*); (5) Saline grasslands (*Festuco-Puccinellietea*, *Juncetea maritimae*, *Saginetea maritimae*); (6) Related heathlands (*Calluno-Ulicetea*, *Loiseleurio-Vaccinietea*); and (7) Related tall-forb and forest-edge communities (*Trifolio-Geranietea*, *Mulgedio-Aconitetea*).

Further, I will introduce the great and novel potential that our continental grassland plot database holds both for fundamental and applied research. The topics that can be addressed in an unprecedented manner include (i) fine-grain species-richness patterns and their underlying drivers across large spatial extents; (ii) functional diversity and species assembly rules; (iii) extrapolation of results from coordinated global change experiments to a continental scale; (iv) consistent re-classification of major grassland types across Europe; (v) standardized parameterization of vegetation types; (vi) contributions to conservation assessments such as EU red listing of habitat types. With some first analyses of diversity patterns in grasslands across Europe I will illustrate this potential.

## **Some peculiar features of the desert steppes of European Russia**

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Plant communities of desert steppes are xerophytic and consist of both compact bunch-grasses and dwarf semi-shrubs. In the European Russia desert steppes are widespread on the Yergeni Hills and on the Caspian Lowland and characterized by some peculiar features. First of all, they are poor in species of plants and presented by a few ecological variants, among them the prevailing following: pelitophytic variant on loamy soils, hemipsammophytic variant on loamy-sandy soils, and halophytic variant on salted soils and solonetz. Communities of feather-grass (*Stipeta sareptanae* and *Stipeta lessingiana*) are widely distributed. Along with them halophytic communities of other bunch-grasses (*Festuceta valesiaca* and *Agropyreta desertori*) play a noticeable role in a vegetation cover of the Caspian Lowland.

The originality of the desert steppes of the European Russia is participation of *Artemisia taurica* Willd. and *Artemisia lerchiana* Web. ex Stechm. in plant communities. On the Yergeni Hills both species are typical. On the Caspian Lowland *Artemisia lerchiana* prevails. *A. taurica* meets seldom. Eastern boundary of its range is the Big Bogdo's Hill and the Lake Elton (to East from river Volga).

The vegetation cover of desert steppes zone of the European Russia is very heterogeneous. Large spaces are occupied by complex halophytic steppes. Complexes include bunch-grasses (*Stipeta sareptanae*, *Stipeta lessingiana*, *Festuceta valesiaca*, *Agropyreta desertori*) and dwarf semi-shrubs (*Artemisieta lerchiana*, *Artemisieta pauciflora*, *Kochieta prostrata*, etc.) communities. The relation between communities of bunch-grasses and communities of dwarf semi-shrubs depends on the area with salted soils and solonetz. In one place communities of bunch-grasses dominate, in others – communities of dwarf semi-shrubs dominate, and there are places with dwarf semi-shrubs communities only.

Sandy soils, sands and sandstones meet seldom therefore a psammophytic ecological variant is insignificant here.

## Stability of ecosystem functioning in Dutch calcareous dune grasslands

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The hypothesis that a greater species diversity leads to a greater stability of ecosystem functioning has been a point of debate for decades. The increasing effects of climate change and the current biodiversity crisis makes this one of the most relevant research topics in current vegetation sciences. However much research is done in small scale *in situ* and *ex situ* experiments. In this research project it is aimed to upscale this research by combining remote sensing techniques and large databases on vegetation, climate and plant traits. The stability of an ecosystem can be assessed by looking at the degree of effect a disturbance has on ecosystem functioning. In this study the effects of large scale drought on biomass production of a species-rich grassland ecosystem is followed over a ten year period. With MODIS-NDVI satellite imaging an area of approximately 260 km<sup>2</sup> of calcareous dune grassland in the Netherlands was monitored. With the Dutch national vegetation database, detailed on-ground vegetation data was available for the calculation of several diversity indices per observed pixel. Also an index for functional diversity was included. An indication of stability was made using the variation in the interaction between a pixel's diversity and the pixel's greenness response anomaly to drought, expressed in the Standardized Precipitation and Evapotranspiration Index (SPEI). Results show a negative effect of drought on the greenness of the observed dune grassland pixels. Comparing high diverse pixel with less diverse pixels show an increased negative correlation between SPEI and the NDVI-anomaly, suggesting a decreased resistance to drought in area's with a low diversity, thus less stability. The correlation is particularly strong in years with severe drought events. In combining large databases with long term satellite monitoring, new methods in ecological research become available, giving opportunities to upscale current research on diversity.

## **The fate of semi-natural grasslands in Latvia in the era of Rural Development Programme**

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In Latvia, all semi-natural grassland vegetation types belong to habitat types listed in 92/43/EEK Habitats Directive, they are 1630, 5130, 6110\*, 6120\*, 6210, 6230\*, 6270\*, 6410, 6430, 6450, 6510, and 6530\*. Semi-natural grassland and scrub habitats cover approx. 47,500 ha (0.7% of the total area of the country). Only 40% of this area is located inside Natura 2000 sites. Overall conservation status of semi-natural grassland habitats was bad with the tendency to deteriorate according to the report on Article 17 of the Habitats Directive for 2007–2012.

Since 2004, semi-natural grasslands are being subject to management support under agri-environment scheme Management of Biodiversity in Grasslands (MBG). Analysis of grassland botanical quality of managed and abandoned semi-natural grasslands was based on the results of Natura 2000 site monitoring (2007–2012) and inventory carried out in summer of 2013 of grasslands managed under activity MBG outside Natura 2000 sites. In total, 2022 ha (350 sites) of seven semi-natural grassland habitats were inventoried (4.5% of the total area of these habitat types). Parameters analyzed were cover of litter layer, shrubs, and aggressive species untypical for particular grassland habitat type, the number of indicator species, and species richness.

The area of grasslands and the number of households participating in the MBG scheme indicate strong positive influence of MGB scheme on maintenance of semi-natural grassland habitats in Latvia (60% of the total area are under MBG). 54 to 92% of grasslands had a good quality of structures (amount of litter layer, dominance of invasive or aggressive native species, cover of shrubs etc.). On the other hand, the results show that almost 25% of the grassland under MBG scheme did not correspond to any EU grassland habitat type anymore, and only 2–17% of area was evaluated as highly qualitative according to species richness in 1 m<sup>2</sup> and total number of semi-natural grassland indicator species.

The low quality of biodiversity could be related to conditions of MBG scheme. Grasslands should be mowed only in late mowing (after 1 August) and grass is allowed to be mulched (chopped). Named management types are frequently referred to have a negative effect on vegetation structure and plant species richness. Because of data limitations we could prove it only partially.

It was concluded that the results of agro-environmental scheme Maintaining Biodiversity in Grasslands appeared less promising than it was expected. To promote semi-natural grassland conservation the MBG scheme should be considerably improved.

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## **Shrubs in grasslands; unwanted invaders or biodiversity enhancers?**

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The outstanding structural diversity in grasslands with scattered trees and shrubs implies strong effect on vegetation heterogeneity (beta diversity). Therefore, it is very surprising that there is so little information on the species richness and variability of shrub-grassland mosaics in temperate region.

We investigated two examples of shrub-grassland vegetation in Romania and in the Czech Republic. The grasslands in Romanian Banat are still managed in a traditional way. Pastures are grazed by cattle, horses, sheep, and goat. Pastures are also used to grow fruit trees. Further, shrub-like beeches and hornbeams are coppiced for fuel and unusable shrubs are from time to time burned to improve the pastures. In the Czech Republic, pastures are usually kept free of shrubs and trees. On the other hand, large areas of former agricultural land have been abandoned and are invaded by shrubs. The striking example of abandoned landscape is a military area in Doupovské hory. The area in Doupovské hory is grazed only by free living ungulates. However, both the extensive grazing in Romanian Banat and the 50 years-lasting abandonment in Doupovské hory resulted in heterogeneous mosaics of scattered or dense shrubs and grasslands.

The pattern of small scale species diversity was similar in both landscapes. However, some interesting differences emerged. The species richness on the scale of 1 m<sup>2</sup> was linearly and negatively dependent on the cover of shrubs in Doupovské hory while it peaked at 30% of shrub cover in Romanian shrub-pastures. Beta diversity on the small scale was positively correlated with variability in shrub cover in the both cases. However, the beta diversity seems to be much more important component of gamma diversity in the Czech shrub-grasslands than in the Romanian shrub-pastures. Alpha diversity fully determines gamma diversity in the shrub-pastures.

Further, we developed a simple model to show the effect of shrubs on the landscape scale in abandoned landscape. The model showed that the presence of shrub-grasslands in the landscape is advantageous for the landscape-scale beta diversity with only small effect on landscape-scale beta diversity. However, when the very dense shrubs prevail (more than 60%) in the landscape the vegetation heterogeneity declines and the landscape-scale gamma diversity quickly declines.

Our results document that the variability in shrub cover significantly contribute to the vegetation variability at different spatial scales in both regions. Shrubs are important in pastures as refugia for species demanding shade or for species that are sensitive to grazing. Therefore, the value of shrubs must be considered when managing the pastures.

## **Spatial variation of the matching between regional and local classifications: an example of Central European grasslands**

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The expectations towards broad-scale classifications of phytosociological data are often twofold: they are believed to reveal the most important broad-scale patterns of the vegetation and, at the same time, to test the validity of previously known patterns which were detected during local studies. We studied the relationship between regional and local patterns obtained from such classifications.

We compiled a data set of 8033 relevés representing Arrhenatheretalia elatioris and Brometalia erecti grasslands of eight countries in Central Europe (Austria, Croatia, Czech Republic, Germany, Hungary, Poland, Slovakia, Slovenia). This data set was classified by beta-flexible agglomerative method, which served as a 'regional classification' in the analysis. From this data set, local subsamples containing 50 plots were drawn randomly with a spatial constraint in order to represent variation on smaller areas. Each local subsample was classified by the same method as was the regional data set. The partition divergence measure was calculated between pairs of relevés based on the dendrogram of the regional and of the local classification. The correlation between partition divergence values of the relevés was applied to quantify the degree of matching between the regional and local classifications. We analysed the spatial distribution of the correlation values and tried to explain differences between areas of strong and weak matching between regional and local classifications. For a more detailed testing we ran analyses with reduced regional coverages as well (combining only one or two countries).

Correlation values of areas in the western part of the Western Carpathians were the lowest, while high correlations were found at the periphery of the study area.

Analyses with reduced extents showed that the position of the areas with the highest and the lowest matching may change if the regional coverage is altered.

We found that both the geometry and special features of the study area can affect the matching between regional and local classifications. The centres of study areas tend to show weaker matching than peripheral parts because of the similarity patterns within broad-scale floristic gradients. Local classifications of floristically unique areas and areas with low beta diversity matched well with the regional clustering.

## **Scale-dependent patterns of plant diversity in Transylvanian dry grasslands (Romania)**

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Commonly, patterns of plant diversity differ across scales and depend on the taxonomic group considered. Thus, comparing different scales and taxonomic groups might provide deeper insights into factors driving community assembly. The Transylvanian Plain (Romania) is characterized by extensive semi-natural grasslands, which are outstanding in terms of species richness. They include recent discovered global maxima for two fine scales. Our sampling design consisted of seven grain sizes, ranging from 0.0001 to 100 m<sup>2</sup>, which were arranged in both nested and separate plots. We recorded the presence of vascular plants, bryophytes, and lichens. As environmental variables we used soil parameters, topographic features, and land-use categories. Moreover, we included five relevant climate parameters. Species richness for all taxonomic groups was modelled as a function of these variables using generalized linear models, and a multi-model inference over all possible variable combinations with AICc was performed subsequently. We found strong differences in driving factors between scales and taxonomic groups. The pattern was consistent with the hypothesis that niche-related variables are more important at very fine scales, while for the larger grain sizes considered here heterogeneity and disturbance-associated parameters became increasingly more influential. The divergences among the responses of taxonomic groups can be explained by their different ecology. Moreover, we highlight that neglecting the scale can lead to incorrect generalizations (Turtureanu et al., 2014).

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**Rocky grassland vegetation (*Stipo-Festucetalia*) of the Pannonian Basin and the Carpathian Mts – biogeographical patterns revealed by semi-supervised classification**

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Diversity of rocky grassland vegetation of *Stipo pulcherrimae-Festucetalia pallentis* was studied in the Pannonian Basin and the Carpathian Mts with the main aim to unify the syntaxonomical classification across ten countries. A joint database was established containing all grassland communities within the study area including 40 077 relevés: AT (4235), CZ (6798), HR (1138), HU (4626), PL (3343), RO (2008), RS (820), SI (1290), SK (15 501), UA (318). This large initial data set served as a source of relevés from which the target relevés were selected. Heterogeneity-constrained resampling with the number of selected relevés driven by beta-diversity was applied on the data selection. First, typical relevés of known associations of the *Stipo-Festucetalia* order were selected by the experts from each involved country and overlaps in the national classifications were indicated and discussed. Then, cores of new associations were searched by the K-means semi-supervised classification method. Distribution of the revised syntaxa showed a clear geographical pattern suggesting existence of geographically and ecologically well-differentiated communities with a specific floristic composition. Based on the obtained results, a new classification scheme was proposed for the *Stipo-Festucetalia* order in the studied region. Financial support was provided by VEGA 2/0099/13.

## ***Patzkea paniculata* grasslands from Velebit Mt (Croatia) in the Balkan-Alpine-Apennine context**

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*Patzkea paniculata* (L.) G. H. Loos (= *Festuca paniculata* (L.) Schinz et Thellung) forms very localized monodominant grasslands in the subalpine belt of the Northern Velebit Mt (Croatia). Ecologically, these grasslands have intermediate position between relatively dry calcareous grasslands belonging to ass. *Festucetum bosniacae* Horvat 1930 and acidophilous grasslands of ass. *Nardetum strictae* Horvat 1930. The whole grassland complex was studied based on vegetation relevés, floristic diversity and ecology. It was shown that the distribution of these communities is determined by factors of topography, geomorphology and pedology, where *P. paniculata* grasslands are developed mostly on SW exposed slopes, with inclination of 11–26°, and in the altitudinal belt from 1250–1320 m a.s.l., on leached soil which completely cover the limestone bedrock. Additionally, their relations to grasslands dominated by *P. paniculata* of other Balkan mountains, the Alps and the Apennines were studied. Together with grassland communities of NW Balkans they are more closely related to Alpine ones than to the central and Southern Balkan ones, which, on the other hand, are more similar to Apennine communities. Grasslands from the Velebit Mt share a small set of common species with the nearest known *F. paniculata* grasslands from the Mts Cincar and Vranica (Bosnia and Herzegovina) e.g. *Festuca bosniaca*, *Euphorbia carniolica*, *Knautia dinarica*, *Scorzonera purpurea* subsp. *rosea*, which are all Illyrian species reflecting phytogeographical position of these communities. With grasslands from the mountains of other Balkan phytogeographical provinces – Mesic (Suva planina, Vlasina and Besna kobila) and Scardo-Pindic (Bistra) it shares only very small proportion of common species, which have wide area of distribution (e.g. *Leucanthemum adustum*, *Stachys officinalis* s.l., *Allium carinatum*, *Chamaespartium sagittale*, *Carex caryophylla*). Floristic connection with the Apennines is very weak with *Campanula glomerata* and *Carlina acaulis* subsp. *caulescens* as common species. However, connection with the Alps represented in ca. ten common species, is much more prominent. Some of common species are *Anthyllis vulneraria* s.l., *Brachypodium pinnatum*, *Hieracium hoppeanum*, *Potentilla erecta*, *Centaurea triumphetti*, *Scabiosa lucida*, *Veratrum album* and *Senecio doronicum*. Such phytogeographical connections of described grassland community reflect its position on NW border of Illyrian province, which can be considered as bridge between the Alpine *F. paniculata* grasslands with those on the Balkan mountains.

## Some Balkan endemics in Kosovo's grasslands and their conservation status

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During expeditions between years 2011–2013 in grasslands of Kosovo we have recorded some Balkan endemics, among them also some plant species with restricted distribution range (local endemics). Most of the Kosovo's grasslands lie in the sub-alpine and alpine zone, where majority of the Balkan endemics were found. As a result of intensive grazing, collection for commercial use and fires, habitat degradation and areal reduction emerged, notably for the following plant species: *Achillea alexandri-regis* Bornm., *Achillea clypeolata* Sibth. & Sm, *Achillea chrysocoma* Friv., *Convolvulus compactus* Boiss., *Genista hassertiana* (Bald.) Buchegger., *Gentianella crispata* (Vis) Holub., *Galium rhodopeum* Vel., *Senecio bosniaca* Beck, *Senecio procerus* (Gris.) Boiss., *Senecio scopoli* Hoppe & Hornsch and *Stachys serbica* Pancic. Carried research has shown that the most vulnerable plant species are those that are distributed in the vicinity of human settlements. The main risks facing these plant species are: limited distribution, low density, livestock, fires, habitat loss and degradation. In order to protect populations of these plant species, certain protective measures were proposed, as inclusion of these species in the Red List of Vascular Flora of the Republic of Kosovo, protecting their natural habitats and undertaking all the necessary measures for their conservation.

## **Fine-scale species-richness patterns in dry grasslands across the Eastern Balkan Peninsula**

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The relationship between fine-scale species richness and environmental factors varies across climatic and biogeographic regions. Therefore, dry grasslands in the Eastern Balkan Peninsula, developed under strong influence of the submediterranean climate, are a suitable model for testing whether the fine-scale species-richness patterns recognized in other areas of temperate-continental Eurasia are valid also for a flora with different evolutionary history.

Our questions are: (1) Which are the main abiotic factors controlling fine-scale species-richness of vascular plants in dry grasslands across the Eastern Balkans? (2) Do species with different evolutionary history (subcontinental and submediterranean) and ecological adaptations (life forms, life history, growth forms) have different responses to environment, and if so, what are the possible causes?

We sampled dry and semi-dry grasslands (*Festuco-Brometea*) across Bulgaria and SE Romania. In total, 172 vegetation plots of 100 m<sup>2</sup> with measured environmental variables were collected. Numbers of vascular plant species per plot were used as a measure of species richness. Species with different life forms, growth forms and geoelements were also counted. Environmental variables included soil pH, plant-available soil nutrients, soil depth (as a surrogate for water availability), biomass weight (as a surrogate for productivity) and selected climatic variables. To quantify relationships between species richness and environmental variables we used regression trees and linear regressions.

Macroclimatic factors were detected as the main determinants of total species richness and that of separate life forms, growth forms and geoelements. Most of the submediterranean species were annuals and most of the subcontinental species were perennials. Total species richness depended mainly on the species-richness patterns of annuals, submediterranean species and forbs, the latter being the predominating group in the species-richest plots. Total species richness as well as numbers of annuals, submediterranean species and forbs increased on the climatic gradient from continentality to mediterraneity, with the species-richest plots characterized by positive mean January temperatures. Water availability played role only within areas with colder winters. Productivity was positively related to the number of perennials and negatively to the number of annuals. Soil pH was negatively correlated with the number of subboreal species, graminoids and legumes.

## **Ecologically similar meadows are not equally threatened: relationship between plant traits and rarity**

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Secondary dry grasslands are known for their high biodiversity, especially at the edge of the Mediterranean basin. We investigate dry and semi-dry Central European and Dinaric (NW Balkan) meadows, which are ecologically parallel, but are not equally threatened. Dinaric meadows are still common and less endangered than Central European one. They were compared in order to test to which extent the ecologically similar meadows (e.g., soil type, altitude and precipitation rate) with similar management practices differ in the terms of the level of threats. In addition to this, the differences in floristic and functional composition between them were tested. We used the Red List (threatened) species to compare traits related to species resource use strategy and ability to compete for light between threatened and non-threatened grassland species and to test the effect of community-weighted means (CWM) on threatened species richness. The results showed that the regions differed significantly in floristic composition. The communities from the Central European region had significantly higher SLA and lower LDMC, which perhaps reflects an increase in intensive agriculture promoting fast-growing species. The occurrence of threatened species did not differ significantly between regions, but threatened species richness was significantly negatively correlated with CWM for height and SLA. This may suggest that threatened species are less likely to occur in high productivity communities where light competition is intense. This study provides initial evidence that changes in CWM for resource use strategy traits may represent a useful mean for predicting threatened species loss in dry grassland ecosystems.

## **How to group new releves? Halophytic plant communities of Central Anatolia revisited**

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Halophytic steppe and marsh communities of Central Anatolia, Turkey, found around salty lakes in depressions, have distinctive composition with many endemic species. They have been researched by my phytosociologists since 1960s, resulting in more than 20 associations of seven alliances under *SALICORNIETALIA FRUTICOSAE* Braun-Blanq. 1933, *HALOSTACHETALIA* (Grossheim) E. Topa. 1938, *ONOBRYCHIDO ARMENI-THYMETALIA LEUCOSTOMI* Akman, Ketenöglü, Quézel 1985 and *JUNCETALIA MARITIMI* Braun-Blanq. ex Horvatić 1934 orders. Aiming to draw a general picture of halophytic plant communities, we complemented 310 published relevés with 250 unpublished relevé data from Central Anatolia and neighboring sites, spanning more than 500 km. We compiled the data in TURBOVEG. Dataset was composed of relevés with the temporal range of 1962–2004 years, sizes of 4–100 m<sup>2</sup> and supported by inconsistent environmental parameters. We analysed the vegetation dataset using modified TWINSpan with total inertia and 3 pseudo-species cut levels (0, 5, 25) to get 25 groups. We interpreted the results based on field observations and environmental parameters provided in the literature.

We identified three major groups i.e. lowland non-halophytic or sub-halophytic steppes encircling salt lakes, halophytic steppes on soil with high salt content and halophytic marshes. Vegetation differentiated along soil salt and humidity gradients around the lakes, occurring as zones or mosaics. Agricultural practices such as ploughing for sugar beet production, overgrazing and overuse of underground and surface waters are causing degradation and destruction of the vegetation. We found no major regional differentiation among the communities except Nallıhan groups, which have locally-distributed diagnostic species. Existing phytosociological units did not cover all communities. So new units unique to Turkey needs to be described as well as vicariants of units present in Europe and Iran. The most effective way to do is to analyse all existing data on halophytic vegetation in Turkey with the help of data storage and analysis softwares. Major problems to overcome would be to reach literature data dating before 1970s and to deal with synonyms. Supplementing data with new relevés from under-represented sites such as Nallıhan and Palas Lake and analyses of soil humidity parameters as well as salt content would improve the understanding of halophytic syntaxa.

## Dry-meadow orchid richness and fitness: does flowering synchrony matter?

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Among the fine spatial scale processes that assemble plant communities, both competitive and facilitative interspecific interactions are currently supposed to be part of fundamental biotic assembly rules (*Rathcke 1983; Stoll and Weiner 2000*).

One of the most fascinating yet tricky biotic interaction is the pollinator sharing within co-flowering entomophilous species, whose facilitative or competitive outcome is still debated particularly regarding the effects on small-size population (*Gazoul 2006*).

We tested the presence of facilitative interactions due to flowering synchrony in calcareous dry grassland communities (*Festuco-Brometea*), with particular reference to orchid species.

The hypothesis tested were: 1. there is a non-random flowering pattern between orchid and non-orchid species; 2. orchid fitness is positively affected by flowering synchrony; 3. orchid richness (presence/absence, number and cover of orchid species) increases with synchrony.

The research was conducted in the Euganei Hills district (NE Italy). 50 2x2 m plots were randomly located and surveyed to determine species composition and monitored 18 additional times throughout the growing season (April, 1<sup>st</sup> to September, 30<sup>th</sup> 2013) to collect data on blooming occurrence for all entomophilous species. Topographic and morphologic features were also measured at the fine-scale (1 sqm). For three target orchid species (*Anacamptis morio*, *Himantoglossum adriaticum* and *Ophrys sphegodes*), some plant performance traits (PPT) were collected on tagged ramets. Overlapping in flowering time was computed as the mean value of co-flowering indexes (V coefficient; *Lepš and Šmilauer 2003*) for each pair of entomophilous species in each plot. For target orchids the amount of synchrony was estimated both as the sum and the average of all V coefficients. A null model test has been performed (*Gotelli and Graves 1996*) to test for the significance of co-flowering patterns.

Overall, a non-random blooming pattern involving all target orchids was found, but it seemed not to affect orchids performance. On the contrary, a strong correlation arose between orchids inflorescence height and pollinator visit rate (estimated as fruit/flower ratio on tagged ramets). Both logistic regression analysis on orchid presence/absence and GLM on cover data revealed a significant effect of mean canopy height and aridity ( $p = 0.0001$  and  $p = 0.05$  respectively), as limiting factors on orchids presence and abundance.

Flowering synchrony turned out not to be a primary factor in regulating orchid presence, abundance and fitness at the micro-scale, where a key role seemed to be played by structural features of the plant community and environmental constraints.

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## **Exploring the double stress in Mediterranean mountain. Response of secondary growth and parenchyma amount on *Juniperus sabina* along an altitudinal gradient**

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The high Mediterranean mountain is characterized by a double climatic stress (winter cold and summer drought), which results in a very short growth season. It's expected that the importance of these constraints varies along the altitudinal distribution, dominated by drought control in the bottom and cold at its upper levels. The analysis of secondary growth and xylem characteristics are used to understand the response of plant species to the environmental gradients along its altitudinal range. In this work we perform an analysis of a combination of ring width and parenchyma characteristics to evaluate the variation along the environmental constraints of a shrub (*Juniperus sabina* L.) along an altitudinal gradient of 750 m in a Mediterranean mountain (Javalambre, eastern Spain). Our hypothesis is that the width of the ring will be determined by the temperature conditions in the early spring and by the summer precipitation, with a subsequent advance of the date of both signals as we descend in altitude. We also expect that the relationship between the signal and the percentage of parenchyma is reflecting the conditions in the month of the onset of xylogenesis (April to May) as well as the conditions at the end of the growth period of the previous year. In overall terms it is expected highs in the amount of parenchyma at both ends of the gradient where the secondary growth is more limited by environmental conditions: cold in the upper stretch and drought in the lower.

## Why vegetation of Balkan rich *Sphagnum*-fens differ from that of more northerly regions?

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The occurrence of boreal mire species in otherwise warm and dry matrix of Balkan vegetation have been analysed during the last decade in Bulgaria, Serbia and Croatia. The most disjunctly occurring and probably postglacial-relict mire species grow in the rich-fen vegetation of the *Sphagno-Tomentypnion* alliance. At the vegetation level, the most detailed data came from Bulgaria, where new association *Geo coccinei-Sphagnetum contorti* has been described. However, the Balkan vegetation of this alliance differs substantially from analogous vegetation in more northerly regions, while other alliances do not differ so much. The crucial aspect is a rarity of calcium-tolerant *Sphagnum warnstorffii* in Bulgaria, an ecosystem engineer, which occurs only in few high-mountain ranges. *Hamatocaulis vernicosus*, another boreal species, is on the contrary more common in Bulgaria than in Central Europe what might be caused by competitive release due to the absence of its competitors. Based on recent genetic and ecological data on *Sphagnum warnstorffii* we gathered recently in Central Europe, we can formulate the hypothesis why this species does not dominate this vegetation in Bulgaria. Genetic difference or ecotypic adaptation will probably not be a reason as we found uniform genetic structure of this species along both ecological and broad-scale geographical gradients. During our research in Central-Europe we found that calcium content in a capitulum correlated negatively with water table depth, but only if rainy period had occurred before the sampling. Older data from Canada also suggest the relationship between capitulum calcium concentration and climate (precipitation vs. evapotranspiration). We can therefore hypothesise that during warm summer periods, calcium in *Sphagnum* plants moves upwards and the concentration of cell-wall bounded calcium in capitula increases. When long-lasting rain-falls occur, this calcium is leached back to lower segments, but in dry and hot Balkan summers this process does not take place. As a consequence, *S. warnstorffii* cannot survive in as calcium-rich fens as in Central Europe and brown-moss fens (*Caricion davallianae*) therefore still develop even under rather low calcium concentrations. The *Sphagno-Tomentypnion* fens are represented by vegetation with *Sphagnum contortum*, which is less calcium-tolerant species than *S. warnstorffii*. From the classification point of view, delimitation of the *Sphagno-Tomentypnion* alliance in the Balkans thus requires further study. We would like to ask other Balkan phytosociologists to co-operate in this effort.

## **Vegetation dynamics and plant cover structure on the volcanogenic substrata (in the Kamchatka peninsula, Russian Far East)**

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The Kamchatka peninsula (North of the Russian Far East) is one of the most active volcanic regions of the world. There are 30 active and 120 dormant volcanoes. Volcanism is the most powerful vegetation factor in the peninsula. Volcanic eruptions occur almost every year and destroy or damage the vegetation cover on vast territories. Thus, Kamchatka is a unique model area for the study of the plant cover volcanogenic dynamics. As the climate in Kamchatka varies in different parts of the peninsula 4 model territories were chosen: the volcanic plateau Tolbachinsky Dol (Central Kamchatka), the Krasheninnikov volcano caldera (Eastern Kamchatka), Ichinsky volcano (the Middle range), and the volcanic plateau Tolmachov Dol (Southern Kamchatka). The series of sample plots were laid on the dated lava flows and nearby according to the altitude gradient. The carbon-14 ( $^{14}\text{C}$ ) dating of volcanic ash layers in soil-pyroclastic cover had been obtained for the late Holocene (the last 10,000 years). The age of volcanogenic substrata was determined by the study of soil-pyroclastic cover in the soil profile (up to the underlying lava flow). The marking ash-layers were determined and the locality of sample plots matched on the large-scale geological maps of dated volcanogenic substrata (compiled in the Institute of Volcanology RAS). The field investigations were conducted on transects and sample plots. The floristic composition and the structure of volcanogenic and non-volcanogenic plant communities were analyzed. The empiric classification of volcanogenic vegetation was elaborated on the base of sample plot data using the methods of Russian geobotanical approach. The detailed data on floristic composition and plant community structure together with the environmental variables and the sites characteristics (altitude, topographical location, exposition, inclination, age of underlying lavas, thickness of soil organic horizon, thickness of soil-pyroclastic cover on the surface of the lava flow, etc.) were used for the study of the influence of volcanogenic and environmental factors on the peculiarities of recovery vegetation dynamics. The sequence and the rate of the plant succession stages were evaluated on the base of vegetation data and dated lava flows on territories with different intensity of volcanogenic disturbance.

## **Phytodiversity and ecology of different populations of genus *Ramonda* in Kosovo**

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In Kosovo genus *Ramonda* is represented with two endemic and relict plant species: *Ramonda serbica* and *Ramonda nathaliae*. This study focuses on: differences on associated plant species between the both *Ramonda* populations in Kosovo and their impact on dominant plant communities. Research was carried out from different populations of *R. serbica* on the Sharri Mountains (5 populations) and Albanian Alps (5 populations), while for *R. nathaliae* two populations from Sharri Mountains. Based on obtained results, *R. serbica* inhabits in more humid and cooler habitats, primarily sheltered by forest canopy, while *R. nathaliae* is found in more open, drier and warmer habitats. For the all researched populations, that we have explored, we recorded a total of 89 associated plant species (1 bryophytes, 8 pteridophytes, 1 gymnosperms and 79 angiosperms) belonging to 35 families and 60 genera. In the both *Ramonda* populations, the ratio of family to genus was 1 : 1.71, family to species was 1 : 2.57 and a genus to species was 1 : 1.48. The dominant families of the associated plant species were: *Compositae*, *Brassicaceae*, *Caryophyllaceae*, *Crassulaceae*, *Lamiaceae*, *Saxifragaceae*, *Geraniaceae* and *Aspleniaceae*. The most dominate plant community in all of the *R. serbica* populations are *Musco-Ramondaetum serbicae*, while in *R. nathaliae* populations are two plant communities: *Cetereto-Ramondaetum nathaliae* and *Ostrya-Ramondaetum nathaliae* new association prov. These differences of plant communities indicated the differences of ecological conditions between *Ramonda* populations.

## **Different approaches to vegetation mapping during wind power plants impact assessment**

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For assessment of the project's impact on flora and fauna present in the wider project area, as part of the nature and/or environmental impact assessment (NIA and EIA), knowledge of habitat distribution of the wider area plays a vital role. Therefore, when assessing more complex projects, a detailed habitat map is developed with mapping scale of at least 1 : 10,000. In order to adequately analyse wind power plants impact on local flora and fauna, and at the same time increase the expediency of the final result, two different approaches, based on vegetation mapping, are used while mapping the habitats. One approach is used to assess the impacts on rare and endangered plants, invertebrate and most vertebrate species within the standard buffer area (up to 250 m around the wind power turbine). In order to establish the presence of suitable habitat types for individual species, phytocenological methodology approach is used for vegetation mapping. In this manner a detailed habitat map according to the National Habitat Classification of Republic of Croatia (NHC) is produced and impact on those three groups can be assessed in regard to loss and change of suitable habitats. At the same time, loss of endangered and rare habitat types can also be established. The second approach is used for bat and bird species. As animals that fly and migrate, these two groups are under stronger pressure of wind plant development. To adequately analyse the possible impact on endangered bat and bird species, it is important to determine how they use the wider project area up to 5 km around the wind power plant. In order to expedite the production of habitat maps adjusted to the needs of ornithologists and chiropterologists, vegetation is mapped based on physiognomic vegetation types, thus forming a modified habitat map. The presentation will show similarities and differences between those two vegetation mapping approaches.

## **Phytogeographical and phytosociological patterns in *Rubus* L. subgenus *Rubus* in Northwest-Europe**

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One of the striking features of blackberries (*Rubus* L. subgen. *Rubus*) is the small, unsaturated distribution area of many apomictic species. This makes the genus very suitable for phytogeographical research, for instance to study the effects of long-distance dispersal beyond the borders of the settled distribution area. Apart from bird migration, anthropogenic transportation with wood or plantation material are believed to have its influence on the distribution areas of *Rubus* species. In our study, we describe the phytogeographical *Rubus* regions of Northwest-Europe on the basis of distribution data of more than 600 bramble species in the British Isles, Denmark, Germany, and the Netherlands. The 14 *Rubus* regions we distinguished are characterised by climate, elevation, and soil characteristics, as well as their characteristic species. Several 'classical' *Rubus* communities are easily recognised in the lists with characteristic species of some *Rubus* regions: the *Rubetum silvatici* Weber 1995 (*Lonicero-Rubetea plicati*) in the North-German Plain region, the *Sambuco racemosae-Rubetum rudis* Tüxen & Neumann ex Weber 1999 (*Sambucetalia racemosae*, *Rhamno-Prunetea*) and the *Pruno-Rubetum elegantispinosi* Weber 1974 (*Pruno-Rubion radulae*, *Rhamno-Prunetea*) in the Rhenish Massif region. The same holds true for several newly described associations, viz. the *Rubetum taxandriae* Haveman et al. 2012 (*Lonicero-Rubetea plicati*) in the South-Netherlands region and the *Senecioni ovati-Rubetum iuvenis* Haveman et al. 2014 (*Sambucetalia racemosae*, *Rhamno-Prunetea*) in the Rhenish Massif region. This raises questions about the *Rubus* communities in other regions, such as the South-Germany region, for which a *Rubus bavaricus-Rubus epipsilos* community was mentioned in literature, or the regions where no data on *Rubus* communities are available. Species composition and ecology of these communities are discussed. From the data presented here, we argue that the species composition of *Rubus* communities is determined for a large part by neutral processes, and not primarily by ecological factors.

## **Mesoxeric perennial ruderal vegetation of the Rhine-Main-Area (Western Germany) and its contribution to an Eurasian View of Nature Conservation**

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**Aims:** This article outlines the results of a long lasting research project from 1997–2013 concerned with mesoxeric perennial ruderal vegetation on sandy and chalky alluvial soils in Western Germany (Rhine-Main-Region) and their syntaxonomical position in Eurasian syntaxonomy. Centered on the class *Artemisietea vulgaris* and heading to a modified hierarchical structure in its whole Eurasiatic distribution range it covers also neighboured high rank units as from *Arrhenatheretalia* or *Rhamno-Prunetea*, also dealing with methodological, ecological, biodiversity and conservation topics.

**Methods:** The investigation area covers about 150×50 km. Dataset analysis combines classical syntaxonomic and stratification methods to enable a wide scale of options in both fields of describing and numerical vegetation ecology. The distribution and structure of vegetation have been analysed, 3 of 9 main natural units (“Hauptnatureinheiten” nach Ssymank et al. 1999) with a sufficient frequency of sub data sets have been statistically investigated in details.

**Results:** A large amount of over 30 syntaxa has been investigated and compared to the most actual Eurasian literature. New suggestions for classifications on high rank levels are given.

1. There's enough statistical evidence for the 2 central Eurasian Classes *Galio aparinae-Urticetea vulgaris* and *Artemisietea vulgaris*.
2. *Artemisietea vulgaris* is divided in the 2 orders *Cirsio vulgaris-Artemisietalia vulgaris* comb. nov. and *Daucetalia carotae* nom. nov. as a new edited synonym for the *Onopordetalia acanthae*.
3. The *Cirsio-Artemisietalia* is described with the 2 Alliances *Cirsion arvensis-vulgaris* comb. nov. and *Arction lappae*, the *Daucetalia* with the 3 Alliances *Onopordion acanthae*, *Dauco-Meliloton* and *Elymo repentis-Falcarion* comb. nov.

The ecological dependency to varying management, standing factors and nature conservation are discussed leading to new insights and evaluation concepts in landscape ecology and nature conservation.

**Conclusions:** Despite the still existing lack of information on some Eurasian areas and hence the preliminary character of this new classification, this article hopes to participate in the ongoing globalization of syntaxonomy and conservation measures which are of great practical value in times of global change.

## **Quality assessment of Natura 2000 habitats – Approach in Flanders (northern Belgium)**

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To assess direct or indirect effects of a plan or project on a Natura 2000 protection site, or to estimate the potential for restoring Natura 2000 habitats, threshold values in biotic and environmental characteristics need to be defined so that habitat quality can be assured.

In this contribution, we will explain the concept of habitat quality, and present detail about definitions, relevant environmental characteristics, and the occurrence for two example habitats (6510 lowland hay meadows, and 4010 wet heathland) in Flanders (northern Belgium). Data from hundreds of vegetation relevés with accompanied environmental data are used to develop a quality index, and to explore several techniques for determining threshold values.

For assessing habitat quality a quality index is developed, which provides an ecological scale indicating favourable and unfavourable local conditions. It is the weighted mean of several biotic indicators transformed into a distance measurement, showing the distance of an observed measurement to a threshold value. The correlation of these biotic indicators with several relevant abiotic variables is verified, and multiple threshold values tested. Using this quality index in generalized linear and additive models, quantitative thresholds were defined for each variable that determined the occurrence of the habitat type.

Finally, we will explain the use of two threshold values (one to assess a good quality and one to assess an optimal quality) in Flemish policy, and provide possible deductions. These entail e.g. similar indices that can be useful for assessing the regional conservation status of Natura 2000 habitats (article 17 reporting, every six years).

## **A supervised classification method – Cocktail Determination Key and CoDeK**

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To synthesize the ecological knowledge from the vegetation plots, one of the important things is a formalization of vegetation classification. A formalized classification is consistent and repeatable by unequivocal assignment rules. Cocktail method was developed to formalize the expert system into algorithms based on the species group concept. Species group concept is the central idea in vegetation classification based on application of the Braun-Blanquet approach. Thus, the unequivocal assignment rules used in Cocktail method can be practically discussed and improved. In this study, a new cocktail method, Cocktail Determination Key, is introduced. This method can be programmed to be applied automatically by the software, CoDeK, which is an application based on the R program (<http://bit.ly/cocktail-determination-key>). The data input can be done by files using plain text format, or it can be run in the JUICE-R function by JUICE software.

The Cocktail Determination Key contains  $n$  Cocktail formulae ( $X_i$ ). While running this key, each vegetation plot is compared with each formula in a stepwise manner ( $X_1$  à  $X_2$  à  $X_3$  à ... à  $X_n$ ). If the plot fulfils the conditions defined by formula  $X_i$ , it is assigned to the vegetation type defined by formula  $X_i$ . Cocktail formula in the Cocktail Determination Key contains five main parts: the rank of the formula, species groups, numbers in front of the species groups, logical operators (AND, OR, WITH, WITHOUT, NOT) connecting the species groups, and the code of vegetation unit assigned by this formula.

The advantages of Cocktail Determination Key in comparison to other published supervised methods are: it provides the clear argument and logic, based on the presence or absence of species groups in a specific habitat, used in classifying the vegetation; it can be applied in species rich communities; it can be developed step by step without knowing all the existing vegetation types in advance. However, the disadvantages of Cocktail Determination Key are: to construct all the formulae is time consuming and the over-training must be avoided.

## **Use of mean Ellenberg indicator values revisited (again)**

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Ellenberg indicator values represent estimated optima of plant species along main ecological gradients. Values assembled by Ellenberg are valid mostly in central Europe, but similar systems were developed also in other parts of Europe (e.g. Landolt's values for Switzerland, Borhidi's for Hungary, Jurko's for Slovakia, Zarzycki's for Poland, Hill's for Great Britain, Pignatti's for Italy) and also outside Europe (Klinka's values for British Columbia). Means of Ellenberg indicator values for species occurring in given vegetation plot (sometimes weighted by their abundances) are commonly used to infer habitat conditions from species composition. To evaluate how accurate is such inference, mean Ellenberg values are routinely correlated or regressed with measured environmental variables, and a good fit is considered as a proof that Ellenberg values are good estimates of real environmental conditions.

The problem is that one can get strong and significant relationship between mean Ellenberg indicator values and measured environmental variable even in case that species Ellenberg values are replaced by random numbers, and mean of such random numbers therefore have no ecological meaning. This paradox situation occurs in cases of environmental variables which have a strong effect on species composition. The reason is that weighted mean of species indicator values and environmental variable are not independent from each other. They are linked by changes in species composition: mean Ellenberg values are derived from species composition (by calculation), while environmental variables influence species composition. When relating mean Ellenberg values to environmental variables, it is important to separate the relationship between environmental variable and species composition (which is not of our interest in this case) from relationship between environmental variable and indicator values (which is what we are testing).

In a previous study, Zelený and Schaffers (2012) pointed out similar issue with testing the significance of relationship between mean Ellenberg values and scores from ordination diagrams or results of cluster analysis, which was explained by circularity of reasoning. Here, I will show that this issue is more general and includes also testing the relationship between mean Ellenberg values and environmental variables or experimental treatments. I will propose a way how to deal with this problem, illustrate it on examples of real vegetation data and demonstrate a simple software (<http://bit.ly/ellenberg>), which calculates the correct significance values for regression or correlation between mean Ellenberg values and other variables (environmental variables, ordination scores, cluster assignment etc.).

### Reference

Zelený D. & Schaffers A. P. 2012: Too good to be true: pitfalls of using mean Ellenberg indicator values in vegetation analyses. *Journal of Vegetation Science*, 23: 419–431.

## Poster presentation – Abstracts

### **Coenology and ecology of *Glyceria declinata* Bréb. – new species in flora of Ukraine**

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*Glyceria declinata* Bréb. is widespread species in Atlantic Europe in areas with temperate climate (between the parallels 60° and 36° north). The species is invasive in North America, Australia and New Zealand. *G. declinata* has been recognized in most Central European countries only in the middle of last century. Before, it was considered as a different rank taxon of *G. fluitans* (L.) R. Br. or *G. notata* Chevall. Nowadays it is common species in the neighboring to Ukraine countries – Poland and Slovakia.

Up to now, 3 localities only were known from territory of former USSR camp (two in Belarus, one in Latvia). None of Ukrainian floristic works which dealing with vascular plants does not mention this species, although it was found in the western part of country in 19 century. Three oldest specimens of this species from the territory of present Ukraine are kept in the Herbarium of the Polish Academy of Sciences (Krakow). Firstly they were mistakenly identified by collectors as *G. fluitans*, but in 1958 they were reidentified as *G. declinata* by S. Walters.

The presence of this species in the Ukrainian Carpathians was established by us during the summer 2009. New 23 localities of species were revealed on the territory of Western part of Ukraine within 2009–2013 research work of hydrophilous flora and vegetation. It occurs mainly in the mountains at elevation between 430–950 m a. s. l. (21 localities) and it is rather rare on lowland (only 2 localities at elevation 200–270 m a. s. l.). The species is considered to be on the eastern limit of its distribution in Ukraine.

*G. declinata* is a pioneer species that colonize mud flats and banks along slow moving rivers and streams and along the shores of lakes and ponds. It is adapted to long periods of inundation, but it generally grows in the less inundated areas than more inundation-tolerant *G. fluitans* and even *G. notata*. It was established, as a result of identification according to revision of literary sources, that communities with participation of *G. declinata* belong to 3 classes: *Phragmiti-Magno-caricetea* (all. *Glycerio-Sparganion*, ass. *Glycerietum fluitantis*, *Glycerietum notatae*; all. *Eleocharito*

*palustris-Sagittarion sagittifoliae*, ass. *Alopecuro-Alismatetum plantaginis-aquaticae*), *Molinio-Arrhenatheretea* (all. *Cynosurion cristati*, ass. *Prunello vulgaris-Ranunculetum repentis*), *Bidentetea tripartitae* (all. *Bidention tripartitae*, ass. *Bidentetum tripartitae*).

*G. declinata* occurs in lowlands localities with low cover values in *Glycerietum fluitantis* association and prefers the channel shoals. The most typical habitat of species in the mountain belts are moist, trampled places, puddles on forest roads and paths, periodically inundated depressions. Whereas these localities are concentrated in precipitation-rich areas, soil there is moist, sodden for many weeks. It is considered the best condition for *G. declinata* where plants are always flowering and fruited. In the mountains it doesn't occur on the river banks and along the shores of ponds. But it can develop on the exposed bottoms of summer-dried ephemeral pools in their vicinity. Sometimes it occurs in the small pools, diggings, which are inundated up to 50 cm and never are subject of total desiccation. This is only kind of habitats where *G. declinata* dominate, but usually it grows in the complex with *G. plicata*. Rarely the species may occur in very disturbed totally desiccated (in the summer period) places, alongside the new roads and logging units.

## **Distribution of alien plants in the Tatra Mts and main factors affecting it**

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The Tatra Mts represent the highest range of the arc of Western Carpathians, with the highest peak, Gerlach, reaching to 2655 m a.s.l. Since the establishment of the national parks main impacts of human activity resulted from tourism and winter sports, mainly building of new hotels, attractions, cableways, roads, which create new niches for the establishment of alien species and represent conduit of spread of propagules of alien species. To decrease the pressure on the more vulnerable alpine and subalpine zone, most of the hotels and attractions are concentrated in the montane zone of the mountain range. Additionally, valley roads are closed to vehicular traffic except for the access and therefore all the tourist trails are accessible only by foot.

The aim of the presented study was to analyse patterns of distribution of alien plant species in the mountains on the model region of the Tatra Mts, focusing primarily on the aspect of communications as the conduit of spread of alien species. The data were collected during years 2009–2011 in several ways: (i) altitudinal transects along the tourist routes in mountain valleys, (ii) transects along main roads, (iii) transects along railways and iv) plots located in the surrounding of mountain chalets.

Applying all above-mentioned data collection methods, together we found 29 archaeophytes and 17 neophytes. The most frequent alien species were *Trifolium hybridum* (36 localities), *Matricaria discoidea* (28), *Lupinus polyphyllus* (26), *Melilotus albus* (26), *Capsella bursa-pastoris* (23), *Epilobium ciliatum* (19), *Juncus tenuis* (18). Majority of alien species was found in the lower altitudes in the localities with intensive human activities. Altitudinal maximum of the species and its frequency in the mountain range were statistically significantly correlated. From all of the evaluated characteristics, the altitude, distance from the main road, slope, cover of the tree and shrub layer and cover of the bare rock were the most correlated with the number of the alien species.

Pattern of the distribution of alien species along the main corridors in the Tatra Mts reflects the intensity and type of use of the communication. The main roads are in general used more frequently than any other type of communication in the studied region and host the highest number of aliens. Fact that the intensity of use of the communication is more important than the type of the road surface is supported by our observation that other roads, both paved and asphalt, with limited vehicular access are very similar in their alien species richness. Narrow paths, which cannot be accessed by vehicles, are almost free of alien species, even though they are found in the widest range of altitudes and are often parallel to the paved or asphalt road in the same valley.

## Flora survey in Jászság micro region, Hungary

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The examined area is a plain micro-region in Hungary; its districts are 701 square kilometer. (Elevation of Jászság is between 84.5 and 101 meters.), located in the eastern part of the Hungarian Great Plain where the river control and spate discharge were begun in the 18th century. Before this work the river system was meshed the all region. After this transformation many backwaters were stood back. The ground covering was formed on the stream deposit of the river Zagyva and the river Tarna. This consists of clayey silt and upon was heaped loess. In our days this area is a fragmented agricultural landscape. The remaining semi-natural habitats are located in mosaic. The significantly ploughmen of yore dominated the vegetation of a micro region with marshes, moorlands, shallow lakes with mosaic soft- and hardwood gallery forests dominated it. The mountain of medium height one is attached to by his flora weakly only, in indigenous is poor. Currently szolonyec salt pastures and meadows, plain marsh meadows, smaller marshes and the mostly plantation character derivative forests typical. Primarily we research the flora of the area, it was stated in 2009. We evaluated the floristic data on the basis of the Hungarian species list [1].

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## **Variability of the CSR functional types among Croatian populations of the invasive *Erigeron annuus* (L.) Pers.**

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According to the CSR system, plant species can be grouped into different functional types, based on their preference to environmental factors associated with stress and/or disturbance. Functional types are assigned to plants by measuring a certain set of traits; hence plants of the same type should show similar expression of traits (apart for showing similar ecological behaviour) (Grime 2001). Many factors are believed to be of relevance for the invasive success of alien plants, and plasticity in the expression of traits is one of the frequently studied phenomena in that context (Davidson et al. 2011). We aimed to assess the CSR type of different populations of *Erigeron annuus*, searching for variations among populations, which would indicate variability in their ecological behaviour. We have surveyed 13 populations in Central Croatia, sampled five plants from each population and measured the required traits, using the methodology after Hodgson et al. (1999). For the calculations of the leaf traits, five leaves from each plant were used (in total 25 leaves per population). The populations were selected from anthropogenic habitats where *E. annuus* usually occurs. However, we attempted to select from as diverse microhabitats as possible, especially aiming for populations that contained somehow visually distinct individuals, to capture the effect of different environments on the same species. The calculations have shown that *E. annuus* is commonly a competitive-ruderal plant. The populations were grouped into two CSR types; most populations were of CR type (eight populations), while others were similar, but displayed a more competitive strategy (C/CR type, five populations). Among these two groups, based on ANOVA, a significant difference in the leaf traits was observed, with the exception of fresh leaf weight. SLA and dry matter content have shown the greatest variability. In conclusion, observed variability of leaf traits was reflected on a minor difference in CSR type of studied populations.

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## New data on alien *Acacia* species in Croatia

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Today, vegetation of a given area may be strongly influenced by human-driven introduction of alien species. Biological invasions are considered among the main factors of global changes (Mooney and Hobbs 2000) and the identification of future invaders may help in taking effective steps to prevent their dispersal and/or establishment (Mack et al. 2000). At European level, an increasing attention is given to invasive alien species (IAS) and to the development of methods for documenting the reasons for successes and failures of alien species (COST Action TD1209 ALIEN Challenge 2013–2017). Australian *Acacia* show different status of invasiveness in Europe: several species display an invasive status in some Mediterranean countries, but not in others. Flora Croatica Database (FCD) contains *Acacia dealbata*, *A. saligna* and *A. retinoides*, with just 12 records of their locality, prior to this survey. At present, these species are not indicated as invasive in Croatia. Two of them, *A. dealbata* and *A. saligna*, are certainly IAS in Italy, and the first also in Spain and Portugal. The COST-STSM-ECOST-STSM-TD1209 was precisely devoted to survey the actual distribution of acacias along the Croatian coast (which is expected to offer the suitable environment for acacia growth) while monitoring location of plants (gardens or natural areas) and flower visitors. The survey brought 147 new records for *Acacia dealbata*, and other 13 on other acacia species, showing wider distribution of acacias in Croatia then previously thought. However, their distribution is limited to the warmest parts, with as much as 90% of all localities situated in elevations lower than 80 m a.s.l., having absolute minimum yearly temperature above 1.1 °C. Yearly precipitation ranged from 820 to 1200 mm (10% and 90% percentile). *A. dealbata* is highly preferred as ornamental in private (86.8%) and shared gardens (3.5%). A remaining 9.7% of records, anyway, refer to plants grown in abandoned or unattended gardens, demonstrating the potential of this species to expand if not properly controlled.

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## **Some rare and endangered geophytes in the serpentine of Kosovo**

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We present a summary database documenting information on rarity, geographical distribution, taxonomy and conservation status of 11 geophyte species in serpentine soils of Kosovo, already included in the Red Book of Vascular Flora of Kosovo. Kosovo's serpentine vegetation represents a diversity that yet has not been sufficiently explored. These soils are spread in different parts of the country, at altitudes of 400–2100 m. Large serpentine complexes are found in the northern Kosovo but also southern part of the country is rich in serpentines, therefore in endemics. Serpentine (ultramafic) rocks and soils are characterized by low level of principal plant nutrients (N, P, K, Ca) and exceptionally high levels of Mg and Fe. Serpentines of Kosovo are important particularly for flora of the country because of their richness in endemic species. In particular we have analysed the following 11 plant species: *Aristolochia merxmuelieri*, *Colchicum hungaricum*, *Crocus flavus*, *Crocus kosaninii*, *Epimedium alpinum*, *Gentiana punctata*, *Gladiolus illyricus*, *Lilium albanicum*, *Paeonia peregrina*, *Tulipa gesneriana* and *Tulipa kosovarica*. Five out of these eleven geophytes fall within Critically Endangered IUCN based threat category and five out of eleven are local endemics. *Aristolochia merxmuelieri* and *Tulipa kosovarica* are stenoendemic plant species that are found exclusively in serpentine soils. Information in our database should prove to be valuable to efforts in ecology, floristics, biosystematics, conservation and land management.

## **Plant species of the genus *Paeonia* in Kosovo and their conservation status**

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During the years 2011–2013 we have researched the types of genus *Paeonia* in the Republic of Kosovo and we have assessed the conservation status of species from this genus widespread in Kosovo. From this genus are widespread in Kosovo only three types: *Paeonia mascula* (L.) Mill., *Paeonia peregrina* Mill. and *Paeonia officinalis* L. The conservation status of the species was based on the “Guidelines for Using the IUCN Red List Categories and Criteria – Version 8.1 (August, 2010)”. The analysis has been conducted by using the program RAMAS Red list Professional, where a special importance has been given to the following data: generation length, geographical distribution, data on population (number of mature individuals), Extent of Occurrence (EOO), and Area of occupancy (AOO) in km<sup>2</sup>, number of populations/subpopulations etc. Species *Paeonia mascula* is found in five locations and is evaluated in category Endangered (EN), *Paeonia peregrina* was found in three locations and is evaluated in category Vulnerable (VU) and species *Paeonia officinalis* is found only in one locality and is evaluated in the category Endangered (EN).

## **The effects of domestic livestock grazing on Alpine tundra in the western U. S.**

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Alpine areas are sensitive biomes that are fragile, even when the potential or real impact is not intense. Our research has focused on the effects of grazing (cattle, horses, sheep) impacts on plant community composition and soil erosion in alpine areas of the Rocky Mountains and Sierra Nevada. Grazing can have dramatic effects on plant communities and soils in alpine ecosystems particularly within arid and semiarid regions. Therefore, understanding the links between environmental drivers, grazing disturbance, plant functional traits, and ecosystem properties is critical for understanding long term patterns of biodiversity and ecosystem sustainability. Our study is aimed at determining the differences between grazed and non-grazed alpine meadows in the mountains of western U. S.

Plant species composition of alpine habitats in the Sierra Nevada and Rocky Mountains is influenced by the availability of soil water. Grazing animals can alter soil and hydrologic environments in various often interacting ways. One analytical tool for predicting the effects of grazing on different ecosystems is through the analysis of community scale plant functional traits. Differences in functional trait composition, biogeographical patterns and processes in plant communities are used to compare grazed to non-grazed areas in similar habitat types, such as dry meadows, even in areas with different floras. In this time of extreme and changing climate knowledge of how ecosystems could change is crucial for future decision making to protect biodiversity for the future. Adaptations of alpine plant species to large mammal grazing is also not well understood, as well as the role of grazing in structuring these systems. This contribution seeks to determine these differences between grazed and non-grazed alpine communities.

A stratified random sampling design and system of transects was used to inventory vascular plants in similar habitats of the alpine ecosystems across selected areas within Yosemite National Park, Sequoia NP, Rocky Mountains NP and San Juan Mts. Three major localities have been chosen in the alpine tundra or near the timberline. One represented an area with little grazing impact, a second area has had historic grazing only, and the third has some current grazing.

The preliminary results show that the regeneration of vegetation is of locality dependent. Generally, higher rodent densities in grazed meadows than ungrazed meadows influenced the overall pattern of studied vegetation. The soil erosion in alpine areas of some localities with specific environmental conditions (e.g. with

different amount of precipitations, different wind direction) still continue and is similar to recently grazed areas. Thus, we are able to recognize the impact of previous management even after 100 years of cessation of grazing.

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## Alpine vegetation of the Western Sayan

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The Western Sayan is the mountainous region placed in the central part of Eurasia. The mountainous chain is about 600 kilometres long. It is characterized by the system of high mountain ridges (up to 3121 m) and well-developed alpine belt occupying about 16% of area. Due to its location, the macroclimate of the Western Sayan is continental.

The basis of the analysis was 540 relèves of alpine, chionophytic, dry meadow, dwarf-shrub tundra and alpine screes. Classification was carried out using the Braun-Blanquet approach according to Westhoff and van der Maarel (1973), supplemented by the use of the programs TWINSpan and MegaTab (Hill 1979, Hennekens 1996).

The vegetation of Western Sayan is described and classified into 14 plant communities.

Alpine tundra of the Class *Loiseleurio-Vaccinietea* is represented by an association (*Vaccinio uliginosi-Dryadetum oxyodontae* Zibzeev, Nedovesova 2014) and four communities (*Rhododendron aureum-Vaccinium uliginosum*, *Betula rotundifolia-Anthoxanthum alpinum*, *Betula rotundifolia-Carex iljinii*, *Abies sibirica-Vaccinium myrtillus*). The alpine tundra is characterized by predominance of ericoid dwarf-shrubs (*Vaccinium vitis-idaea*, *V. myrtillus*, *V. uliginosum*, *Empetrum nigrum*) and well-developed layer of lichen.

At present alpine dry meadows (Class *Carici rupestris-Kobresitea bellardii*) are represented by three associations (*Flavocetrario cucullatae-Dryadetum oxyodontae* Zibzeev, Nedovesova 2014, *Festuco sphagnicolae-Dryadetum oxyodontae* Zibzeev, Nedovesova 2014, *Carici ledebouriae-Dryadetum oxyodontae* Zibzeev, Nedovesova 2014) and two communities (*Festuca sphagnicol-Cladonia arbuscula, Hedysarum austrosibiricum-Festuca sphagnicola*). These communities are characterized by a well-developed layer of cryophilous drought-resistant alpine species (*Kobresia myosuroides*, *Kobresia sibirica*, *Carex rupestris*, *Lagotis integrifolia* Minuartia verna, *Pedicularis oederi*, *Potentilla gelida*) as well as by a distinct lichen layer (*Cetraria islandica*, *C. loevigata*, *Flavocetraria cucullata*, *F. nivalis*, *Thamnolia vermicularis*, *Vulpicidia tilesii*).

The Western Sayan chionophilous communities of the Class *Salicetea herbaceae* (ass. *Polytricho sexangularis-Ranunculetum altaicae* Korolyuk 2001, *Salici turczaninowii-Sibbaldietum procumbentis* Danilchka et Chytry 1995 and *Gentiana grandiflora-Sibbaldia procumbens*) contain a group of regional Asian alpine species (*Aquilegia glandulosa*, *Carex aterrita*, *Gentiana grandiflora*, *Veronica densiflora*, *Viola altaica*). A characteristic feature of the subnival chionophytic meadows is an essential phytocoenotic role of prostrate species of *Salix* (*Salix turczaninowii*, *S. reclusii*, *S. berberifolia*).

Vegetation of subnival screes (Class *Rhodioletea quadrifidae*) is represented by a single association only: *Saxifraga oppositifoliae*–*Rhodioletum quadrifidae* Zibzeev 2013. It is characterized by an original floristic composition comprised of petrophytic cold-tolerant plants (*Cardamine bellidifolia*, *Cerastium lithospermifolium*, *Cerastium pusillum*, *Oxygraphis glacialis*, *Paraquilegia microphylla*, *Rhodiola quadrifida*, *Saxifraga bronchialis*, *S. cernua*).

**Nomenclature and syntaxonomic notes on the alpine and subalpine calcareous grasslands from the class *Elyno-Seslerietea* BR.-BL. in Serbia**

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The present work aims at providing the general overview of the alpine and sub-alpine calcareous grassland communities, their number and relationships, as well as the nomenclature of these syntaxonomic units appearing on the Serbian territory. According to the last comprehensive overview of the Serbian vegetation, the total of 67 syntaxa on association and subassociation levels were listed within the *Elyno-Seslerietea* class. Many of these syntaxa were given provisory, or just mentioned in the vegetation overviews of different areas, in both cases their existence was reported without the phytosociological tables. Only for 35 syntaxa the tables were published, and these were used as our data set. Relevés of the total of 35 syntaxa on association and subassociation levels were subjected to the numerical analyses, and also to the nomenclatural revision. The results of the classification and ordination revealed the syntaxonomic relations of the communities within the investigated vegetation. The correct names of the syntaxa and their nomenclature typification according to the rules and the recommendations of the International Code of Phytosociological Nomenclature are suggested.

## **Phytosociological researches on the high-mountain grasslands of Galičica Mt. (Macedonian part)**

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The high-mountain grasslands on Galičica Mt. because of the past deforestation are extended to lower altitudes than usually, and they can descend on 1550 m. For this study we have done and analyzed 200 relevés using the Braun-Blanquet method. The application of classification and ordination methods by PC-ord software resulted in recognition of nine plant community subordinated to the two larger vegetation groups.

According to the percentage of the characteristic species of higher syntaxonomic categories (classes and orders) we concluded that plant communities of the first large groups are related to the class *Daphne-Festucetea* and other plant communities subordinated to the second group are included to the class *Elyno-Seslerietea*.

Diagnostic species for each plant community, determined by statistical fidelity measures are presented in a synoptic table. The life form spectra of the recorded 349 species in the study area according to Raunkiaer's classification and chronological analysis of species are made. In addition, information of the site characteristics, differences, structure and syntaxonomical position of the communities are given.

## **Habitat diversity of the Bulgarian part of Vlahina Mt.**

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Vlahina Mt. is situated in southwestern part of Bulgaria on the border with Macedonia. It is characterized by high variety of orographic conditions, soils types and basic rocks which lead to great diversity of flora and vegetation. Up to now the flora of mountain is represented by 750 species. Until the 90s of the last century the access to this part of the country has been largely restricted as its statute of a border area. Owing to this, the knowledge about flora, vegetation and habitats of Vlahina Mountain is not exhaustive.

The aim of our study was to analyze the existing habitat diversity according to the Habitat Directive 92/43/EEC in the Bulgarian part of Vlahina Mt. We also attempted to analyze the threats leading to reduction of areas of different habitats in the study area.

## **The environmental impact of ski tows in the Apennines (Central Italy)**

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In the 1970s, in Italy, winter tourism starts catching on, first on the Alps, and then on the Apennines. Since the 1990s winter tourism has been undergoing a severe crisis, due to various factors and especially to climate change, shifts in the market and structural factors.

Despite the limited success of tourism and the absence of an economic response, even in recent years, have been built, or substantially modified, numerous ski tows in the Apennines.

Here we present the results of the environmental assessment of the vegetation of semi-natural grasslands, determined through the phytosociological method, of an area affected by ski tows.

The study area is located on Mount Carpegna, in the central Apennines. The ski tows is located within a SCI area and has a direct impact on two priority habitats, the 6219\* and 9210\*.

Contrary to what stated in the project instructions, alterations especially of herbaceous plant communities were documented. These changes are correlated to two specific actions: the remodeling of the morphology, with movement of the soil, and seeding of non-native species on uncovered areas.

At a distance of five years from the interventions are observed severe alterations of the flora and vegetation of the involved area: there are areas with deep soil, in which can be observed many non-native species, coming from grassing, and areas with soil erosion, characterized by a greater naturalness thanks to the re-colonization of native vegetation.

The estimation of the environmental impact caused by the construction of the ski area was used to evaluate the cost-benefit of this kind of investment. Evaluation was severely negative.

The analysis of vegetation was crucial because it allowed the monetization of environmental damage, expressed mainly in terms of biodiversity loss, assessed by estimating the cost of environmental restoration of damaged habitats.

## **Change of main tree species Composition in Belgrade Forest, Istanbul: its past and present status**

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The aim of this study is to evaluate changes in main tree species of Belgrade Forest from 1888 to present. In the study, historical maps (dating 1888 and 1938) were digitalized in ArcGIS 10.0 and the area of forest types was calculated. Areal changes in forest types were compared with the maps of plant communities (1986) and latest forest management plan (2012–2022).

Belgrade forest is the most important forest part in the northern forest zone of İstanbul. The forest owes its presence to water resources and aqueducts built in Byzantium and Ottoman periods supplying water to the city. First degradations appear with the effects of settlements inside forest. The map prepared in 1888 shows that villages move inside the forest as meadows and farmlands. Similarly, grazing is seen in degraded hornbeam coppice stands (413 ha). In addition, coppice stands of chestnut covers of 1263 ha, while oak high forest has an area of 1131 ha. However, after the removal of settlements in the forest, *i.e.* Belgrade village, and the establishment of the forestry school (1857) near Belgrade forest (Bahçeköy), the forest regenerated naturally until 1<sup>st</sup> World War.

The most destructive damages occurred after 1<sup>st</sup> World War (1918–1923) due to authority gap. During this period over cuttings mostly affected valuable oak stands. As a result, stands in the form of degraded coppice increased particularly around settlements close to the forest. It was calculated that coppice forest of oak covers 1343 ha and chestnut increased from 1263 ha (1888) to 1329 ha in the map of 1938. In addition, meadows and farmlands are seen as coppice stands of oak and chestnut in 1938.

From 1938 to 1986, effective conservation policy made a positive influence on the forest composition. According to a phytosociological study carried out by Yöneli (1986), Belgrade forest is composed of *Quercus petraea* subsp. *iberica*-*Carpinus betulus* community which has *Quercus frainetto*, *Fagus orientalis* and typical (*Castanea sativa*) subcommunities. In vegetation map of Yöneli (1986), pure and mixed stands of oak species (*Quercus frainetto*, *Quercus petraea*) are seen all over the forest. However, stands of chestnut have dramatically decreased due to Ink disease (*Phytophthora cambivora* (Petri) Buisman) and Chestnut blight (*Cryphonectria parasitica* (Murrill) Barr). In the map, *Castanea sativa* sub-community has an area of 426 ha but it is found in groups or individually in the forest. From 1986 to 2012, forest types haven't changed considerably.

In spite of long term protection, the forest still carries the traces of irregular utilization in the past. Currently, pure and mixed coppice and high stands are found in the forest.

## **Floristic composition, ecology and distribution of *Quercus suber* L. forests**

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The main goal of the EVS project on sclerophyllous forests is to merge available phytosociological relevés from international, national and regional databases and to unify the classification of vegetation of sclerophyllous forest in southern and western Europe.

As a first goal of this research group, we aim to characterize *Quercus suber* L. sclerophyllous forest types and to analyze their spatial distribution along climatic gradients within southern and western Europe.

We put up a database, gathering more than 1500 published phytosociological relevés presenting *Q. suber* cover above 25% (3, 4 or 5 on the Braun-Blanquet abundance-dominance scale).

Vegetation types are characterized according to species composition, environmental parameters (climate, topography) and ecological indicators. We computed divisive classification analysis (modified TWINSpan) and formalized classification (Cocktail method), to obtain an assignment of relevés to defined vegetation types. Additionally, we analyzed the current and potential distribution of *Q. suber* forests across southern and western Europe, by using maximum entropy models and environmental variables.

One of the main results of this join-research is the encouragement and promotion of a coenological study along the complete European range of *Q. suber* formations. Finally, we stress the importance of broad scale studies through the use of national and international databases, encompassing one or more biogeographical regions.

## **On the *Pinus nigra* subsp. *nigra* reforestation in the central Apennines**

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We present here a floristic-vegetational study performed in four representative reforestation areas of *Pinus nigra* that are located in protected areas in the central Apennines. The aim was to detect the possible effects on the specific diversity and the renaturation state a century from their replantation. The reforestation areas considered were: the Mt. Predicatore pinewoods (Regional Park of Gola della Rossa and Frasassi); the Mt. Tegolaro pinewoods (near to the Site of Community Importance [SCI] of 'Monte Giuoco del Pallone e Monte Cafaggio IT5330009'), the Piè Vettore pinewoods (National Park of the Sibillini Mountains) and the Mt. Pettenaio pinewoods (National Park of the Sibillini Mountains). The analyses were carried out in representative areas that were homogeneous in their general features and size. To verify the present-day dynamics, diachronic analyses were also carried out using data from the literature and the available cartographic material. The results of this study have made it possible to show that the vegetational dynamics have been strongly influenced by the different levels of coverage of the pine trees. The typical and gradual vegetation succession that has developed in the adjacent sectors is often simplified within the reforestation areas considered. For the Piè Vettore pinewoods and the Mt. Pettenaio pinewoods, that are located in the supratemperate termotype, it was also possible to detect the presence of sub-acidophilous species, which were not found in the surrounding native woodlands, and therefore this allows the hypothesis of the impact of the coniferous litter on species diversity due mainly to the altitude. Among the sub-acidophilous species of particular phytogeographic interest is *Goodyera repens* (L.) R. Br. that is new report for the Umbria region. In the territories investigated it reaches its southern limit of distribution along the Italian peninsula. On the basis of data obtained in the investigated reforestation areas, the process of renaturation is advanced over large areas, with the entry of numerous nemoral species and with more than sufficient regeneration of these. As well as providing important ecological information, the present study has provided an essential knowledge-base for the planning of future silvicultural actions that will be designed to further promote the renaturation that has already started.

## Italian oak (*Quercus frainetto* Ten.) forests in Montenegro

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*Quercus frainetto* Ten. is a species of termophilous deciduous forests of SE Europe, ranging from South Italy, across Balkan Peninsula to Aegean Anatolia. The centre of its distribution is placed in the Balkan Peninsula, where achieves a local dominance under temperate, subcontinental conditions partly influenced by Mediterranean. Considering its distribution in Montenegro species is mainly restricted to southern and central part of the country. Its associations are known under different names: *Quercetum confertae adriaticum montenegrinum* Bleč. et Lak. 1966, *Quercetum farnetto-cerris* Rudski 1949, *Quercetum frainetto montenegrinum* Blečić et Lakušić 1967, *Quercetum farnetto-cerris montenegrinum* Blečić et Lakušić, prov. Although the authors pointed to specificities of these forests, details about its floristic composition and structure has never been published.

In this paper we will present: i) the floristic composition and community structure of Italian oak forest in Montenegro; ii) ecological conditions in which it is developed; iii) make comparison with Italian oak forest in neighboring countries.

Italian oaks forests in Montenegro are characterized by clear differentiation of layers. Tree layer covers mainly more than 80%, and it is composed of Italian oak (*Quercus frainetto*), Turkey oak (*Quercus cerris*), white hornbeam (*Carpinus orientalis*), terebinth (*Pistacia terebinthus*), and common ash (*Fraxinus ornus*). Shrub layer covers 5–10%, and it is composed of white hornbeam (*Carpinus orientalis*), dogwood (*Cornus sanguinea*), false alder (*Phillyrea media*), terebinth (*Pistacia terebinthus*) and hawthorn (*Crataegus monogyna*). The herb layer consists of 102 taxa. The most characteristic species are *Ruscus aculeatus*, whose cover in some stands exceeds 50% and make them impassable. Rather high fidelity also has: *Asparagus acutifolius*, *Hedera helix*, *Oenanthe pimpinelloides*, *Asphodelus microcarpus*, *Bellis perennis*, *Luzula forsteri* and *Veronica chamaedrys*.

These forests have extra-zonal character and they develop in the zone of white hornbeam and Macedonian oak, up to altitude of 200 m. They inhabit flat or mildly uneven terrains, rarely slopes (up to 15 degrees). Geological substrate is represented by flint: sand, clay and marl; while pedological one is represented with eutric soils above eoconic flint or alluvial-deluvial soils (in the vicinity of lake).

Comparative analysis of Montenegrin Italian oak forests with similar one from the neighbouring countries, showed the closest relation with communities: *Ruscus aculeatus* – *Quercetum frainetto* – *cerris* (Rud. 1940) B. Jov. (1951) 1979 and *Carpinus orientalis* – *Quercetum frainetto-cerris* (Knapp 1944) B. Jov. 1953.

## **Comparative study of different-aged sessile oak stands in the Börzsöny Mountains, Hungary**

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Coenological based diversity examinations were carried out in the Börzsöny offset on the sessile oak dominated stands. Börzsöny is one of the less disturbed mountains in Hungary with low human impact. It has been a part of the Danube-Ipoly National Park since 1997, and it is a part of the Natura 2000 network too. In spite of the present silviculture it is covered in natural forests which are very rich in different species. For the forestry, it is the sessile oak that is one of the most preferred native tree species so we chose our examination substances based on this fact.

To reveal the silviculture's effects on the biodiversity, as a first step botanical survey of selected sampling plots were carried out in 6 forest stands, characterised by same standard parameters, but representing different age groups, in order to find out theirs' structural and dominancial relations. The Shannon- and Simpson- diversity indices were used for comparison of biodiversity values of different age-groups. Besides we have analysed the social behavioural types and ecological indicators. Altogether 88 vascular plant species (15 trees, 11 shrubs, 62 herbaceous taxa) were identified in the stands of sessile oak wood lands. Only two invasive taxa, the *Robinia pseudo-acacia* and the *Solidago canadensis*, appeared with low covers on the records.

In case of the social behavioural types in all forest layers the competitor and the generalist species can be found principally. The ruderal competitors and the specialist species have appeared on the herb layer solely. In point of the relative heat claim, the relative soil humidity and the relative soil reaction only some categories have come up, which shows recited categories' limiting effect on the number of species. As for the heat claim the thermophilic forests and habitat demanding species have appeared like in forested steppes. When we examined the relative soil humidity those species have come up that prefer the mesic habitats. During the process of evaluating the relative soil reaction the neutral soil plants and those species were typical that prefer the slightly basic soil. After rating the Shannon-, Simpson- diversity results we have found that the trend is the same in all three layers, the results depend on the sensitivity of the indexes. As for the Simpson-index the diversity always comes up with higher rates because this index is specialized on the mass appearing species, while the Shannon-diversity index is specialized on the rare species. The rate of the diversity is rising to the 61-year-old stand then it shows a descending tendency. It can be explained with the changes of the levels' structures. The examined territory has reached its maximum diversity in case of the 61-year-old stand because the biotic and abiotic factors assist the biodiversity mainly at this age group. At the elder stands the rarefied or totally destroyed shrub layer has not only caused the decrease of the number of species, but species that prefer penumbra and mesic habitats have also descended at the herb layer.

## **The vegetation with *Taxus baccata* L. in an area of Central Apennines, Adriatic coast**

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With this study we intend to deepen the punctual knowledge of *Taxus baccata* coenosis and others related to these, already subject of previous phytosociological studies that involved the entire calcareous ridge (Biondi 1982; Taffetani et al. 2004; Catorci et al. 2009). The aim of this work is to highlight the vegetation variability of the biotope correlated with the complex morphology of the valley and different ecological conditions and also the human activity of coppicing. The study area is the SCI “Macchia delle Tassinete”, located in the calcareous ridge of Cingoli, the third and lower relief of the Umbria-Marche Apennines, that stands between the Marche Apennines and the sea, with a NE–SW orientation.

The same locality is characterized by the presence of a large population of yew (*Taxus baccata*). This species is present in all the Italian regions, although in isolated and extremely limited localities, relict forms of the Tertiary preserved until today.

These enclaves are present throughout the Central Southern Apennines, but the locality object of this study is certainly one of the largest and easternmost refuge areas of central Italy.

The population occurs in the first part of the valley (Fosso delle Scalette), where the exposure to humid winds coming from the sea and the northern quadrants create microclimatic conditions suitable for the development of this species that prefers calcareous substrates and the oceanic climate.

In the more shady and humid area, despite the low altitude, a real beech forest of low altitude, with yew (*Taxus baccata*), occurs; in this habitat the yew (*Taxus baccata*) occurs with different coverages in relation to the different topography, assuming, at times, the aspect of a real yew wood, as in the upper part of the valley in correspondence of a small gorge.

In this forest of Atlantic type, in addition to the yew and the beech, *Ilex aquifolium* and *Carpinus betulus* are also present, with very high coverage, which have the same ecological requirements.

In the sunny and dry areas, the species of the order Fagetalia decrease and beech forest gives place to a forest dominated by *Ostrya carpinifolia* in which the presence of the *Taxus baccata* becomes more sporadic.

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## Plant invaders and species diversity in (peri-) urban forests of Ljubljana, Slovenia

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The diversity of vascular plant species and plant invasion has been studied in the (peri-) urban forests of Ljubljana. Among these forests are also different alluvial and riparian forests with high levels of plant species diversity. However, due to the vicinity of urban areas, the human impact on these forests is intense, and they are also among the most exposed forests to the invasion of alien species.

Three forest locations in Ljubljana have been selected; the first is the Rožnik site in the urban area; it is overgrown by *Quercus petraea*, *Picea abies*, *Castanea sativa*. The second is the Gameljne-poplar site, located in the flood area of the Sava River; it is dominated by *Acer pseudoplatanus*, *Alnus glutinosa*, *Salix eleagnos* and *Fraxinus excelsior*. The third is the Gameljne-pine site, located on the upper-terrace of the Sava River. In this secondary pine forest, *Pinus sylvestris* is dominant species in the upper tree layer, and *Carpinus betulus* and *Tilia cordata* occur in the lower tree layer. The Gameljne sites are in the peri-urban area.

In total, 161 vascular plant species were recorded at three study sites. The number of vascular species varied between 61 (Rožnik site) and 85 (Gameljne-poplar site) per site. High number of herb layer species, including only non-woody species, has been recorded (104 species or 65% of all). Based on Raunkiaer's life-form system, hemicryptophytes (40%) and phanerophytes (34%) prevail among identified vascular species. The relatively high number of geophytes (15%) suggests that studied forests are in the late succession stage (mature forests).

In the studied (peri-) urban forests, numerous non-indigenous plant species were recorded. The majority of them have been declared to be invasive species in Slovenia, which adversely affect the forest habitats and outcompete native plant species. Presumably, these invasive species, which represent 6% of the flora recorded, come from the Sava River or from urban areas, i.e. gardens and parks. The majority of these invasive species are of the North American or Asian origin. Among three studied locations, the level of plant invasion is the highest at Gameljne-poplar site (8 species). The most abundant invasive species at this site are *Solidago gigantea* and *Fallopia japonica*. Other invasive species are *Rudbeckia laciniata*, *Erigeron annuus*, *Helianthus tuberosus*, *Impatiens glandulifera*, *Impatiens parviflora*, and *Physocarpus opulifolius*. Invasive species at the Rožnik site are *Robinia pseudacacia*, *Berberis thunbergii* and *Impatiens parviflora*.

The dynamics of expansion of invasive species should be carefully monitored, and appropriate measures for its limitation need to be established in the near future.

## **The patterns of altitudinal and regional vegetation distribution in the Crimean Mountains**

Didukh Y. P.

The Crimean Mountains are considered the district of the Crimean-Novorosiysk subprovince of Euxine province (Didukh, 1992). Three parallel ridges, covered with forests, compose the mountain massif (External, Internal, Main ridges). The southern slopes end in cliffs in some areas. Foothills and plateaus are dominated by steppes along with meadows and petrophyte communities.

Zonality, which foremost is common for forests and steppes with the maximum altitude of 1545 m a.s.l. and differs from zonality of the south and north macroslopes, is typical for the mountains.

The Northern macroslope: *Elytrigio nodosae-Quercion pubescentis* (ass. *Carici michelii-Quercetum pubescentis* (from 450 m a.s.l.) – *Paeonio dauricae-Quercion petraeae* (from 400–450 to 700–800 m a.s.l.) – *Dentario quinquefoliae-Fagion sylvaticae* (from 700–800 to 1200 m a.s.l.). The Southern macroslope: *Jasmino-Juniperion excelsae* and *Elytrigio nodosae-Quercion pubescentis* (ass. *Brachypodio rupestris-Quercetum pubescentis*, *Elytrigio nodosae-Quercetum pubescentis* (from 400–450 m a.s.l.) – *Brachypodio rupestris-Pinion pallasianae* and *Paeonio dauricae-Quercion petraeae* (from 400–450 to 800–900 m a.s.l.) – *Carico humilis-Pinion kochianae* and *Dentario quinquefoliae-Fagion sylvaticae* (from 800–900 to 1200–1700 m a.s.l.). Steppes with *Festuco-Brometea*, subordinated to all. *Veronico multifidi-Stipion ponticae*, are spread on the foothills (till 400 m a.s.l.). The tops of barrows (600–1000 m a.s.l.) are covered by steppes communities of all. *Adonidi-Stipion tirsae* and meadows of *Trifolio pretense-Brizion elatioris*. The tops of mountains (1000–1500 m a.s.l.) are represented by the communities of *Carici humilis-Androsacion tauricae* and *Helictotricho compressi-Bistortion officinalis*. The district is divided into four major geobotanical regions, where separate alliances are absent. The decrease of occurrence of submediterranean elements and the increase of steppe pontic ones can be observed from the southwest to the northeast.

Evergreen *Arbutus andrachne*, *Cistus tauricus*, *Ruscus ponticus* are present in the southwest part of the South Coast of Crimea, and steppe species, such as *Stipa lessingiana*, *Linosyris villosa* penetrate to broken forests in the northeast part of the South Coast of Crimea. The methodology of synphytoindication (Didukh, 2011) was applied for the ecological estimation of region specification and syntaxa that enabled to calculate indices for 12 edaphic and climatic factors and define the correlation among them and the changing syntaxa.

## **Broad-leaved-spruce forest in European Russia: distribution, syntaxonomy and ecology**

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Broad-leaved-coniferous forests are of special interest for phytosociological analysis because of their transitional character between two forest vegetation classes: *Querco-Fagetea* and *Vaccinio-Piceetea* that determines their high diversity and floristic heterogeneity. The syntaxonomical scheme of broad-leaved-coniferous forests of European Russia has not been completely developed up to now, also no distribution maps of even the most widespread syntaxa exist.

The aims of the study are: 1) to give a detailed description of association *Rhodobryo rosei-Piceetum abietis* Korotkov 1986 (Rh.-P.) – the most widespread association of broad-leaved-spruce forests in European Russia; 2) mapping of distribution of this association.

The study is based on original releves from the database developed in the Center for Forest Ecology and Productivity RAS (<http://www.cepl.rssi.ru/bio/forest/>; <http://www.givd.info/ID/EU-RU-006>), also data from published sources were used.

Ass. Rh.-P. spreads in the south taiga and mixed conifer-broad-leaved forest zones from Baltic countries and north-western part of Russia to the Middle Volga region. In the middle taiga and broad-leaved forest zones there are isolated communities of Rh.-P. in specific habitats. Ass. Rh.-P. was first described in the northern part of the Valdai Upland. The main features of communities of ass. Rh.-P. from different geographical locations are mixed species composition of tree stands that consist of *Picea abies*, *Tilia cordata*, *Quercus robur*, *Acer platanoides* and the nemoral-boreal character of the herb layer. Diagnostic species of ass. Rh.-P.: *Picea abies*, *Carex digitata*, *Gymnocarpium dryopteris*, *Luzula pilosa*, *Rhodobrium roseum*, *Plagiomnium affine*.

The ass. Rh.-P. is assigned to the class *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937, order *Fagetalia sylvaticae* Pawłowski, Sokołowski et Wallish. 1928, alliance *Querco roboris-Tilion cordatae* Bulokhov et Solomeshch 2003.

Despite the strong link between communities of ass. Rh.-P. and broad-leaved forests belonging to the ass. *Mercurialis perennis-Quercetum roboris* Bulokhov et Solomesch 2003, in the Center of the Russian Plain communities of these associations are clearly differentiated, the former occur in less drained sites on more acid and wet soils. Ass. Rh.-P. shows floristic similarity to ass. *Melico nutantis-Piceetum abietis* (Cajand. 1921) K. Lund 1962, but differentiates from it by the group of nemoral species: *Aegopodium podagraria*, *Galeobdolon luteum*, *Mercurialis perennis*, *Lathyrus vernus*, *Stellaria holostea*, *Daphne mezereum*.

The results of phytosociological analyses allow distinguishing three subassocia-

tions which represent “western”, “central” and “eastern” geographical subdivisions of ass. Rh.-P.

Subass. Rh.-P. *typicum* Korotkov ex Zaugolnova et al. 2001 is distributed in the north-western part, it is differentiated by presence of *Dryopteris dilatata*, *Hepatica nobilis*, *Anemonoides nemorosa*, *Cinna latifolia*, *Melampyrum sylvaticum*, *Viola selkirkii*. The communities of subass. Rh.-P. *caricetosum pilosae* Zaugolnova et Morozova 2004 prov. are found in the central and southern parts – in the Moscow region and in adjacent ones. This subass. is characterized by higher abundance of *Carex pilosa*, *Corylus avellana* and presence of *Quercus robur* in the tree layer. Subass. Rh.-P. *abietetosum sibiricae* Zaugolnova et Morozova 2004 prov. is distributed in the Middle Volga region. It is characterized by presence of *Abies sibirica* in the tree layer and some Uralo-Siberian species in the herb layer.

## **Diversity of fir-spruce and lime-fir-spruce forests of Priuralie (eastern part of European Russia)**

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Fir-spruce (*Abies sibirica*, *Picea obovata*) and lime-fir-spruce (*Tilia cordata*) forests occupy a key position in vegetation of Priuralie region, on the west of contact area of European boreal and hemiboreal forests. These forests' distribution determines, to a high degree, biogeographical borders on this territory. The estimation of fir-spruce and lime-fir-spruce forests diversity is based on the ecological-morphological (dominant) vegetation classification. The classification is based on the original field materials, vegetation maps and published data. As the result 7 groups of associations and 17 associations of vegetation have been determined.

Fir-spruce forests are spread from the northern part of Vetluga river basin to the foothill of Urals (the eastern border of researched area) on loam podzolic and sod-podzolic soils connected with uplands and slopes of river valleys. The limitation of their distribution is connected with the western border of siberian fir's range. On the west fir's fraction is not more than 0.1–0.4 of forest stand. By the east the participation of fir rises to 0.3–0.6 (0.7) and fir-spruce forest begin to dominate in vegetation. Fir rarely forms pure stands. Fir-spruce forests are considered separately from spruce forests, primarily due to the essential role of some siberian species in plant communities. In the researched area fir-spruce forests are presented with 4 groups of associations and among the leaders in the formation of forest cover; Priuralie region, along with the Pechora basin, is the main arena of their distribution.

Lime-fir-spruce forests are presented mainly in the eastern part of the region. These forests are dominant on the left bank of the Kama and Viatka-Kama divide. They are mostly associated with sod-low and medium podzolic soils formed on the eluvial-diluvial loams and clays indigenous Permian rocks. Located near the extreme north-eastern distribution limits of broad-leaved trees and other nemoral elements, this forests are characterized by an increase of role of siberian species in the composition of all layers, an increase of lime participation in tree layer with decrease of maple (*Acer platanoides*) (in comparison with lime-spruce forests, for example), an increase of projective cover of grass (especially – ferns and siberian tall-grass) and the reduced role of shrubs. Lime-fir-spruce forests are presented with 3 groups of associations.

Main part of these forests is largely changed with lumbering, including selective logging of fir, and fires. Large areas of forests have been reduced or replaced by birch and aspen (rarely – lime) forests.

## **Comparison of ecological and vegetation characteristics between *Pinus peuce* Grisb. forest communities**

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The paper reveals a numerical and ecological analysis of 39 published relevés of *Pinus peuce* dominated communities in the Balkan Range, and 10 unpublished relevés from the territory of the Republic of Macedonia (Nidže and Šar Mountain) on limestone. To select the optimal partition and the number of clusters, we used the method Optim Class, and therefore we chose multivariate analysis using the PC-ORD software, where Flexible Beta method and Jaccard distance measure were applied. Analyzed relevés were objectively divided into six groups (clusters) which define well differentiated forest communities. Based on the synoptic table diagnostic species are presented for each group separately. We determined a chorological spectrum and life forms of the six groups of relevés. To confirm the influence of the major environmental conditions on the vegetation were used average of Ellenberg indication values.

The first cluster of relevés (from the R. of Macedonia) are obviously much different so far undescribed community. The analysis of Ellenberg parameters displayed positive correlation between community from the first cluster and parameter of light, this is why has a higher incidence of the hemicryptophyte-chamaephyte component, while chorological spectrum indicates that Balcanic and Eurasian are dominated, but significant role also have the Orophilous-south European geo elements.

## **Formalized classification of floodplain forests, willow scrubs and alder carrs in Europe**

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Phytosociological classification of *Alnion incanae*, *Alnetea glutinosae* (including *Salicion cinereae*) and *Salicetea purpureae* in Europe will be presented. We compiled large number of vegetation relevés from existing national European databases. Moreover, we digitalized relevés from areas where floodplain forests are missing in electronic databases and searched for other small regional databases. The classification will be performed based on results of cluster analyses compared with national vegetation surveys and our field knowledge. Each vegetation unit will be characterized by a Cocktail formula. We also plan to prepare electronic identification key for easy assignment of vegetation relevés.

## **The distribution and dynamics of floodplain forests in West Siberia taiga zone**

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The research is based on vegetation elaboration in some regions of Ugra, primarily in floodplains of three rivers: Sabun, Liamin and Yugan. These territories have the least level of technogenic transformation. Because of cold and humid climate, plain relief, features of hydrography a lot of bogs of different types there are distributed in the central part of the West Siberian taiga. The draining role of the rivers is the reason of forming of complicated forest communities in the floodplain. Within a floodplain we allocate three geomorphological zones: young, mature and old floodplain. The young floodplain is characterized by high intensity of alluvium accumulation and sharp hydrological condition fluctuations. The communities of pioneer trees and shrubs are abundant in the area. According to features of river catch area lithology and some other factors, the young growth of common pine (*Pinus sylvestris*), larch (*Larix sibirica*), birch (*Betula pubescens*, *B. pendula*) are formed, but usually there are primary aggregations of grass and willow (*Salix viminalis*, *S. dasyclados*). Gradually new growth of dark coniferous trees appears in the communities. The processes of inundation and sedimentation are not significant in mature floodplain. Soils contain a lot of nutrients. The dark coniferous forests are formed in the area. The spruce (*Picea obovata*) is usual in floodplain forests of various types, but pure spruce forests are rare, and their frequency is increased from East to West. The fir (*Abies sibirica*) is located on the most trophic habitats. In the south of the region the fir is the most abundant edificator of floodplain forests. But in the north of Surgut region it's role is down because of the features of geological history of the region. The floodplain forests with firs on the north boundary of areal are almost ever characterized by the high biodiversity. To the North and East the part of Siberian pine (*Pinus sibirica*) is increased. In undisturbed conditions the large old-aged (more than 300 years old) Siberian pine forests are occurred. Because of frequent forest fires the common pine forests are formed on sandy soils. In the north of the area the high-productivity larch communities are occurred. On the old floodplain the forests are developed according to zone landscape-making processes. The productivity and the biodiversity are falling down. The bogs are occupying.

## **Factors driving species diversity in mountain riparian forests at landscape scale**

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The riparian vegetation along individual streams has been well-studied, but only a limited number of studies have been made in the context of stream networks, catchment areas or landscapes with many diverse catchments. Moreover, forest vegetation in spring-fed areas (area with moist waterlogged soil due to underground water discharge, located either at the place where a stream channel begins or at the foot of valley slope) are usually neglected and still poorly understood. However, forests in spring-fed areas are regarded as riparian in most of the European vegetation classifications, together with riverine communities. We asked: 1) What are the main factors driving the species composition in mountain riparian forests at the landscape scale?; 2) What are the differences in environmental control between riparian forests growing along river banks and in spring-fed areas?; 3) Is it possible to distinguish groups of species with similar responses to significant environmental gradients?

Vegetation plots were sampled along 100 rivers in the Sudetes (south-western Poland, Central Europe). Slope, topographic wetness index (TWI), stream power index (SPI) and distance from river source were used as explanatory variables. The significance of variables was tested by ordination techniques. Species responses were analysed (HOF models) for the species that fitted the ordination models best.

The species composition of riverine and spring forests is controlled by different environmental factors. Floristic variation in riverine forests is related to distance from the river source, altitude and SPI; while, floristic variation in spring forests is linked to altitude and solar radiation. The contribution of the HOF model types is different in riverine and spring forests.

The study highlights different environmental parameters that control the variation in species composition in riverine and spring forests. Riverine forests, as well as the rivers, are the products of their catchments and considerably depend on the conditions that exist within the contributing area; while, forests growing in spring-fed areas are mainly controlled by local conditions. This distinctiveness is supported by analysis of environmental gradients and should be taken into account in conservation planning and when developing vegetation classifications based on ecological knowledge.

## Germination achievement exhibits successful strategy to escape from competition in clonal dominating plants from wetland forest

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However trade-offs between sexual and vegetative reproduction are currently an important issue in research on the evolution of clonal plant life histories, results of experimental studies seems to give inconsistent results. Clonal reproduction is often more important than sexual reproduction, but there is considerable inter-specific variation and the importance of the two reproductive modes can change with environmental conditions. We examined plant species fitness and environmental factors to investigate allocation patterns and the role of trade-offs between sexual and vegetative reproduction in reproductive success of *Carex elongata* and *C. elata* dominating in alder carrs. We examined plants from 54 vegetation plots along 350 m transect in Černiš wetland alder carr forest in south Czech republic. Structural equation modeling (SEM) in *C. elata* revealed 5.9 and 1.5 times more seed mass and ramets, respectively, at plots with low density of *C. elata* compared with plots with their high density. In *C. elongata* SEM, density and number of ramets was negatively correlated with density of *C. elata* (1.8 and 1.6 times). Seed mass decreased with increasing densities of *C. elata* and *C. elongata* (2.6 and 3.5 times less, respectively). Generalized Linear Mixed Models (GLMM) revealed, that the strongest effect on germination was mediated through nutrient availability, abiotic factors showed almost no effect contrary to our expectations. We detected, that the strongest effect on germination was mediated through nutrient availability, abiotic factors showed almost no effect contrary to our expectations. We revealed strong asymmetric competition of *C. elata* that indicates strong influence *C. elata* on density of *C. elongata*. Therefore *C. elata* exhibited as a superior vegetative spreading competitor while *C. elongata* showed high seed set and increased germinability in cause of patchy generative spreading. However seed mass is negatively influenced by interspecies and intraspecies competition, germination is on competition independent. This process does not reduce ability of seeds to attach available patches across the environment.

## **Syntaxonomical synopsis of alder carr and riparian alder forests in Slovakia**

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Black alder (*Alnus glutinosa*) and grey alder (*A. incana*) form dominant forest vegetation types on alluvial and marshland localities, including river terraces, water-logged terrain depressions, contact areas of water reservoirs or spring fed areas. Vegetation synthesis of such forests was done in Slovakia in accordance with the standard Braun-Blanquet approach. The analysed data set of 918 phytosociological relevés originating from both published and unpublished sources was collected in period of 1937–2012. The unsupervised numerical classification (cluster analysis performed in PC-ORD program) divided the relevé material into ten floristically and ecologically interpretable clusters. They corresponded to the formerly described associations of the Euro-Siberian alder carr forests of the alliance *Alnion glutinosae* (class *Alnetea glutinosae*; three associations) and the European ash-alder riparian forests of the suballiance *Alnenion glutinoso-incanae* (class *Quercio-Fagetea*; seven associations). The major variation patterns in species composition, which were interpreted using Ellenberg's indicator values (EIV) and altitude, corresponded to the altitudinal gradient and EIV for moisture, nutrients and soil reaction. In order to support nomenclatural stability, the present critical revision followed the rules of International Code of Phytosociological Nomenclature. Our study was supported by grants VEGA (2/0059/11, 2/0019/14) and GAPF (1/19/2013).

## **Preliminary results of the classification of Montenegrin riparian woody vegetation**

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Floodplain forests and wetlands are among the most neglected habitat types in Montenegro. BlečićetLakušić 1976 published in their “Prodromus of Plant Communities in Montenegro” 13 associations, that belong to the three classes *Quercetea robori-petraea*, *Salicetea purpureae* and *Alnetea glutinosae*. Most of the associations published by Lakušić are according the code (ICPN 2000) not validly published and moreover based on a very narrow idiosystematic approach. The most recent publication (Božović 2011) besides summarizing the hitherto published literature did not present any new facts.

A preliminary classification of 75 releves from woodlands and shrubs collected in the past four years in the floodplains of the rivers Lim, Tara and Morača as well as along the shore of Lake Skadar shows within the woodlands a clear separation of stands of mixed narrow leaved ash (*Fraxinus angustifolia*) from grey alder (*Alnus incana*) stands. The shrub communities comprise at least partly heavily grazed assemblages with dominating willows belonging to *Salicion eleagni* and those dominated by *Tamarix* from the southernmost part of Montenegro. The affiliation to syntaxa of higher rank is to be solved in a survey including at least the neighboring countries of the Balkan peninsula which is in progress.

**Does European badger (*Meles meles*) affects significantly the vegetation around setts: case study from scotch pine silvicultural forests.**

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The burrowing and habitation of badgers disturbs the vegetation in natural forests (Obidziński and Głogowski 2005, Obidziński and Kiełtyk 2006, Kurek, Kapusta and Holeksa 2014). These researches conducted mainly in relatively species-rich broadleaved forests habitats, the data from silvicultural scotch pine forests are scarce.

Our study was conducted in cultivated Scotch pine forests in the Western Poland in June, 2013. The vegetation on 40 badger setts and 40 control plots were described. The setts parametres, environmental factors and plants traits were also considered. Collected data were analyzed by multivariate analysis (DCA, CCA and RDA methods) using CANOCO 5 (ter Braak and Šmilauer 2012) software.

The results obtained confirm herbal and shrub species richness increases in the vicinities of setts significantly. Badger habitation caused a considerable change in herbal species composition. Soil disturbance, epizoochorous and endozoochorous seed dispersal play a prime role in this process. European badger is indicated as an effective disperser of ruderal and segetal species and may significantly affected vegetation in species-poor scotch pine cultivated forests.

## **Specificity of fine root distribution in permafrost soils under the larch forests of Central and Eastern Siberia**

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Underground carbon allocation links soil ecosystems and the forest canopy, providing a flow of organic carbon to the soil from the CO<sub>2</sub> fixed by photosynthesis. Plants allocate large quantities of carbon underground for the construction and maintenance of roots and micorrhizae, such that belowground carbon allocation may represent the largest sink for gross primary production. Despite the magnitude of belowground carbon allocation it remains the least understood C flux in plant communities.

Fine roots (roots < 2 mm in diameter) are minor in terms of the total forest biomass but play a prominent role in the functioning of forest ecosystems. Due to their relatively short life span and rapid turnover, fine roots represent a major sink for the trees' annual carbohydrate gain and play a central role in soil C dynamics. It has been estimated that fine root growth may account for about a third of the global annual net primary production (Jackson, Mooney and Schulze 1997), which emphasizes the important role of fine root dynamics in the global C cycle.

Many factors affect root growth and root system size (e.g. Schenk 2005). Temperature, nutrient availability, soil acidity, water availability and some other biotic and abiotic factors have been found to be key factors influencing fine root biomass and fine root turnover.

In this study, we examined specificity of fine root distribution in the permafrost soils under the mossy-subshrub larch forests (*Larix gmelinii* (Rupr.) Kuzen.) We have studied four sample plots (two of those situated in the northern taiga of Krasnoyarsk region (N 67°, E 100°) and two are mountain permafrost larch forests in the Lake Baikal region (N 53°, E 110°)).

It was found that about 90–95% of total fine root biomass in these ecosystems is situated in the upper 0–20 cm soil layer. Tree fine root biomass in this layer averaged 20–25 g/m<sup>2</sup> and 10–42 g/m<sup>2</sup> is a fine root biomass of subshrubs and grasses. Trees, sub-shrubs and grasses have different patterns of fine root distribution in the 0–20 cm soil layer. About 70–80% of sub-shrub fine roots occupy the upper 0–10 cm soil layer, while 70–80% of tree fine roots situated in the lower 10–20 cm. Grasses contribute only 2.5–3.0% of total fine root biomass in these ecosystems and 80–90% of these roots are distributed lower than 5cm soil depth.

Such patterns of fine root distribution can be explained by different strategies of these plant life forms. Sub-shrubs are vegetative mobile life forms that need a shallow root system for vegetative dissemination. Additionally, sub-shrubs are oligotrophic species that can survive under xerophytic conditions with low nutrient availability. It allows them to occupy forest litter layer that can be seasonally

overdried. Larch is a mesotrophic long living life form that requires higher water and nutrient supply for transpiration and growth needs. Grasses growing in these forests are mostly mesotrophic species as well. Such stratification of fine roots biomass in the upper soil layer causes different sustainability of these life forms to forest fire events and provide different patterns of soil carbon accumulation in permafrost soils under the larch forests.

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## **Botanical diversity and structure of vegetation cover of dry submediterranean ecosystems on the Northwest Caucasus**

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Unique dry submediterranean ecosystems are characteristic for the Northwest Caucasus. They are most presented on the Abrau peninsula and developed in a low-mountain seaside belt. Botanical-geography specifics of the region are defined by its original flora (Novorossiysk subprovince of the Evksinsky province of the Mediterranean region) and vegetation (Lavrenko, Isachenko, 1976). The hemi xerophyte oak forests and pistachio-juniper sparse forests are widespread on this territory.

Influence of altitudinal zonality, a variety of forms of a relief, specifics of rocks (limestones, slate marl, sandstones) cause complexity and heterogeneity of a vegetation cover. For the most reliable display of vegetation modeling of spatial distribution of basic plant species of the region is carried out. The analysis is carried out with use of a method of the maximum entropy (Phillips et al., 2004). As the basic species dominants of hemi xerophyte forests and sparse forests (*Juniperus excelsa*, *Pistacia mutica*, *Quercus pubescens*) and dominants of the mezophyte forests (*Fagus orientalis*, *Carpinus betulus*) are taken. Their spatial organization is investigated according to the major bioclimatic parameters (average air temperature of the warmest and coldest month, an amount of precipitation). As a factor also absolute height is used. As a result predictive maps distributions in the submediterranean ecosystems of basic species were created.

At the following stage of this research the analysis of the spatial organization of vegetation is carried out. Vegetation mapping at the present stage is an important method of geobotanical researches. It is used for an estimation of a botanical diversity, for detection of differentiation of a vegetation cover. Special importance has mapping in mountain territories where heterogeneous structures of a vegetation cover are formed and there is an influence of altitudinal zonation (Ogureeva, Kotova, 2002). Large-scale maps of vegetation on key areas of the mountain territory are made. For display of non-uniform vegetation cover heterogeneous structures (petrophytic series, expositional combinations, eco-dynamic ranges) are used. Heterogeneous structures of a vegetation cover are additory valid criteria of allocation of high-altitude belts and estimation of their botanical diversity.

## **Effects of litter raking on vegetation dynamics along soil acidity gradient in a deciduous forest**

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Together with coppicing, timber cutting and wood pasture, litter raking was a widespread activity in Central European lowland forests in the past centuries. This activity had a profound impact on forest vegetation, but its actual impact on understorey plant species composition under various environmental conditions is poorly understood. We studied species change along the soil acidity gradient following litter raking. Permanent plots have been established in oak-dominated forest in the southeastern part of the Czech Republic. Various treatments (control, litter removal in spring and in autumn) were applied and species composition was recorded for four years. Temporal vegetation variability positively correlated with soil acidity, meaning that vegetation on more acidic soils was changing less than vegetation on more basic soils. This result suggests that vegetation on more acidophilous soil can be more sensitive to disturbances such as litter raking.

## Area and shape of forest patch – have they really harmful effect on forest community structure?

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Forest fragmentation is the replacement of large areas of native forest by other ecosystems leaving isolated forest patches, with negative consequences for the most of the native forest biota. Fragmentation reduces the total area covered by the forest, which may result in the extinction of some species. Isolation of forest fragments increases their vulnerability to various external influences including the invasions of neophytes and population declines of typical forest species. The aim of our study is to explain the influence of various fragmentation parameters on natural species composition of hardwood floodplain forests in Slovakia. The study is based on the dataset of 118 relevés ordered within the suballiance *Ulmenion* (riparian mixed oak-elm-ash forests along great rivers). Relevés were sampled using the standard methods of the Zürich-Montpellier School (Braun-Blanquet 1964; Westhoff 1973) on the plot area 20×20 meters, during vegetation seasons 2010 – 2012. Localities were chosen according to the forestry map of recent distribution of hardwood floodplain forests in all lowlands with alluvia of great rivers in Slovakia (using ArcGis 10.2). Forest patches with different area and shape were sampled. Each phytocoenological relevé was made in internal environment of the forest, at least 15 meters from the forest edge on the plot where tree layer consists of typical hardwood floodplain forests species (*Fraxinus angustifolia*, *Quercus robur*, *Ulmus minor*, *U. laevis*). The digital map of forests was rasterized to a cell size of 15 m. FRAGSTATS software was used to obtain following fragmentation indices: patch area, patch perimeter, area perimeter ratio, Shape index, Circle index, percentage proportion of core area and isolation via Euclidean nearest neighbour distance. Recorded species were assigned into the groups of “good forest species”: diagnostic for *Ulmenion*, constant for *Ulmenion*, diagnostic for *Salicion albae*, species diagnostic for *Carpinion* and “negative species”: archaeophytes, neophytes and ecological aliens (species native in Slovakia but coming from different habitats). The influence of area, shape indices and isolation of forest patch on the occurrence, proportion and cover of species from defined groups was tested using generalized linear model (GLM, R software). The results show significant increase in the number of species diagnostic for *Ulmenion* and *Salicion albae* in bigger, compact patches. The proportion of native and non-native species is independent on patch area but is significantly affected by shape index of the forest patch. Patches with compact form, closer to the circle (low Shape index) have larger proportion of diagnostic and constant *Ulmenion* species and less proportion of aliens than patches with complicated shape and disturbed natural boundaries (higher Shape index). These results confirmed the negative influence of fragmentation to the natural species composition of the *Ulmenion* forests.

## **Factors determining the presence of forest specialists at regional scale in Pannonian lowland sand oak forests**

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The remained lowland oak forests play an outstanding role in the conservation of the biodiversity in the Pannonian lowland. Many animal and plant species can survive in this region only in this habitat. Moreover it is important part of the Pannonian forest-steppe habitat mosaic. One and all stands of this habitat is endangered, according to its significance the proportion of stands without any protection is remarkably high. There is a danger that the extent of this habitat can shrivel into fragments in few decades, therefore there is a last possibility to study them in their present state.

We studied the distribution of forest species in the stands of steppic and mesic oak forests and secondary (planted or spontaneous) forests in the region between the Danube and Tisza. The actual and historic habitat maps of the Kiskun-LTER database were used in order to determine the history of forest stands. Altogether 380 (20×20 m large) relevés were made in semi-natural forests and forest plantations.

According to our result the adult individuals of oak tree are extremely rare in the middle and in the southern and eastern part of the studied region. However the seedling of oak tree can be found at many stands, more commonly in poplar forests than in oak forests. The forest specialist species could survive only in stands where the forest cover is permanent since 1780 (date of I. military mapping in Hungary). In the secondary forest stands planted on grasslands or arable lands only the generalist species can establish which are mostly zoochor species and can spread effectively. There is a significant special gradient in the distribution of the forest specialist species. These species can be founded mostly in the northern and western part of the region.

Comparing the distribution of dry and mesic forest specialist species we found that the mesic species can be found more eastern and southern. The reason for it is that the climate at the southern and eastern part of the region is already not suitable for the dry oak forest, which is independent from the soil water table, while the mesic oak forest is dependent on the soil water. Thus the second one can occur also at those places where the climate is already too dry, however the soil water table is available.

Because of the biogeographical importance and endangered state every stands of lowland oak forests should become protected immediately. The exploitation of the still existing stands is not acceptable and the regeneration potential should be studied in the future more detailed.

## Study of species composition and game damage in the regrowth layer of a gap-managed floodplain *Quercus robur* forest

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Hardwood floodplain forests are very important for Hungarian forest management and nature conservation. These forests covered once substantial areas of Europe, near the large rivers. Due to deforestation, oak floodplain forests were fragmented, and their structure were changed. In Hungary oak floodplain forests make up less than 2.9% (18 910 ha) of the total forest cover. Nowadays these forest types occur near Dráva River and Tisza River, in larger proportion. Their long-term survival is common interest of forest managers and nature conservationists. Natural and artificial regeneration of floodplain forest, especially of *Quercus robur* – representing outstanding economic value – are endangered by many factors (powdery mildew, browsing pressure, climate change, decrease of groundwater level). In this study we focused on browsing pressure.

Our research was carried out in Bükkhát Forest Reserve in south-west Hungary (Drava plain), consisting of oak-ash-elm gallery forest and hornbeam-pedunculate oak forest communities. We studied species composition and game damage of regrowth layer in the buffer zone (gap managed forest) and in the core area of the forest reserve. Our research was focused on two questions: What is species composition of regrowth layer (in gaps, in effect zones of gaps, and in core area)? Is there a difference in the browsing rate of the apical shoots regrowth layer between examined areas?

We found 2554 individuals of 29 tree and shrub species. Most common species were *Quercus robur*, *Carpinus betulus*, *Cornus sanguinea*, *Ligustrum vulgare*, *Acer campestre*, *Ulmus minor*, *Fraxinus angustifolia*. Characteristic species of floodplain forests also appeared: *Acer tataricum*, *Ulmus laevis*, *Frangula alnus*. The gaps are rich in species (23), 21 species were found in effect zones, and 16 species in the core area. Pedunculate oak (*Quercus robur*) was dominant in the gaps (44%), due the planting. In the effect zones of gaps, and in the core area very few oaks were found, only 2% and 4% accordingly, of all records. In gaps pioneer species (*Salix alba*, *Populus tremula*, *Salix caprea*, *Morus alba*) also occurred, enriching the flora of Bükkhát forest. The average browsing pressure is high in the study area, 65.7% of individuals are browsed. Significant difference of browsing rate of apical shoots was found between the gaps, the effect zones of gaps, and core area. Browsing rate is lowest are in the gaps (62.7%). The greatest browsing rate was found by: *Ulmus minor* (89.5%), *Acer campestre* (80.8%), and *Carpinus betulus* (62.9%).

The high game pressure may hinder the development of regrowth (especially *Quercus robur*), so contributing to the change of Bükkhát forest reserve. This research was supported by TÁMOP-4.2.2.A-11/1/KONV-2012-0004.

## **Climate adaptation and environmental assessment in wet continental beech woodlands using empirical distribution curves**

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Vegetation-environment relationships in semi-natural habitats attract much interest in studies of ecosystem functioning. Regions with high geographical and climatic variability are expected to suffer remarkable changes of abiotic conditions due to current climate change. Therefore, it is essential to analyze species-specific responses at a susceptible scale and especially, to identify significant climatic driving forces of the distribution. In our research a statistical-empirical approach of climatic performance in wet continental Illyrian type beech woodlands was computed on the theoretical basis of ecological niche modeling. High resolute vegetation and environmental datasets with twenty-eight designated bioclimatic variables as potential predictors were applied to reveal climatic niche responses of beech woodlands and the conformity to regional climatic range. The main goal is to define efficient sets of macro-ecological indicators describing habitat variability and adaptive capacity as a climatic adequacy estimation in order to get a more detailed decision supporting scientific knowledge. In the first step, four principal components of the exploratory factor analysis were extracted, orderly referring to temperature, precipitation and their seasonality by fifteen significant predictors, containing in eight temperature and seven precipitation variables. In the second step as the result of climatic niche performance, adaptability and vulnerability indicators were identified, articulating to absolute and relative subsets and the four main kernel indicators. In the third step adjusted adaptability/vulnerability ratio were calculated from climatic risk profiles and indicators of macro-ecological adaptation were defined pointing to the niche based climate suitability. Using relevant sets of indicators, climate response variability can be evaluated and the statistical climate assessment framework can be applied for ecological analysis on niche performance in some other climate related natural vegetation type. Analysis was supported by “TÁMOP 4.2.2.A-11/1/ KONV-2012-0004” research grant.

## **Spatial pattern of oak seedlings and weed vegetation in a reconstructed natural stand of *Aceri campestri-Quercetum roboris* community**

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The research was carried out in a relict and reconstructed stand of the rare and protected *Aceri campestri-Quercetum roboris* community located in the Botanical Garden of Szent István University (Gödöllő, Hungary). The main objective of the study was to survey the spatial pattern and frequency of oak seedlings, weed and weed-like vegetation in the reconstructed part of the forest stand. Application of data based on Quantum GIS. In 2012 phytosociological relevés were carried out in the forest focusing on the target taxa. For appropriate number of data a spatial grid was used, that cover the whole examined area (ca. 1 ha). The distance was 10 m between neighbouring grid points. The presence and percentage cover of each selected species in a quadrat (2×2 m) around a vertical pin (=grid point) was recorded and visually estimated. In addition, oak seedlings were counted in each quadrat.

The evaluation of data showed, that the surface cover of oak seedlings is nearly inversely proportional to the cumulative surface coverage of weeds. In forest edges the weed coverage and diversity exceeded, than those inside, presumably due to the higher disturbance level and distinct abiotic circumstances. In sampled patches the total surface cover of weed species and oak seedlings was 25.5% and 12.2%, respectively. The surface coverage of weeds was decreased to 22 meters from the forest edge, but than started to increase, mainly due to the uneven spatial pattern of the dominant weeds, *Hedera helix* and *Chelidonium majus*. Two invasive species occurred in the studied area, however both *Solidago canadensis* (0.5%) and *Robinia pseudo-acacia* (0.4%) showed low surface coverage. Concerning the oak seedlings their frequency distribution was uneven, with highest density in the middle range of the surveyed area. The considerable number of oak seedlings allows the spontaneous renewal of this forest stand, thus it could provide more diverse and favourable tree age distribution on a longer timescale.

## **Ruderal woodlands in Austria – an attempt for classification**

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Ruderal woodland as defined here is characterized by one or several neophytic woody species in the canopy. We selected 918 relevés from the Austrian Vegetation database covering the time span between since 1966.

The dataset clearly shows, that only *Robinia pseudacacia*, naturalized in eastern Austria since about 150 years, forms discrete communities described as *Chelidonio-Robinietum* on groundwater logged stands and the *Balloto-Robinietum* on drier soils with a more light demanding herb layer.

Plant assemblages characterized by other woody alien species like *Acer negundo*, *Ailanthus altissima*, *Buddleja davidii*, and *Paulownia tomentosa* are usually to be arranged according to their stand characteristics. They occur on depositions or soils strongly influenced by man or on very dynamic stand in river corridors, where still elements of the natural vegetation exist in the canopy.

In many cases especially when none of the alien species dominates the canopy an affiliation to an association is not possible. Habitats showing less human impact usually are assigned to associations of the dominating native woodland species.

## **Invasibility of forest ecosystems in Šumadija region (central Serbia)**

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Invasive woody species presents one of the biggest threats to diversity and function of forest ecosystems. Two “the worst” invasive trees in Europe are *Robinia pseudoacacia* and *Ailanthus altissima*. This species are proliferating and rapidly expanding their range through the natural, seminatural and anthropogenic ecosystems of Serbia.

This paper presents an overview of researches of forest communities in Šumadija region in central Serbia during 20 century, in which were recorded the presence of invasive alien species *Robinia pseudoacacia* and *Ailanthus altissima*. Aim of this study is to determine which forest communities are the most sensitive to the invasion and which factors determine invasibility of these communities, as base for creating a new research about change of these communities over time, with special focus on invasive alien species number, abundance and distribution.

Invasive woody species *Robinia pseudoacacia* and *Ailanthus altissima* were recorded in thermophilic forest communities, mostly in the southern exposure at low altitudes. In mesophilic communities these species are rare or completely absent. These species are abundant in ecosystems that are under strong anthropogenic influence. Their number, cover and abundance increases with the degree of degradation of the ecosystem, and they are most numerous in communities on poor and degraded soil, dominated by shrub species and with presence of weedy and ruderal species, which indicate the constant disturbance of forest ecosystems.

Future research will include an analysis of the current status of plant communities in the Šumadija region and the presence, distribution and abundance of invasive plant species in these communities. Detailed phytosociological and ecological research of sites that previously have been the subject of investigations (during 20 century) and research of new, so far unexplored sites will contribute to better understanding of vegetation change during time and impact of invasive alien species on this process as part of global change.

## **Coppice vs High Forest: relationship between forest structure and floristic variability under different management types**

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In this study we compared two silvicultural management types, Coppice with Standards (CWS) versus High Forests (HF), on the basis of structural and floristic diversity. The aim is to investigate the relationship between the forest management and the understory diversity, with particular attention to the presence and abundance of the habitat's diagnostic species (*sensu* Directive 92/43 EEC). Moreover, we aim to understand which structural parameters are more related to the floristic richness patterns.

The study was carried out in the Montagne della Duchessa massif located between the Lazio and Abruzzo regions (central Italy). In the surveyed area, beech forests occupy a surface of about 1200 ha, ranging from 1000 m to 1900 m a.s.l., and have been managed mainly as Coppice with Standards (CWS) and as High Forest (HF) until the '60s. 66 square plots (400 m<sup>2</sup> each), selected through a random-stratified method, were carried out during the April-July period (2012–2013).

In terms of structural features, we found that the differences between the two systems after 50 years were related to the past management: CWS were more even-aged and mono-layered, and also characterized by lower DBH, height and by a higher sprouts contribution, with respect to HF.

Given the similar time period from the last cut, the higher species number observed in CWS with respect to HF (145 vs 118), may be a direct effect of past management type and intensity. Shorter rotation times and greater impact severity, over the time, may create a higher heterogeneity of environmental conditions, which encouraged the establishment of eliophilous species. On the contrary, in HF a certain continuity in time of the canopy cover (longer rotation times) may probably guarantee over the time a greater stability both of the microclimatic conditions and of the species pool.

Moreover, CWS hold a lower number of habitat's diagnostic species (*sensu* Directive 92/43 EEC) (23% of the total species number, respect to the 29% in HF). Results show a higher diversity degree for the understory species and also a lower diversity degree of diagnostic species in CWS. In terms of equitability, few species (*Aremonia agrimonoides*, *Lathyrus vernus*, *Cardamine bulbifera* and *Galium odoratum*) dominate the understory species pool in HF, whereas in CWS these species are more homogeneously distributed in frequency term. Moreover, some of the HF understory dominant species are also habitat's diagnostic species and, despite their higher frequency, are better distributed among the diagnostic species pool (better equitability) with respect to CWS.

Then, the correlation analysis results show that plant richness could be mainly a matter of density and space occupancy: a lower number of trees less aggregated, even if with higher diameters, may promote an higher species richness. Given the negative correlation with the stems aggregation, this relationship is confirmed particularly for the understory.

## **Validation of a priori forest type classifications to predict floristic composition**

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Forest type classifications based on field or satellite data collection have been used to identify conservation priorities, and thereby support decision-making, zoning and conservation planning. For these reasons, the capacity of different methods of forest classification to predict floristic composition is a crucial topic and needs to be examined.

Here, three predictions are tested, considering how floristic composition is consistent with different forest type classifications: (1) forest type classifications are valid for floristic inferences (2) biogeography-based forest types perform better than stand structure-based forest types; (3) the efficiency in predicting floristic composition is depending on which factors affect floristic patterns: biogeographic or anthropogenic drivers.

Species presence-absence of all vascular plants, sampled in the Italian Network Level I (CONECOFOR), are analysed to determine the best floristic classification using cluster analysis and non-metric multidimensional scaling. Analyses of similarity are used to test for differences between the National Inventory of Forests and Carbon (INFC), the European Forest Type Categories (EFTC) and the Corine Land Cover 2006, and factors affecting floristic patterns are tested.

## **Multifacet analysis of patch-level plant diversity in response to landscape spatial pattern and history on Mediterranean dunes**

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In recent years coastal dune landscapes have undergone consistent transformations and currently they are pinpointed as one of the most threatened ecosystems worldwide, being prone to biodiversity loss. Understanding the probable drivers that shape the distribution of biological diversity along coastal dune ecosystems in response to landscape pattern and transformation seems to be a priority. Relying on multitemporal land cover maps (1954–2008) and on a vegetation databases, we analyzed how landscape spatial pattern and the local history have affected taxonomic (TD), functional (FD) and phylogenetic plant diversity (PD) on natural dune patches along the Lazio Coast (Central Italy). Floristic data was derived from a geo-database of random vegetation plots (4 m<sup>2</sup>). Functional trait information was available for the surveyed species from previous field measurements. A dated phylogenetic tree was reconstructed using a super-tree approach. A set of landscape patch-based metrics, considered as adequate proxies of the main processes affecting plant diversity, was computed. In particular, patch local history was taken into account by quantifying temporal urbanization trends and erosion processes occurring in the last 50 years in the surroundings. Rao's quadratic entropy index was used to estimate the TD, FD and PD of each patch. Diversity measures were then related to landscape metrics via linear models. Each diversity facet responded differently to landscape parameters. We observed that erosion processes in addition to the expanding human pressure from the inland, tend to decrease the TD of coastal dune ecosystems. Fragmentation processes act decreasing FD, weakening the ability of coastal ecosystems to respond effectively to changes. PD behaves differently, indeed none of the patch-based metrics affect this facet. Landscape transformations seem to be too recent to affect the accumulated evolutionary history of coastal dune communities. In order to preserve the functionality and uniqueness of coastal dune ecosystems our results support the need to redefine conservation priorities and adapt management strategies to include complementary components of biodiversity.

## **Phytosociological and ecological positioning of European Atlantic dune grasslands**

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Each European country has its own methods monitoring the status of the Natura 2000 areas. The development of a single European database with vegetation data aims to make conservation and monitoring of these Natura 2000 areas more effective. The focus of this project will be dune grassland systems along the Atlantic coast, from southern Norway to northern Portugal including the British Isles. Assembling a database for the dune grasslands along the Atlantic coast, facilitates the following research goals in this project. Describing and explaining the phytosociological and ecological variation in Atlantic dune grasslands and contributing to the EU Red List assessment, which describes trends and distributions of different red list species. The following questions will be covered in this research; what is the phytosociological position of vegetation within the grey dune habitats along the European Atlantic coast? What factors are the most important drivers for the variation in vegetation composition of Atlantic dune grasslands? And finally: what are the trends for the EU Red List species and what is the variation between countries or between vegetation types?

## **Syntaxomical revision of coastal halophilic vegetation in Croatia**

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For the purpose of syntaxonomical revision of coastal halophilic vegetation, all available data from Croatia were collected, comprising a dataset of 458 relevés. All relevés were recorded in accordance with the Braun-Blanquet methodology. Classification was performed by log-transformed plant species cover/abundance values, using Ward's method. The optimal level of the classification was determined by the without-replacement bootstrap method. Most of clusters correspond to single associations, and they belong to several vegetation classes: *Sarcocornietea fruticosae* Br.-Bl. & R. Tx. 1952, *Juncetea maritimi* R. Tx. 1951, *Thero-Salicornietea* Pignatti 1953 em. R. Tx. in R. Tx. & Oberd. 1958, *Cakiletea maritimae* R. Tx. 1950, *Ammophiletea* Br.-Bl. & T. Tx. 1943, *Crithmo-Limonietea* Br.-Bl. 1947. As a final result, a new revised syntaxonomical division of coastal halophilic vegetation in Croatia is proposed. All associations are characterised by diagnostic species, substrate types, ecological indicator values, life forms, chorological types, species richness and distribution maps.

## **Relations between features of salt affected soils and occurrence of halophytic plant communities**

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Plant-soil relationships within a saline habitat were studied in a wide area of the north and southern Serbia. The aim of this study was to estimate the impacts of the salt affected soils characteristics and environmental conditions on occurrence of certain plant communities.

During the vegetation survey a total of 67 phytosociological relevés was collected corresponding to 18 sampling plots. The soil samples were taken from a depth range from 0–20 cm; analyses of the main soil features, including pH, EC and the total salt content were performed using standard USDA methods recommended for salt affected soils. The relationships between plant communities and soil features were studied by DCA with passively projected explanatory variables. *For estimation of ecological conditions, species ecological indicators for light L, temperature- T, moisture- M, soil reaction- S, nutrients- N and salinity- C were used.*

Results show the strong effect of soil features on the vegetation composition, where the soil chemistry and environmental indicators being the most important factors of species composition at the halophytic habitat, especially moisture and humidity. DCA analysis carried out three major vegetation types. DCA ordination diagram clearly represents differences of vegetation patterns and soil and environment characteristics between north and south region of Serbia. Vegetation types at the north are more homogeneously distributed along the gradient corresponding to the soil humidity, nutrients and moisture, as key factors besides pH, EC and total soluble salts. Halophytic communities on the south of Serbia have differentiated into the two groups, where the first group was more influenced by temperature and CaCO<sub>3</sub> content, and the second by the moisture and total nutrients value.

## **Vegetation of Gosa area (Albania)**

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The Gosa area is a complex of habitat types consisting of coastal lagoon, river delta and estuary, salt marshes, sand dunes, riparian and pine forests... Research of vegetation according to Braun-Blanquet method revealed 14 various vegetation types: *Eryngio-Sporobolium virginici*, *Euphorbia paraliae-Agropyretum junceiformis*, *Medicagini marinae-Ammophiletum australis*, *Salicornietum europaeae*, *Puccinellio festu-ciformis-Arthrocnemum fruticosi*, *Limonio-Artemisietum coerulescentis*, *Crypsidetum aculeate*, *Juncetum maritimo-acuti*, *Eriantho-Schoenetum nigricantis*, *Holoschoenetum vulgaris*, *Phragmitetum communis*, *Typhetum angustifoliae*, *Bolboschoenetum maritimae*, *Pistacio lentisci-Juniperetum macrocarpae*, *Pinus pinaster –halepensis* community, *Salicetum albae*.

Habitat map of the Gosa area was made and conservation issues are discussed.

## New Bulgarian plant communities described from gravel bars

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Different vegetation types occurring on dynamical habitats of river gravel bars were described from several Bulgarian rivers. We sampled 43 phytosociological relevés which were made in summer 2013 on 19 rivers (Struma, Treklyanska Reka, Rilska Reka, Bistritza, Stara Reka, Mesta, Cherna Mesta, Beli Iskar, Cherni Iskar, Svinskata Reka, Beli Vit, Cherni Vit, Vit, Zavodna, Cherni Osam, Osam, Tazha, Tundja and Stryama) of 5 mountains (Vitosha, Milevska Planina, Rila, Malashevskia Planina and Stara Planina). Field work was focused mainly on river gravel bars in temperate conditions of montane and submontane areas (altitudinal range 294–1208 m). Gravel bars are usually occupied by plants typical for very different habitat types and this could make difficult to classify them. Species composition and dominants of the described herb and shrub vegetation is very similar to vegetation which commonly occurs on gravel bars in the same conditions in other European regions. There are also some differences caused by the presence of Balkan species (e.g. *Cirsium appendiculatum*, *Tanacetum parthenium*) and Mediterranean or Submediterranean species (e.g. *Cirsium ligulare*, *Echium italicum*, *Scrophularia canina*). More common were European or Eurasian thermophilous species (e.g. *Chondrilla juncea*, *Dipsacus laciniatus*, *Petrorhagia prolifera*, *Pulicaria dysenterica*, *Poa compressa*, *Teucrium chamaedrys*) and on higher ranges occurred subalpine or montane species (e.g. *Rumex alpinus*, *Telekia speciosa*). However, these differences were not sufficient to describe these types as new associations or subassociations. We classified most of the relevés to three associations, all new for Bulgaria: herbaceous open or closed vegetation dominated by *Calamagrostis pseudophragmites*, throughout the whole sampled area – *Tussilagini farfarae*-*Calamagrostietum pseudophragmitae* Pawłowski et Walas 1949; shrubby vegetation with dominant *Salix elaeagnos* and *S. purpurea*, only the Stara Planina – *Salicetum elaeagno-purpureae* Sillinger 1933 and shrubby vegetation with *Salix purpurea*, throughout the whole sampled area – *Salicetum purpureae* Wendelberger-Zelinka 1952.

## **Steppe vegetation of the forest-steppe zone in the Volga area (Russia)**

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The area of the research lies in forest-steppe zone between the Volga and the Ural River within the Russian Federation. It includes the northern part of Samara region and north-western part of Orenburg region.

Applying the method of J. Braun-Blanquet in 2013 67 geobotanical relevés were done in the investigated area. All the relevés were accumulated in the database created with the help of the TURBOVEG (Hennekens 1996) software package. The groups of the plant communities which are similar in their floristic composition have been allocated. Identification and the name of the new syntaxonomical units were performed in conformity with ICPN (Weber et al. 2000). During the research 4 associations were determined: *Salvio nutans-Stipetum pulcherrimae*, *Salvio stepposae-Stipetum lessingianae*, *Achilleo setaceae-Stipetum capillatae*, *Artemisio marschallianae-Stipetum pennatae* (*Festucion sulcatae*, *Festucetalia valesiacae*, class *Festuco-Brometea*). 2 associations are rare and can be recommended for conservation.

## **Ecology-coenotic and biogeographic peculiarities of communities of the *Festucetea vaginatae* class in Ukraine**

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*Festucetea vaginatae* class represents the phytosystems of psammophytic steppes. In Ukraine it numbers 34 associations, which belong to four alliances and one order. In ecologic and coenotic rows its communities are placed between coenoses of coastal vegetation (*Ammophiletea*) and real steppes (*Festuco-Brometea*). A relief character (plate sites, dunes, inter dune lowlands and depressions), soil fixation, its humusness, and also a degree of eolic processes. Hyperspace of ecologic conditions from humid (deep depressions) to semi-desert (tops of dunes) promote to considerable coenotic wealth and coenodiversity of the class. Insignificant coenotic formness, small anthropotolerance and slight renewness are the peculiarities of the class communities. Coenotaxonomic specification is in ecobiomorphological relationship of peculiar species, among which cespitose grasses, bulbotuberiferous and kaudexous and also root sucker obligate psammophytes. Grass stand thinness, insignificance of sublayers, firm position of predominant species and relatively slight mean specific saturatedness of coenoses are the peculiarities of coenotic structure. Biogeographic differences of the class syntaxa of Ukraine territory are found at the alliance level and are caused by history of region development and their landscape and ecological peculiarities. Two chorological types of syntaxa are distinguished. The Black Sea Region and Azov Sea Region chorological type (at the seashores of the Black and Azov Seas) are represented by coenoses of the *Festucion beckeri*, *Scabiosion ucranicae*, *Verbascion pinnatifidii*, *Cynodonto-Teucrium polii* alliances, the Middle Dnipro Region (in the middle of the Dnipro stream) by the *Artemisio dniproicae*-*Salicion acutifoliae* alliance.

## **Biogeographical peculiarities of communities of the *Thero-Salicornietea* class in Ukraine**

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On the ground of phytosociological database use the biogeographical inventory of syntaxa expansion of lower and mean ranges of the *Thero-Salicornietea* class is carried out. It is identified that internal structure of the classes reflects geographical variability of vegetation. Chorological community types are defined. At Ukraine territory biogeographical differences of syntaxa are identified at the association level and are caused by history of the region development, their landscape and ecological peculiarities and by participation of endemic (new endemic) species. For throughout territory of Ukraine with saline soils *Salicornietum prostratae*, *Suaedo salsae-Salicornietum prostratae*, *Petrosimonia oppositifoliae-Salicornietum*, *Bassietum hirsutae*, *Halimionetum pedunculatae*, *Suaedetum salsae* association communities are typical. The Syvash Region chorological type is characterized by presence of *Ofaisto monandri-Salicornietum* association and by participation of many endemic species in the class communities (*Ofaiston monandrum*, *Pholiurus pannonicus*, *Frankenia pulverulenta*, *Puccinellia syvaschica*, *Limonium czurjukiense* and others). The Crimean chorological type unites the communities of muddy volcanoes of the Kerch Peninsula and characterized by presence of *Petrosimonia brachiatae-Artemisietum santonicae* and *Lepidietum crassifoliae* associations. Syntaxa of the Azov Region (the Azov Region spits) and the Left Bank of the Dnipro (solonchacs of the Left Bank of the Dnipro) chorological types are distinguished by coenoflora composition.

## Steppe vegetation diversity of the Don basin

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Don basin, where important botanical and geographical boundaries, is of great interest in the study of vegetation in Europe and is a key biodiversity steppes.

In total, the study of the steppes of the Don basin as part of a class *Festuco-Brometea* Br.-Bl. et Tx. 1943 at this level of analysis syntaxonomic previously allocated one order and two alliances and 4 suballiances. In the rank of the association allocated 21 syntaxon within which allocated 43 subassociations.

Identified ecological and floristic composition of the particular associations of alliance *Festucion valesiacae* Klika 1931 allow us to consider them within the boundaries suballiance *Bupleuro falcate-Gypsophilenion altissimae* Averinova 2005, *Phlomenion pungentis* Saitov et Mirkin 1991, new suballiance: *Festuco rupicolae-Stipenion pennatae* Demina 2012 and *Cleistogeno bulgaricae-Jurinenion stoechadifoliae* Demina 2012.

Studied phytocoenotic environment *Hyssopus angustifolius* Bieb. on the Donets Ridge, which was discovered by us in the wild state on the southern macro Donets Ridge, in the border regions of Lugansk (Ukraine) and Rostov (Russia) regions. On the East European Plain – the only reliably known his whereabouts. Phytodiversity represented associations *Thymo dimorphis-Hyssopetum angustifolii* Demina 2012 and *Senecio schvetsovii-Hyssopetum angustifolii* Demina 2012 of class *Festuco-Brometea*, uniting petrophytic community featuring semishrubs (Steppae petrophile) steppe type and association *Sileno borysthénicae-Hyssopetum angustifolii* Demina 2012 of class *Helianthemo-Thymetea* Romashchenko, Didukh et Solomakha 1996, which combines a pioneer community petrophytic semi-shrubs (Petrophyton).

Bunchgrass and by semi – desert-steppe bunchgrass forming on solonchaks chestnut soils in the south-eastern part of the Rostov region, merged into a new alliance *Tanaceto achilleifolii-Artemisienion santonicae* Demina 2012, close to alliance *Poo bulbosae-Caricion stenophyllae* Saitov 1989.

West-black-sea and pontic-west-caspian geminalofitnye community are considered in the new suballiance *Trifolio arvensis-Limonienion sareptani* Demina 2012.

Plundered by Volga-Kazakhstan and eastern-black-sea – west-caspian steppe well- demarcated and allocated to a new suballiance *Artemisio lerchianae-Stipenion lessingianae* Demina 2012.

Psammophyte community sand areas on terraces above the floodplain in the valleys of the Don classified as *Festucetea vaginatae* Soó em. Vicherek 1972 to order *Festucetalia vaginatae* Soó 1957 and alliance *Festucion beckeri* Vicherek Union in 1972, which included two new stand suballiance: *Chamaecytiso borysthénici-Artemisienion arenariae*, representing immature community psammophytic pio-

neer vegetation and suballiance *Stipo borysthenicae–Artemisienion marschallianae*, representing malformed steppe and meadow steppe psammophyte community.

Given that the volume and position of many syntaxa interpreted by many authors in different ways, and that cannot be identified syntaxa established in Central Europe for the great floristic vegetation of Eastern Europe, the adoption of these decisions on rank higher syntaxonomically units considered preliminary.

## **Geographical and syntaxonomical differentiation of the *Festuco-Brometea* class within the plain part of Ukraine**

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Steppes represent zonal type of vegetation of Ukraine. In the past, the area occupied by them, amounted to 60% of the country. Currently steppe vegetation was significantly transformed, mainly by plowing. It has remained mainly on the territories of nature reserve fund and on areas unfit for plowing (such as slopes of river valleys, outcrops, etc.).

In Ukraine, there is a problem of classification of steppe vegetation using the Braun-Blanquet approach. There was described many of syntaxa (mainly in the forest-steppe zone) that are local. A numerical analysis was conducted for the generalization of clearly distinguishing vegetation units. For this purpose we collected 2336 relevés in TURBOVEG database. We used our own data (468 relevés), published and unpublished data of other authors. For comparison also have been added numerous relevés from the forest-steppe zone of Ukraine, as well as from Central and Eastern Europe and Western Russia. Narrow and hardly distinguishing species were combined into broad understanding aggregates. All data have been processed by JUICE 7.0, using the Modified Twinspan Classification.

It was found that all data set was divided into 8 clearly distinguished clusters that represent ecologically, edaphically and zonally different types of the steppe vegetation. They can be considered as 8 alliances: *Cirsio-Brachypodium pinnati* Hadač et Klika ex Klika 1951 (xero-mesophytic grasslands in the Western part of Ukraine within Volhynian-Podolian Upland and Carpathian region), *Potentillo arenariae-Linion czerniaevii* Krasova et Smetana 1999 (limestone vegetation of the Black Sea Lowland), *Poo bulbosae-Stipion graniticolae* all. nov. prov. (the vegetation of siliceous outcrops of the Dnieper Upland), *Artemisio-Kochion prostratae* Soó 1964 (transformed steppes, mainly by pasturing), *Fragario viridis-Trifolion montani* Korotchenko et Didukh 1997 (meadow steppes of Forest-Steppe zone, and also of the northern part of Steppe zone), *Marrubio praecoci-Stipion lessingianae* all. nov. prov. (forb-bunchgrass steppes mainly in Steppe zone), *Tanaceto millefolii-Galatellion villosae* all. nov. prov. (bunchgrass steppes of the south part of the Steppe zone), *Artemisio tauricae-Festucion valesiacae* Korzhenevskij et Kljukin ex Dubyna et al. in Dubyna et Dziuba 2007 (Pontic-Caspian desertified steppes in the littoral zone of the Black Sea and the Sea of Azov).

## **Restoration effect of mulching and mowing on semidry grassland of *Bromion erecti* alliance after five years of experiment**

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Grasslands in Biele Karpaty Mts are famous for their high species richness. During the 20th century many people left their land. Abandonment of grasslands especially on the remote sites led to the successional changes. To investigate the restoration effect of mulching and mowing on semidry *Bromion* grassland the field experiment was founded in the Bošácka dolina Valley. Every year from 2009 the effect of four management treatments was tested: mowing, mulching in summer, mulching in autumn, and no management (control). The main questions of the study are: i) Is mulching appropriate management for restoration of the abandoned grasslands? ii) Are there any differences in the effect of mulching in different seasons? iii) What are the differences in effect of mulching and mowing? The experiment is designed in four completely randomized blocks. The list of species with percentage cover and presence and absence data on smaller subplots were recorded. Multi-way ANOVA was performed on logarithmically transformed data on species richness of vascular plants in two scales (1×1 m and 10×10 cm). Frequency data on species composition were analysed by Principal Component Analysis (PCA) and by Redundancy Analysis, when interactions of all four treatments with time were tested.

Based on the results it is evident, that during the first three years any type of applied management had positive effect on the species richness increasing both in plots 1×1 m and 10×10 cm comparing to no treatment control. Later, in the fourth year, both mulching treatments led to decrease of species number in comparison with mowing. Surprisingly, in the fifth year the plots managed by mulching in spring were richer in species than mowed plots while plots mulched in autumn together with no managed plots had approximately less species than plots managed with mowing. Comparing the frequency of individual species in plots managed by mowing during the five years of experiment there was increase of species like *Betonica officinalis*, *Hypericum perforatum*, *Koeleria pyramidata*, *Potentilla alba*, *Rosa gallica*, *Salvia pratensis*, *Trifolium alpestre*. On unmanaged plots and plots mulched in autumn there was increasing frequency of *Brachypodium pinnatum*, *Crataegus monogyna*, *Fragaria viridis*, *Vicia tenuifolia*, *Viola hirta*. Gradient analysis revealed sig-

nificant effect of all applied treatments. It is evident from the results of RDA that absence of any regular management leads to the loss of typical species of dry grasslands. The results of PCA clearly show that management is not the main driver of species composition in studied grasslands. It seems, that inter-annual weather fluctuations play very important role and may strongly determine the suitability of management regime in different years. But it is evident from our results, that mulching is appropriate treatment for restoration of the abandoned *Bromion* grasslands during the first five years of restoration. Regular autumn mulching applied longer than three years leads to decrease of species richness and its effect on species richness is similar to no management regime. The research was supported by project VEGA 2/0099/13.

## **Thermophilous and mountain non-forest vegetation pattern on the crossing of Carpathian and Pannonian region (case study from Western Carpathians, Slovakia)**

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On the territory of Slovakia, two significant European biogeographical regions of high importance, the Carpathian and the Pannonian are overlapped. Muránska planina Mts, a small karstic area situated on the south of Western Carpathians in Central Slovakia, was chosen as a model region for study of diversity pattern of xerothermophilous and mountain non-forest vegetation. Owing to its location, the territory of Muránska planina National park (established on about 40 square kilometres including buffer zone) is a very valuable region with a wide variety of natural habitats and ecosystems that host many species populations. According to recently published checklist, altogether 1480 taxa of vascular plants were documented in this area. Many thermophilous plants, pannonian elements inclusive (e.g. *Aconitum anthora*, *Allium ochroleucum*, *Anthericum ramosum*, *Campanula sibirica*, *Carduus collinus*, *Carex humilis*, *Chamaecytisus hirsutus*, *Erysimum odoratum*, *Festuca pallens*, *Hippocrepis comosa*, *Linum tenuifolium*, *Peucedanum cervaria*, *Prunella laciniata*, *Seseli annuum*, *Stachys recta*, etc.) occur there together with numerous mountain species typical for high elevations of Central Carpathians (e.g. *Androsace lactea*, *Bartsia alpina*, *Campanula cochlearifolia*, *Carex firma*, *Delphinium oxysepalum*, *Dryas octopetala*, *Festuca tatrae*, *Gentiana clusii*, *Pedicularis verticillata*, *Ranunculus breynianus*, *Rhodax rupifragus*, *Saxifraga wahlenbergii*, *Soldanella carpatica*, *Thymus pulcherrimus* subsp. *sudeticus*, *Trisetum alpestre*, etc.). This phenomenon is known and had been studied by many botanists since the half of the 19<sup>th</sup> century. In addition, there is the high number of Carpathian endemics present in the flora of the territory, inclusive the famous local endemic of European importance, *Daphne arbuscula*.

In our study, we focussed on the diversity pattern of non-forest vegetation developed mostly on the open south- and southeast exposed rocky and grassy slopes in the altitudes between 425 and 1080 m a.s.l. During the last decade, 115 relevés of this vegetation type were sampled using standard methods of zürich-montpellié approach and compared with previously published data. The phytosociological relevés were stored in the database program TURBOVEG and analysed using the program JUICE 7.0.98. For the numerical classification the Ward method, relative Euclidean distance as a similarity measure and square root transformation of species covers were used (PC-ORD). The main environmental gradients of species composition were analysed by DCA in the CANOCO 4.5 package.

The various mosaics of plant communities were detected in succession series

from pioneer rocky stands through open rocky grasslands dominated by *Festuca pallens*, *Carex humilis* and *Sesleria albicans* to tall grass communities dominated by *Calamagrostis varia*. Plant communities belonging to 5 classes (*Sedo-Scleranthetea*, *Festuco-Brometea*, *Elyno-Seslerietea*, *Thlaspietea rotundifolii*, *Mulgedio-Aconitetea*) inclusive pannonian grasslands of the alliance *Bromo pannonici-Festucion pallentis* and high mountain-subalpine grasslands of the alliance *Astero alpini-Seslerion calcariae* grow in the study area, mixed together to create an overlapping structure. Associations of transitional character between the classes *Festuco-Brometea* and *Elyno-Seslerietea* (e.g. *Orphantho luteae-Caricetum humilis*) are common. Thus, specific position of Muránska planina Mts on the crossing of Carpathian and Pannonian bioregion is manifested also on the level of syntaxa.

## **Effects of cut mowing and grazing with Hungarian Grey Cattle on species composition and biomass productivity on Pannon grasslands**

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Phytosociological samples were collected: grassland stands with low intensity grazing (under-grazed pasture), overgrazed pastures, meadows (hayfield) and the stands where animals drinking. The areas were suitable for following up the changes of vegetation and production in every grazing season of a year. 5 pieces of 2×2 m phytosociological samples were examined on each sample area in April, May, June, August and September.

In case of the undergrazed pastures low number of species was detected in the and the control area. About one month per year grazing time in the undergrazed area was not enough to achieve a better state for species diversity, and the amount of forage remained high. The overgrazed pasture carries a low forage value and contains a high number of weed species, despite the spectacularly high total number of plant species, consequently, grazing pressure has to be decreased. Although the number of species is lower in the hayfield, species composition and ability for forage supply is much better, showing that the proper management of the area is taken here.

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## **Effects of conservation management on the grassland vegetation of Sár Mountain near Gyöngyös in Hungary**

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We studied the vegetation of grasslands on the Sár Mountain, in Gyöngyös (Hungary). The areas are mowed regularly by the Bükk National Park and mechanical shrub control was done as well. The effects of these habitat management techniques were investigated on grasslands of different degradation levels.

Coenological studies were made between May and June in 2013 with 2x2 m relevés. The study areas were characterised according to nature conservation value categories and life forms.

Our results showed that the above mentioned management techniques had positive effects on the diversity of grasslands. On the managed grasslands the abundance of woody species decreased, while the abundance of annual and perennial grass species and dicotyledonous herbaceous species increased. The highest species number (58–78) was recorded in the case of control areas. The number of species was high (47–49) in the areas managed by mowing and mechanical shrub control. The lowest species number (43) was recorded in the areas which were not mowed after mechanical shrub control.

According to the nature conservation value categories the number of protected species was the highest in the control areas.

Our results approved that regular mowing is needed after mechanical shrub control to sustain the diversity of abandoned grasslands in the long run.

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## **Vegetation survey along a catena in Tihany Peninsula (Balaton Uplands National Park, Hungary)**

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Spatial pattern of aboveground vegetation can be strongly determined by the soil moisture content. Research of the latter is especially current during the climate change.

In order to reveal interactions between the vegetation pattern and soil moisture content we conduct vegetation and pedological examinations on a slope connected to the North-West shore of Lake Belső in Tihany Peninsula (Balaton Uplands National Park, Hungary).

The vegetation was monitored by Braun-Blanquet method in the end of spring and in autumn, 2013. Surveys were performed in 27 permanent plots (size of 2×2 m) designated in three parallel transects in direction of the slope. Along the catena, soil moisture content was measured twice a year (in summer and autumn, 2012 and 2013).

Moisture of the soil shows regressive trend from the bottom to top of the slope. At the foot of the slope, soil humidity is twice as much than that of the upper section. Depending on the soil moisture, species composition of the vegetation differs significantly along the slope. Dominant species in the wet grassland at the bottom are *Trifolium pratense*, *Carex riparia* and *Poa trivialis*; in the following wide xero-mesic transitional zone there are *Festuca pseudovina*, *Achillea collina* and *Bromus sterilis*; and in the drier grassland at the top *F. pseudovina*, *Salvia nemorosa* and *Teucrium chamaedrys* are considerable. Diversity of the vegetation is proved to be higher in the drier grassland area ( $H_s=2.1\pm0.4$ ). Regarding the average cover, it is lower (76%) compared to the wet grassland (99%). Species composition showed relatively good naturalness in all tested vegetation types.

## Changes in sand vegetation in Southern Banat (Vojvodina, Serbia)

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Deliblato sands are the largest continental sand area in Europe. It's located in South-East Banat, in Northern Serbian province of Vojvodina. Characteristic of this area is a specific geological structure – large crust of aeolian siliceous-carbonate deposits of sand originating from the Pleistocene. As the largest oasis of sand-steppe and steppe-woods vegetation in Pannonian Basin, Special Nature Reserve “Deliblato Sands” is one of the most important centers of biological diversity of Europe and the most important sand-steppe area in Serbia.

Since the year of 1815 the process of forestation has begun there, with the goal of binding and stopping the expansion of sand. With the goal of localization of sand, in 1978, grazing was completely forbidden.

Planted species and lack of management in steppe and sand areas, enabled a succession of all types of vegetation. On the other hand, the pressure of anthropogenic factors due to the exploitation of sand and illegal grazing is extremely changed the landscape and quality of the sand habitats.

First phytocoenological research in this area were carried out in the period 1948–1950, when were described the two sand communities- *Festucetum vaginatae delibaticum* Stjepanović-Veseličić 1953 and *Corispermum-Polygonetum arenariae* Stjepanović-Veseličić 1953. After these studies followed a long period with no new data about sand vegetation from Southern Banat.

A detailed and suitable monitoring of the status of sand vegetation of this area is one of the priorities for their effective management and requires an integrated approach. Analysis of sand vegetation began again in the 2012 and 2013.

This paper presents the preliminary results of present state of sand vegetation in Banat and the degree of changes that occurred in the last 65 years.

Relevés are collected with the same methods (Braun-Blanquet approach) and from the same locations as in the previous research. Also relevés were taken from new sites with free sand.

Differences in sand vegetation of southern Banat after 65 years were established on the basis of changes in floristic diversity, degree of presence and coverage of diagnostic and target taxa (Lausi index of coverage, Simpson diversity index are calculated). We also calculated the degree of similarity between old and new dataset using Sorensen and Ellenberg indices. We analyzed changes in floristic composition and ecological conditions by multivariate techniques, using DCA. For description of ecological conditions Ellenberg's indicator values were used. The DCA ordination confirms nutrients, soil reaction and moisture gradients as the most important for changes of this vegetation.

## Classification and ecology of dry grasslands in Serbia

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Dry grassland harbours a significant biodiversity of plant and animal species and Serbia is one of the centres of floristic diversity in Europe since 39% of European species thrive on its territory.

In this paper we present syntaxonomical diversity of dry grassland vegetation in Serbia. Phytocoenological relevés from all relevant literature sources and our investigations were stored in the vegetation database of grassland vegetation of Serbia (EU-RS-002). After the heterogeneity-constrained random resampling, the final dataset contained 1897 relevés and 1323 species. Species composition was classified hierarchically by beta flexible method.

We identified 11 clusters which are well characterized by their species composition and ecology. The first three clusters have included loess and sand steppe grasslands developed in Pannonian part of Serbia (*Festucion rupicolae* and *Festucion vaginatae*). Our analyses show floristic similarities of the alliances *Festucion vaginatae* and class *Festuco-Brometea*. The second three clusters have included Balkan ultramafic rocky grasslands of the order *Halacsyetalia sendtneri*, Balkan submediterranean montane steppe grasslands on calcareous substrates of the order *Astragalo-Potentilletalia* and Balkan alliance *Saturejion montanae* developed on limestone. The third large group of relevés comprised Balkan alliance of the dry grasslands on deep soils *Chrysopogono-Danthonion* and subcontinental steppes of the alliance *Festucion valesiacae* developed in hilly areas of Serbia in the thermophilous oaks zone. The results of analyses might be useful for unification of different classification systems in Balkan countries.

The study was funded by the FP7-REGPOT project AREA No. 316004.

## **Biogeographical processes of species-rich Mediterranean grasslands (*Scorzonero-Cryspogonetalia*): case study of Ćićarija (Croatia)**

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It is widely discussed how landscape fragmentation affects floristic richness. The effects vary in time and might depend on the specific character of vegetation. Many previous studies in habitats occupied by plants of low dispersal ability (e.g. forests or wetlands) recognized fragmentation as a major cause of biodiversity decline. This is a great ecological problem especially in Europe, where traditional land use change is being observed. Influence of landscape fragmentation on grassland vegetation is poorly recognized as dispersal abilities of plants inhabiting these ecosystems vary significantly. Landscape fragmentation effects on biodiversity should be also analyzed at different scales.

*Scorzonero-Cryspogonetalia* is one of the most common Mediterranean grasslands community and of great environmental and economic interest. The aim of this study is to examine whether abundance and plant species distribution in grasslands of Ćićarija (Croatia) change significantly in relation to management (pasture /meadow, extensive management /abandonment) and topographic variables. Vegetation sampling was performed in 98 plots of 10×10 meter according to Braun-Blanquet method (1964). The size of every isolated grassland patch was estimated on the basis of available orthophotomaps. Parameters describing shape of the patches (landscape metrics) were calculated on the basis of vector data using Quantum GIS and FRAGSTATS software. Orthophotomaps and field measurements were used to estimate distances to the nearest patch of the same type (nearest neighbor distance).

In this study we examined: pastures belonging to *Carici humilis-Centaureetum rupestres* Horvat 1931 and *Brachypodium rupestre* variant (abandoned sites), meadows *Danthonio-Scorzoneretum villosae* Horvat & Horvatić in Horvatić 1958, abandoned meadows *Anthoxantho-Brometum erecti* Poldini 1980. We believe that these grassland types depend on management and isolation therefore the availability of plants.

Conservation probably should be applied to larger fragments of grasslands, which potentially can provide conditions for a higher number of plants. In practice identification of isolated patches that cannot be colonized from neighboring areas is important for conservation practices. Management should also be focused on increasing the connectivity between larger sized grassland patches.

## **To what degree the landscape parameters determine species richness and composition of dry grassland fragments in Goričko Nature Park, NE Slovenia**

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The landscape structure of Goričko Nature Park is a typical result of “frozen processes”, which appeared within the Central European agricultural landscape in the past. The study area covers approximately 8 km<sup>2</sup>. Species richness and composition of all remnants of dry grasslands were sampled. 80 fragments were analysed in relation to: fragment management, fragment area, number of different bordering habitat types, distance to settlements and distance to roads. All together 180 plant taxa were recorded, 46 being habitat specialists. Fragment area does not affect the total number of species per fragment ( $r = -0.077$ ,  $p = 0.499$ ) and the number of typical species (habitat specialists) per fragment ( $r = -0.107$ ,  $p = 0.345$ ) significantly. The alpha diversity of the fragments is not in significant correlation with the fragment area ( $r = -0.192$ ,  $p = 0.088$ ). Species richest are abandoned fragments in different succession stages. Significant correlation between the fragment size and species frequency of 9 (out of 46) habitat specialists were found: they prefer smaller fragments with an area of 0.15–0.26 ha. With the increase of different bordering habitat types, the total number of species per fragment increased on abandoned fragments and decreased on regularly mowed and ruderalized fragments. With increased distance from the settlements the Shannon-Wiener diversity rates increased. Regularly mowed fragments are on average closest to the settlements, while fragments in different succession stages are the most distant. Ruderalized fragments are located closer to the road system, while fragments in different succession stages are the most distant from the roads. No relations were found between species richness and area size, which confirms that today's network of dry grassland fragments are actually last remnants before their final local extinction. Past and present management practices are the key driver for species richness and composition of the studied grassland fragments. Abandonment and conversion to arable land had caused the decline of dry grasslands and still represent a major threat to them within the Goričko Nature Park.

## **Assessing community assembly in North Adriatic Karst with trait and evolutionary distances**

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Two approaches to account for ecological differences have been developed, one based on trait differences (functional diversity) and another based on evolutionary history (phylogenetic diversity). Usually, these approaches are used separately, but, since functional and phylogenetic diversity may be complementary and both have limitations, combining them allows one to obtain an integrated view of processes structuring communities. In the North Adriatic Karst, some of the richest and densest grasslands in the world are found. Meadows occur on mesic conditions, whereas pastures occur on oligotrophic conditions. We combined trait and evolutionary differences to compute functional-phylogenetic distances and assess community assembly processes in meadows and pastures of the Karst region. We found that the meadows presented higher pairwise distances than the pastures, as expected because of the milder soil conditions in the former. We found a signature of convergent evolution, because functional distances were smaller than phylogenetic distances. In the meadows, we found overdispersion irrespective of the importance given to functional or phylogenetic distances, suggesting that species from one subclade outcompete species from a different subclade and that those subclades are not so distant in the phylogeny. In the pastures, we found functional clustering and phylogenetic overdispersion, meaning that environmental filtering was the main driving force, that phenotypically similar species competed for the same resources, and, since traits were convergent, that coexisting species were filtered from different clades.

## **Verifications of previous predictions as a base for more reliable long-term predictions for grassland dynamics in the classical Karst**

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The classical Karst (Kras) in Slovenia covers an area of 238 km<sup>2</sup> which was previously severely deforested. During the last 250 years (from 1763/87–2012) the landscape has completely changed: grassland surface declined from 82% to 20% and forest progressed from 17% to 73%. The Multi-Layer Perceptron model was validated before making predictions for further landscape change by Markov chain method. A predicted habitat map for 2009 was produced and then compared with the habitat map, based on field survey. Image similarity statistics indicate 89% similarity and the spatial distribution of predicted grasslands agrees in 98% of locations. The prediction shows that grasslands will cover 18 km<sup>2</sup> less in 2025 in comparison to recent stage and will further shrink to just 6 km<sup>2</sup> in 2100. The speed of grassland encroachment was calculated on 2.2 km<sup>2</sup>/year. Until 2015, the area of forests will expand by 18 km<sup>2</sup>, compared to 2012. In 2075, forest will cover 88% of the whole study area, and will reach 90% in 2100, achieving than an almost steady state situation. Different congruent aspects regarding spontaneous reforestation (e.g. landscape beauty, diversity, forestry and wilderness) are discussed. However, legal obligations of Slovenian as an EU country, regarding the conservation of Natura 2000 grassland habitats, require maintenance of favorable state of Natura 2000 habitats. Since the Slovenian accession to EU in 2003, 5% of grasslands was already lost by overgrowing.

## Presence and phytosociological significance of some endemic species in the vegetation of dry grasslands of the Republic of Macedonia

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The work presents a review of the dry grasslands that develop on carbonate geological base in the central and western (submediterranean) parts of Republic of Macedonia, covered by the alliance *Saturejo-Thymion* Micevski 1971, order *Astragalo-Potentilletalia* Micevski 1971 and classis *Festuco-Brometea* Br.-Bl. et R. Tx. 1943. A number of endemic species, described from the territory of the Republic of Macedonia develop in the belt of dry grasslands, on carbonate geological substrate. Such is the case with the following taxa: *Allium bornmulleri*, *Anthyllis aurea* var. *multifoliolata*, *Astragalus sericophyllus*, *Astragalus mariovoensis*, *Centaurea grbavacensis*, *Centaurea kozjakensis*, *Dianthus kapinaensis*, *Helianthemum marmoreum*, *Micromeria cristata* subsp. *kosaninii*, *Saxifraga grisebachii*, *Scorzonera mariovoensis*, *Seseli vandasii*, *Stachys iva*, *Stachys horvaticii*, *Thymus skopjensis*, *Viola herzogii*, and others. They are very important elements in the composition of dry grassland vegetation, with significant cenological value. The aim of our research was to study the diversity of vegetation of dry grassland over carbonatae bedrock, the presence of endemic species and to find floristical, horological and ecological differences among investigated communities.

## **Patterns of plant species distribution along latitudinal gradient in southern Bulgaria and northern Greece**

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South Balkan Peninsula is a place where Mediterranean and Central European climatic influence meet which determine a zone where species character for each region coexist. We hypothesize that sub-Mediterranean and Mediterranean species are more numerous in grassland communities on the west but do not penetrate further to the north, whereas on the east fewer of them reach higher latitudes. The aim of our study is to test how plant species composition changes along the North-South gradient on grasslands of southern Bulgaria and northern Greece up to 1000 m altitude. Results expand the knowledge about contact zone and borders of continental and Mediterranean vegetation types on the Balkans.

A dataset of 2500 relevés was used to reveal the variation of three main characteristics of the plant communities along the N-S gradient. 1) Number and abundance of (sub-) Mediterranean species; 2) Number and abundance of diagnostic species for vegetation classes (*Thero-Brachypodietea*, *Helianthemetea guttati* and *Festuco-Brometea*) based on preliminary list; 3) Plant life-forms ratio in relevés.

This study is a part of project funded by the Bulgarian National Science Fund “Patterns in spatial distribution of habitats, plant communities and plant species in southern Bulgaria in relation to environmental and bioclimatic gradients”.

## **Relation between floristic diversity and geometrical, geographical and demographical characteristics of some islands in the northern Dalmatia (eastern Adriatic, Croatia)**

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Eastern Adriatic islands, as a part of the Mediterranean basin, with more than 1000 islands and islets, have a high biodiversity. Unfortunately, even until present time not all of the islands have been floristically researched, while some of the islands have only poor floristic data. Nevertheless, many of Croatian islands have comprehensive data of vascular flora. Recently, the number of plant species on Croatian islands has been put in relation with island areas according to a well-known model of SAR (species-area-relation). Although the study of species-area relationship, in general, has been used successfully to predict island biodiversity, the influence of other island characteristics on species number has received less attention. Because islands are considered intrinsically more fragile than mainland areas, this research aimed to investigate if plant diversity can be related to island geography and geometry, but also demographical characteristics. Island shape metrics (e.g. fractal dimension, shape index, etc.) were measured for a set of islands in the middle part of eastern Adriatic, and geographical characteristics (area, elevation, distance to nearest island etc.) were taken into the analysis. Demographical data was used as indicator of anthropological influence on biodiversity. Regression analysis was made using the number of plant species in relation to geography, geometry and demographical characteristics of islands. Plant species number has shown positive relations to different parameters taken into regression analysis. However, the strongest relation was noticed with demographical data, what can be connected to land abandonment recorded on the researched islands.

## **Vegetation of the islands around the Pelješac Peninsula (South Croatia, eastern Adriatic)**

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The peninsula of Pelješac (355 km<sup>2</sup>, max. altitude 961 m a.s.l.), South Croatia, is the second largest Croatian peninsula. It is situated in the Mediterranean Region, Eastern Mediterranean Subregion, Adriatic Province, and Epiro-Dalmatian Sector. The area has a Mediterranean pluviseasonal-oceanic bioclimate, and it is situated within the lower meso-Mediterranean belt, and falls within the lower humid ombroclime (ombrotype). High level of habitat diversity including habitats within the NATURA 2000 network has been shown on the peninsula. Pelješac has 76 associations and subassociations included within 34 alliances, 28 orders and 27 vegetation classes. From a botanic point of view, the most interesting habitats and those with the highest value of indigenous flora are rare sandy and gravel coasts, dry grasslands, and some abandoned agricultural areas that are important habitats of orchids. The peninsula is surrounded by numerous small islands and islets which can be divided for geographical reason in two groups: i) north-eastern group, composed by 13 islands located in the Mali Ston Bay, and ii) south-western group, composed by 19 islands situated in area between the peninsula and the island of Korčula (the Pelješac Channel). The surface area range of the islands is between 0.208 ha (skerry of Geravac) and 97.087 ha (island of Badija). The coasts are low and rocky, and the islands are uninhabited. Among them, island of Badija has the highest elevation (75 m). The aim of study was to investigate the natural landscape identifying plant communities of the islands. Altogether, 58 original phytosociological relevés were used on 18 islands, collected in 2012 and 2013. Vegetation data were interpreted in terms of syntaxonomical classification, based on cover and floristic affinities, following the Zürich-Montpellier approach. Ten plant associations have been identified and their successional position was pointed out. The woodland series prevail (90% of the area), but they are represented mainly by macchia and garrigues, forming the intermediate serial stages. The most important were the *Myrto communis*-*Pistacietum lentisci* (Molinier (1936) 1954) Rivas Martínez 1975 and *Myrto communis*-*Quercetum ilicis* (Horvatić 1963) Trinajstić 1985 associations. Although human pressure is low, the islands show a relatively low variety of taxa and plant communities.

## **Protected and used mesic meadows in southern part of Central-Forest Biosphere Reserve (Russia, Tver' province)**

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In the territory of Central-Forest Nature Biosphere Reserve there are some protected meadows for which the date when protective regime started is well-defined. The aim of the investigation is to compare the diversity and the successional state of meadow communities under the strict protective regime and those that have been in use up to recent day. We studied three sites in the reserve (protected since 1976, 1985 and 1992), and some currently used meadows (undergone mowing and pastures) in the buffer zone.

Classification units according to Braun-Blanquet approach are determined, their ecological characteristics are given, and the relationships with the community history and type of use are described. Using ordination approach, the main driving ecological factors are designated (nitrogen pool, soil moisture and soil particle size). Meadow communities in the reserve core area now show some signs of degradation and successional changes: the occurrence and abundance of grasses is comparatively low, while those of forbs (including ruderal species) and mosses are rather high. We also observed some cases of tree and shrub renewal (mostly consisting of *Malus domestica*, *Betula pendula* and *Salix*).

## **Investigating the potential of using a biomass from semi-natural meadows as a substrate for biogas production: effect of vegetation type and environmental conditions on biogas yield**

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Grasslands play an important role in the agricultural landscape of Europe. Semi-natural meadows are essential for maintaining biodiversity and have been primarily used in animal husbandry. However, the latter function becomes less important in recent times because of the livestock decrease. As a result, many grasslands have been converted into arable lands, afforested or abandoned. This especially refers to low productive meadows which are particularly important for biodiversity conservation and other ecosystem services. In order to prevent further disappearance of grasslands an alternative ways of biomass use should be implemented.

The aim of the present study was to investigate the potential of biomass from meadows as a source of renewable energy in relation to their species composition diversity, variability and habitats requirements. The present study aimed at assessing 1) vegetation diversity, 2) share of ecological plants groups, 3) content of macroelements and inhibitors of biogas production in plants and soil, 4) productivity of meadows and 5) biogas production.

A total of 40 samples have been collected from 4 different types of meadows belonging to the alliances *Cnidion*, *Calthion*, *Arrhenatherion* and *Molinion*. Sampling plots were arranged in transects and data were collected from the plots of an area of 1 m<sup>2</sup>. The average species richness was calculated and species were combined into ecological plant groups including grasses, sedges, tall herbs and legumes. The abundance of each species group and meadows productivity was computed. Additionally, pH of soil, content of macroelements and inhibitors (total N, Na<sup>+</sup>, Ca<sup>2+</sup> K<sup>+</sup>) of biogas production in plant and soil samples were assessed. The biomass samples were analyzed for total solids (TS) and volatile solids (VS). The biogas production was measured in batch experiments according to standard DIN 38 414.

The results show that diversity and variability of meadows as well as environmental factors strongly influence biomass and biogas production. Biogas yields vary between experiments with biomass from different plant communities. The highest biogas yield was indicated for *Molinia* meadows. This is associated with lowest level of nitrogen content, high species diversity and total productivity. Biogas yields from meadows biomass is comparable with those obtained from other commonly used feedstock, e.g. maize. Biomass from semi-natural meadows used for energetic purposes provide good perspectives for biodiversity conservation.

## **Semi-natural mesic grasslands in the eastern part of the Ukrainian Carpathians**

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The area of the Ukrainian Carpathians is rich in semi-natural grasslands but until now they have not been studied sufficiently using the Braun-Blanquet approach. In the year 2013 fifty-six phytosociological relevés were recorded in semi-natural mesic grasslands in Zakarpatskaya oblast and Ivano-Frankovskaya oblast regions.

Questions: i) What types of semi-natural mesic grasslands can be distinguished in the eastern part of the Ukrainian Carpathians? ii) What is the species diversity richness of these grasslands at two spatial scales?

Methods and results: The phytosociological research was made using the Zürich-Montpellier school approach. Floristic composition and species richness of several types of mesic grasslands were studied at two spatial scales, 1 m<sup>2</sup> and 16 m<sup>2</sup>. The Ward method with relative Euclidean distance as a similarity measure was used for the cluster analysis to distinguish the different grassland types. The relationships between species composition and selected environmental factors were analyzed by canonical correspondence analysis. The differences among the grasslands in species richness on 1 m<sup>2</sup> and 16 m<sup>2</sup> plots were tested by ANOVA with the post-hoc comparison test. The distinguished types of mesic grasslands were classified according to the classification systems used in Ukraine and the other Carpathian countries. Syntaxonomical issues are discussed.

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## **The *Molinietalia* wet meadows in Bulgaria**

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The wet meadows in Bulgaria are considerably diversified involving both mountainous and lowland types, however little is known about their species composition and phytosociological classification. During the years 2001–2008 we sampled 175 relevés of *Calthion*, *Molinion* and *Deschampsion* alliances. Vegetation with *Juncus inflexus*, *Mentha longifolia* and *Pulicaria dysenterica* (*Juncion inflexi*), which is in some national vegetation surveys placed into the *Calthion* alliance, was also included into our research. Bulgarian *Calthion* meadows are characterised by low representation of *Cirsium* species contrary to the Central-European wet meadows and by high representation of *Geum* species (*Geum coccineum*, *G. rhodopeum*, *G. rivale*) and a group of species with SE-European distribution range (e.g. *Juncus tomasii*, *Oenanthe banatica*, *O. silaifolia*, *Silene asterias*). From a group of widely distributed European associations we recorded *Cirsietum rivularis* (single site in NW Bulgaria), *Caricetum caespitosae* (two sites) and *Scirpetum sylvatici*. Other *Calthion* meadows are specific and will belong probably to endemic associations. Vegetation of the *Molinion* alliance is rather rare occupying only several places in Bulgaria, the Znepole region, Podbalkan (district Kazanlak), Lozen, Vitosha and Plana Mts. *Deschampsion* meadows are characterised by low representation of continental species characterising the vegetation which was formerly classified as *Cnidion venosi*, from which only *Gratiola officinalis* is frequent. They are mainly distributed in Sofia basin, Razlog basin and basins below the Stara Planina Mts, always in higher altitudes as compared to Central Europe. Among species endangered in Central Europe, *Orchis elegans* is still rather frequent species in Bulgarian alluvial wet meadows. Vegetation with *Juncus inflexus* involves two types in Bulgaria: one corresponding with the Central-European association *Juncus inflexi-Menthetum* and occurring in mountains, and the lowland one characterised by *Cirsium creticum* and *Eupatorium cannabinum* which will represent separate association. The most species-rich are meadows of the *Molinion* alliance and some meadows of *Deschampsion caespitosae* alliance such as those with *Orchis elegans*.

## **Classification of mesophytic and meso-xerophytic grasslands on Balkan Peninsula**

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Mesophytic and xero-mesophytic grassland communities are widespread on Balkan Peninsula. They are found in lowlands and hilly areas. Syntaxonimically this vegetation belongs to *Festuco-Brometea* and *Molinio-Arrhenatheretea* classes and *Brachypodietalia pinnati* (incl. *Brometalia erecti*) and *Arrhenatheretalia elatioris* orders respectively. In this study, we aimed to find which the transitional syntaxa between these two classes are and to make some comments on their flora and ecology. We analyse relevés from Bulgaria, Serbia, Kosovo, Macedonia, Bosnia and Herzegovina, Slovenia and Croatia collected according to the Braun-Blanquet approach. The relevé plot size varies between 16 and 100 m<sup>2</sup>. We used TWINSpan as a main tool for classification. The vegetation is classified up to alliance level. Diagnostic species are determined according to their phi-values.

## **Notes on thermophilous fringe vegetation (*Trifolio-Geranietea*) in the Crimean Mountains (Ukraine)**

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The aim of this research is to establish the syntaxonomy of herbaceous fringe vegetation of the submediterranean Crimea and their relations with environmental gradients. The data on fringe vegetation in Ukraine are still scarce (Solomakha 2008, Iakushenko 2011), the *Trifolio-Geranietea* T. Müller 1962 communities were neglected in the prodromus of Crimean vegetation (Korzhenevsky et al. 2003).

Study was conducted in the altitudes of 550–800 m both on Northern and Southern macroslopes of Crimean Mountains. After ecological stratification of the 65 relevés, 39 remained. Modified TWINSpan analysis was used to establish the main vegetation types. Collected data were analyzed by multivariate analysis (DCA). Classification resulted in two major vegetation groups.

The first group, preliminary identified as new association *Dictamno gymnostyli-Physospermetum cornubiensis*, contains shaded meso-subxerophytic herbaceous communities rich in broad-leaved perennials on the fringe of mesic Crimean beech (*Dentario quinquefoliae-Fagion* Didukh 1996) and deciduous oak (*Paeonio dauricae-Quercion petraeae* Didukh 1996) forests on nutrient-rich soils, much rare related to the *Pinion pallasianae* Korzhenevsky 1998 forests.

The second group, preliminary described as new association *Dorycnio herbacei-Origanetum vulgaris*, contains xerophilous forest-edge communities rich in steppe elements on well-drained soils in transition zone to open grasslands (tomillars in dry slopes, and meadows from of the alliance *Trifolio pratensis-Brizion elatioris* Didukh et Kuzemko 2009 in mesic conditions).

Despite the syntaxa defined are close related to the *Geranion sanguinei* Tx. in T. Müller 1962 communities, we preliminary suggest Crimean submediterranean fringe belong to the new alliances, analogous to Iberian, Illirian and Southern Balkan alliances, due to significant role of Pontic and Euxinian floristical elements.

## **Ecological and floristic-vegetational characterization of the plant communities dominated by *Asphodelus macrocarpus* Parl. subsp. *macrocarpus* in the central Apennines**

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We present here the results of the phytosociological study performed on the plant communities dominated by *Asphodelus macrocarpus* Parl. subsp. *macrocarpus* that are located in the central Apennines in the supratemperate termotype. *Asphodelus macrocarpus* subsp. *macrocarpus* is a rhizomatous geophyte that has a strong ability to colonize abandoned or underused secondary grasslands belong to *Festuco-Brometea*, *Molinio-Arrhenatheretea* and *Nardetea strictae* classes that are present on the rolling plain and depresses (wide valley, narrow valley) morphologies on deep and wet soils in central Apennine. Like *Brachypodium rupestre* and *B. genuense*, with which it often shares the dominance of the herbaceous layer, it results in a drastic reduction in the species diversity of the grasslands, while at the same time it facilitates the entry of forest-edge species of the *Trifolio-Geranietea sanguinei* class. This behaviour is typically found in the absence of human disturbance at the edges of the woods of the *Fagetalia sylvaticae* order, in the heliophilous ecotonal positions immediately external to the space occupied by the typical sciaphilous forest edge of the *Origanetalia vulgaris* order. In this position *Asphodelus macrocarpus* subsp. *macrocarpus* forms dense mesophilous herbaceous communities with a floristic and ecological autonomy. From the syntaxonomic point, these communities belong to the *Trifolio-Geranietea* class and *Asphodeletalia macrocarpi* order. The *Asphodeletalia macrocarpi* order Biondi & Allegrezza in Biondi *et al.* (2014) aims to conceptually represent the ecotonal space occurring between the wood and the grassland, where the dynamic recovery of serial vegetation starts separating the heliophilous edge from the wood. The order groups together communities of megaforbs including those typologies that have been often confused with the ones typical of grasslands and that show a clear combination, thus representing different levels of the same serial succession on secondary grasslands abandoned by agricultural-pasture activities. As well as providing autoecology and synecology information of the plant communities dominated by *Asphodelus macrocarpus* subsp. *macrocarpus*, the results of this research may be useful for monitoring purposes and then the conservation and / or recovery of the biodiversity of secondary grasslands belonging to Community interest habitats. This is particularly important in the Natura 2000 areas, where the primary purpose is the preservation of biodiversity.

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## **Plant functional trait responses to different land use change in Secondary succession**

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Due the traditional land use change (abandoning of agricultural land, decreasing of grazing and mowing activities, increasing of forestry activities etc.) in the continental part of Croatia, effects of secondary succession leave a great mark on the landscape in terms of large scale losses of semi-natural habitats.

The successional processes were explored using plant functional traits at the level of different series classified according to their different habitats and land use. Plant functional traits show a great correlation to the successional stages and are highly correlated to the successional pathway on each habitat according to the type of land use on it. Most ecological characteristics of the habitat also significantly change by the progress of succession. EIV for temperature, light, continentality and reaction decreases, while the values for moisture and nutrients grow. The share of European and Central European floristic elements among the plants increase significantly with the progress of succession, while the number of cosmopolitan plants, as well as the Eurasian and East European-Pontic floral elements decrease. Further, there is an noticeable increase of chamaephytes, geophytes, macrophanerophytes and nanophanerophytes, while the number of hemicryptophytes, hemitherophytes and hemiphanerophytes decreases. The progress of succession also increases the proportion of perennial and reduces the proportion of annual and biennial plants. Earlier stages are characterized by a greater proportion of plants with scleromorphic type of leafs and heavier diaspore and germinule weight in contrast to the later stages which are mostly characterized by plants with mesomorphic leaf anatomy type and smaller diaspore weight. In the later stages species begin to flower earlier and have a shorter flowering duration. The progression leads to the increase in the proportion of species with berries, drupes and siliques as fruit types, while at the same time it leads to the decreases of the proportion of species with legumes and nuts. All this shows how secondary succession causes major changes in species composition, structural characteristics and environmental and functional features of plants and habitats on which they grow.

## Regional patterns of succession in abandoned fields on loess in the southern part of Carpathian basin

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Vegetation patterns and changes in species composition were investigated in abandoned crop fields and in grasslands previously used as pastures or hayfields. In our analyses we used data from a long-term (15 years) permanent plot study together with additional data obtained by space-for-time substitution method. Vegetation of particular plots was analyzed in relation with the surrounding landscape features. Our study was performed in the southern part of Hungary, which is situated in southern marginal part of the Carpathian basin. The climate of study area is sub-continental – sub-Mediterranean. According to the previous surveys, the potential natural vegetation on loess substrate is a sub-Mediterranean type of loess oak forests. The target grasslands are supposed to be sub-Mediterranean steppe-like meadows with domination of *Chrysopogon gryllus* and *Bromus erectus* and meadow steppes, where dominant grasses are *Brachypodium pinnatum* and *Festuca rupicola*. The flora of the region consists of more than thousand native plant species, and half of this number can be considered as being the regional species pool of loess grasslands. Most abandoned fields studied here were situated within extensively used traditional landscapes with relatively rich species pool, high naturalness and good regeneration potential. Our study on the temporal dynamics of plant community assembly after abandonment supported the hypothesis that seed sources are more important than the age of abandoned fields. High diversity and equitability appeared in some mid-successional plots. Species attaining local dominance had some biotic filter effects on local plant assembly. Dominance rank predicts the strength of biotic filter effects in succession often with strong negative impact on diversity. Dominant species in plots with the lowest diversity are invasive annuals (e.g. *Erigeron annuus*), clonal perennial grasses (e.g. *Bromus inermis*, *Calamagrostis epigejos*) and shrubs (e.g. *Cornus sanguinea*, *Prunus spinosa*). Community level attributes in old-field succession showed that field age is a poor predictor of the progress of succession at regional scale.

## European fen vegetation – synthesis and classification

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Fens are minerotrophic (groundwater-fed) mires with a unique species composition. Despite the broad distribution of fen vegetation and its great plant diversity, it have received much less attention than bogs (ombrotrophic mires). European fens are relatively well characterized by the phytosociological class *Scheuchzeria palustris*-*Caricetea nigrae*. However, floristic composition of this class is diverse. It varies mainly along the gradient of pH and mineral richness, known as the “poor-rich” gradient, with additional regional variation driven by macroecological and historical factors. The syntaxonomy of fen communities is quite complicated since the national classification systems are based on regional variation and different concepts. Thus we need to establish a consistent vegetation system useful for communication among scientists and for management (e. g. interpretation of the habitats of European conservation concern within the Natura 2000 network and applied nature protection).

We present the large-scale synthesis and syntaxonomical analysis of fen vegetation in Europe, a project coordinated by the Mire ecology working group (Department of Botany and Zoology, Masaryk University, Brno, Czech Republic). This research is carried out with the help of dozens of data contributors from the entire Europe.

Our main aims are: 1) to collect available phytosociological relevés from national and private vegetation databases and to gather original relevés in insufficiently explored regions of Europe, 2) to use these data for the classification of European mires on the alliance level (and for the alliances *Caricion davallianae* and *Sphagnoto-Tomentypnion* also on the association level) and 3) to describe the species composition, habitat conditions and distribution of particular vegetation types.

Data collection follows the rules of collaboration and co-authorship already accepted in other pan-European projects on vegetation surveys (<http://euroveg.org/projects>) which are generally inspired in the rules of the European Vegetation Archive (<http://euroveg.org/eva-database>). New partners contributing with new data from uncovered regions or vegetation types are especially welcome to join the project.

## Progress on the Arctic Vegetation Archive: a prototype from Alaska

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Climate change is occurring more rapidly in the Arctic than anywhere else on Earth. The Arctic Vegetation Archive (AVA) working group of the Conservation of Arctic Flora and Fauna (CAFF), the biodiversity arm of the Arctic Council, is gathering a baseline record of the distribution of vegetation and vegetation data within the Arctic, an area of about 7.1 million km<sup>2</sup> (about 70 percent the size of Europe). The AVA was launched in 2013–14 with two meetings in Krakow, Poland, and Boulder, Colorado, USA (Walker et al. 2013, Walker 2014). The AVA working group has started work on two prototype databases for Greenland and Alaska. Here we report progress on the Alaska prototype. Approximately 4000 historical vegetation plots in northern Alaska are being evaluated for inclusion in the Alaska AVA (AAVA). The Alaska Geobotany Center (AGC) is building the AAVA, which will be made accessible to scientists and the public via the Arctic Alaska Geoecological Atlas (AGA), an on-line resource being developed by the Geographic Information Network of Alaska (GINA). The AGA consists of two main parts: the AAVA plot archive and a northern Alaska map archive. For the AAVA we use a Turboveg database and are following protocols being developed for the European Vegetation Archive (EVA) and the Global Index of Vegetation Databases (GIVD). The data are also being deposited in the US vegetation archive, VegBank. A PanArctic Species List (PASL-1) (Raynolds et al. 2013) provides a standard list of accepted vascular-plant, bryophyte, and lichen species names for the Arctic biome. A wide variety of photos, maps, reports, and other ancillary data are linked to each plot's geographic location. High quality plot data and non-digital legacy datasets that are in danger of being lost have the highest priority for entry into the plot archive. Details of the AAVA workflow and the Turboveg data dictionary are contained in the proceedings from the Boulder meeting (Breen et al. 2014). The AAVA received a strong boost with funding from the US National Aeronautics and Space Administration (NASA) in preparation for its Arctic-Boreal Vulnerability Experiment (ABoVE) ([23<sup>rd</sup> EVS-Workshop, Ljubljana 8–12 May 2014](http://</a></p>
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above.nasa.gov/index.html?), which is scheduled to begin in 2015. Abundant ground-based information, such as that contained in the AAVA will be needed to inform the ABoVE remote-sensing and modeling studies.

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## **Vegetation patterns of boreal mires: an example from Arkhangelsk Region, NW Russia**

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Diversity of mire types was studied on the watersheds on the both riversides in the middle flow of the Northern Dvina River, Arkhangelsk Region, European Russia (63°17'– 63°21' N, 41°51'– 42°04' E; Kholmogory District). This flat territory lies 200 km south from Arkhangelsk, and it is characterized by close bedding of the gypsum deposits originated from the Perm period. The mires have developed on the moraine and fluvial-glacial plains (left river bank) and they are wide spread on the limno-glacial plain (right river bank).

Two large oligotrophic bogs with complex vegetation structure, patterned silk-hole mires on different stages of their formation, ordinary open mires and small pine mires as well as a forest swamp with spring effect were investigated for the first time. Fens formed on the floodplain on the left side of the river valley were observed.

The single silk-holes and their united chains were revealed in the surroundings of the Kotozero Lake on the left bank of the Northern Dvina River. This phenomenon was noted also in the vicinity of Dvinskoy settlement on the right river bank.

We focused on present vegetation cover of mires, their floristic features, spatial structures such as vegetation patterns, successions and peculiarities of peat deposits. 225 original relevés were made in August 2013. Species included in the Red Data Book of the Russian Federation were recorded. They are *Lobaria pulmonaria* (L.) Hoffm., *Cypripedium calceolus* L. and *Dactylorhiza traunsteineri* (Saut.) Soð s.l.

Boreal bogs studied on the mentioned above territory are characterized by the widely spread association *Empetro hermaphroditi-Sphagnetum fusci* on bog hummocks; the association *Caricetum limosae* typically grows in bog hollows. The association *Sphagno-Rhynchosporium albae* was described from the regressive hollows and bog pool complexes of the large bogs. The rare plant communities belonging to the association *Trichophoro cespitosi-Sphagnetum compacti* were found on the Lavichnoe bog (63°20' N, 42°03' E).

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Relict fen communities of *Carex lasiocarpa*–*Schoenus ferrugineus*–*Campyllum stellatum*–*Scorpidium scorpioides* according to the Braun-Blanquet classification related to the union of Caricion davallianae Klika 1934, the class of Scheuchzerio-Caricetea nigrae (Nordh. 1936) Tx. 1937 are disjunctive from the main part of distribution area and are situated in the eastern its part. There grow 19 rare for the Southern Urals plant species, including *Schoenus ferrugineus*, *Dactylorhiza ochroleuca*, *Pinguicula vulgaris* which are relicts of European genesis.

To summarize mires of the region are peculiar hotspots of floristical and coenotical diversity, many relict species and communities situated on limits of distribution areas are concentrated here and their presence in the region depends on the condition of mire ecosystems.

The study was supported by the Russian Foundation for Basic Research (project № 14-04-00362-a).

## **Vegetation of Petrifying springs with tufa formation and *Molinia* meadows on calcareous soil in Latvia**

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In Latvia habitats of European importance 7220\* *Petrifying springs with tufa formation* (*Cratoneurion*) (further habitat 7220\*) and 6410 *Molinia meadows on calcareous, peaty or clayey-silt-laden soils* (*Molinion caeruleae*) (further habitat 6410) belong to one of the most rare and endangered. In most cases the habitat 7220\* is located in forests (often in 9180\* *Tilio-Acerion forests of slopes, scree*s) where no forest cutting is carried out or it is not needed for the habitat maintenance purpose. More rarely calcareous springs flow out in open areas – grasslands or fens, forming an ecotone zone with habitats 6410 or 7230 *Alkaline fens*.

In case traditional agriculture activities are stopped (grassland mowing or grazing) the open areas are subjected to overgrowth that influences habitats 7220\* and 6410.

Studies of the above mentioned habitats are carried out mainly in Western Latvia (10 sites) where most often the co-existence of habitats 7220\* and 6410 is observed. In the 5 studied sites about 30 years ago or even earlier freshwater lime extraction was carried out and freshwater lime deposits are still open that have not overgrown with homogenous vegetation.

Vegetation descriptions have been made both in habitats 7220\* and 6410, as well as in transition zone using Braun-Blanquet method. In the relevés vascular and bryophyte species are determined. In habitat 7220\* communities from *Montio-Cardaminetea* Class occur with significant presence of bryophytes in the plant cover, like *Cratoneuron filicinum*, *Palustriella commutata*, *Philonotis calcarea*, *Bryum pseudotriquetrum* etc. but in habitat 6410 Humid oligotrophic grasslands *Molinion caerulea* the main dominant species include *Sesleria caerulea*, *Molinia caerulea* and *Carex hostiana*. It has been determined that in habitat 7220\* about 200 vascular plant species and 150 bryophyte species are known. In the habitat 6410 120 vascular and 30 bryophyte species are registered. Data gives an evidence that in about 10–20 m wide ecotone zone between habitat 6410 and 7220\* species diversity is higher (at an average for 5 species in one relevé) and in addition in this zone rare and protected species, like *Tortella fragilis*, *Ctenidium molluscum*, *Trichostomum crispulum*, *Pinguicula vulgaris*, *Primula farinosa*, *Orchis militaris*, *Crepis praemorsa*, *Iris sibirica* etc. are known.

The habitat complex with Petrifying springs with tufa formation and *Molinia* meadows has a significant role in the conservation of species diversity in Latvia.

## **Classification of European bog vegetation. Familiarization with the starting project**

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Numerous national and regional classifications of bog vegetation (class *Oxycocco-Sphagnetum*) have been recently developed. Therefore, the classification is simultaneously inconsistent among European countries and formal criteria of delimitation of vegetation types are still missing. The aim of this conference contribution is to point out the European vegetation scientists on starting project focused on the formalized classification of bog vegetation. Our aims are as follows:

- 1) Creation of the relevé database with most of the available data from whole Europe
- 2) Classification of the European bog vegetation
- 3) Defining diagnostic, dominant and constant species for particular vegetation units
- 4) Producing formal definitions using Cocktail method (*Brühlheide 2000, Journal of Vegetation Science*) that enables automatic assignment of relevés to vegetation units.
- 5) Distribution of particular bog communities in Europe

New contributors with suitable data from less known regions, where phytosociological data are still missing for us are especially welcome to join the project. In general terms, we will follow the rules of collaboration and co-authorship already accepted in other pan-European projects on vegetation surveys (<http://euroveg.org/projects>) which are generally inspired in the rules of the European Vegetation Archive (see the document EVA Data Property and Governance Rules in <http://euroveg.org/eva-database>).

## **Concordance of diversity patterns among multiple taxonomic groups in freshwater ponds**

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Using of surrogate species is a useful approach in biodiversity mapping and conservation planning at large scale. Existing studies on cross-taxon congruence in freshwaters are spatially restricted to few biogeographic zones and mainly focused on running waters. Here, we investigated concordance in diversity and assemblage composition between aquatic macrophytes and several invertebrate groups (Turbellaria, Hirudinea, Crustacea, Odonata, Trichoptera, Lepidoptera, Heteroptera and Diptera) in small standing waters (ponds) in Slovakia. Our aims were to assess cross-taxon congruence in species richness and assemblage composition, and to identify indicator group/groups of taxa with potential to represent the overall biodiversity of ponds. The pilot study on 49 ponds revealed generally weak correlations in species richness (range of Spearman rho: -0.52–0.32) and assemblage composition (range of Mantel rho: -0.08–0.14) between macrophytes and invertebrate groups. Species richness of submerged macrophytes appeared as a single best predictor of total species richness. However, the model showed relatively low predictive power (cross-validated RMSE ~ 6 species) and explained only about 23% of deviance in overall species richness. So far the surrogate group approach has not appeared useful in prediction of diversity and assemblage composition between macrophytes and invertebrates in Central European ponds. However, the research is still in progress under the project BIOPOND ([www.biopond.sk](http://www.biopond.sk)).

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## **Dynamics of riparian plant communities dominated by invasive alien plants**

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To find out the dynamics of riparian plant communities dominated by invasive alien plants the method of repeated recording of species composition at permanent plots (PP) were chosen. Five permanent plots were established in 1999 at the bank and close alluvium of the Morava River (Western Slovakia). Plots were selected with regard to adequate representation of the most frequent invasive neophytes in the region: *Impatiens glandulifera* (PP1), *Helianthus tuberosus* (PP4), and *Aster lanceolatus* (PP2, 3, 5). Every year in late summer phytosociological relevé in each plot was made.

Dynamics of the studied plant communities is aptly characterized by changes in the species composition between the first and subsequent years. The species turnover on PP was influenced mainly by water regime of the Morava River (timing and duration of floods and dry periods). Extremely wet and extremely dry years seem to have the most substantial effect on the occurrence and/or abundance of both natural and alien species. However, changing conditions during 14 years of the investigation affected various alien species differently and also the dynamics of species composition on the PP-s was different.

*Helianthus tuberosus* is not able to survive long-term flood during the vegetation period, because flooding can damage its underground tubers. It can completely retreat from the plot. The most resistant to changing conditions is *Aster lanceolatus*, which can survive even long summer flood and can make new shoots, which flower in late autumn. *Impatiens glandulifera* tolerates with difficulty long term dry and hot summer period. Occurrence and abundance of this therophyte species is not predictable and it probably depends on seed sources situated in higher parts of the Morava river catchment area.

The stand dominated continuously by *Aster lanceolatus* (PP5) is the most stable, with the lowest changes in species composition, life form composition and life strategies composition. Other plots (PP1, 3, 4) changed considerably, including change of dominant species, number of species, life forms and prevailing life strategies.

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## **Changes of the $H^+$ , $NH_4^+$ , $PO_4^{3-}$ and the $K^+$ concentration along the vegetation belts of a *Sphagnum* dominated mire from the centre to the shore**

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The aim of this study was to describe the changes of the  $H^+$ ,  $NH_4^+$ ,  $PO_4^{3-}$  and the  $K^+$  concentration along the vegetation belts of Nyíres-tó mire from the center to the shore. It situated on the north-east plain of the Carpathian basin, and known as the southernmost occurrence of *Oxycocco-Sphagnetea* associations on the plains of Europe. It formed by floating mire succession in an abandoned bed of Tisza-river and belted by peaty herbaceous- and woody associations and peatless gallery forests and meadows.

We collected and analyzed mixed water samples in each six plant associations, from the central *Eriophoro vaginati-Sphagnetum recurvi* Hueck 1925, across the *Betulo pubescenti-Sphagnetum recurvi* Zólyomi 1931, *Salici cinereae-Sphagnetum recurvi* (Zólyomi 1934) Soó 1955 *sphagnetosum fallacis* Nagy 2002, *Calamagrosti-Salicetum cinereae* Soó et Zólyomi in Soó 1955, *Calamagrosti-Salicetum cinereae* Soó et Zólyomi in Soó 1955, to the *Galio palustris-Caricetum ripariae* Bal.-Tul. et al. 1993 situated at the shore of the mire. The water samples had been collected by us at the middle of warm, shiny and dry June and at the middle of cold, cloudy and rainy October in 2009.

The concentration of ammonium varied between 0.01 and 0.2 mg/l, and increased from the center to the Alder-carr, and decreased strongly from here to the shore in June. In October it increased from the center to the lag zone permanently, and varied between 0.07 and 0.5 mg/l. The concentration of phosphate decreased from the center to the edge of mire more or less continually either in summer (0.02–1 mg/l) or in autumn (0.01–2 mg/l). We observed remarkable differences between of summer- and autumn concentrations in case of all plant associations. The concentration of potassium varied between of 3.06 and 6.48 mg/l in June, while it varied 2.12 and 11.95 mg/l in October. The measured values varied heavily even between of one association and show remarkable seasonal differences. The pH correlated with the vertical pattern of vegetation strongly either in summer or in autumn: it increased continually from the *Sphagnum* dominated center to the *Sphagnum* less shore.

We can state, that the Alder dominated association has outstanding importance in the regulation of phosphate and ammonium in the water of the investigated mire, while the acidity clearly correlated with the amount of peatmosses. Our observations must be related to the nitrogen-fixing bacterium, *Frankia alni* lives in the roots of Alders, and to the cation exchange ability of *Sphagnum*s.

## **Numerical classification of aquatic vegetation in Serbia**

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The aim of this study was to create numerical classification of aquatic vegetation in Serbia.

The TurboVeg database for aquatic vegetation was created, compiling 974 relevés. Relevés were derived from 19 sources, both peer reviewed papers and monographs, as well as MSc and PhD theses. They covered the period of five decades (1953–2010), including short and long-term phytocoenological surveys.

The dataset was analysed using SYN-TAX 2000 program, by non-metric hierarchical clustering OrdClAn (Ordinal Cluster Analysis) method, using the Goodman-Kruskal  $\gamma$  resemblance coefficient. Cluster analysis revealed 25 aquatic vegetation groups (VG1-VG25). Constant, diagnostic and dominant species of vegetation groups were statistically determined, providing a base for comparison of the traditional and numerical vegetation classification.

## **Phytosociological analysis of communities with *Adiantum capillus-veneris* in the foothills of the Julian Alps (Western Slovenia)**

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We conducted a phytosociological study of the communities hosting a rare and endangered fern *Adiantum capillus-veneris* in the foothills of the Julian Alps, in Karst and in Istria. Based on comparisons with similar communities elsewhere in the southern Alps (northern Italy) we classified most of the recorded stands into the association *Eucladio-Adiantetum*, and relevés from the southern Julian Alps into the new subassociation *Eucladio-Adiantetum hymenostylietosum recurvirostrae* subass. nov. Stands in conglomerate rock shelters along the Soča at Solkan are classified into the new association *Phyteumato columnae-Adiantetum capilli-veneris* ass. nov., as they indicate a contact of communities of two classes, *Adiantetea capilli-veneris* and *Asplenieta trichomanis*. Diagnostic taxa of the new association are *Asplenium trichomanes*, *Phyteuma scheuchzeri* subsp. *columnae*, *Paederota lutea* and *Leontodon hispidus* subsp. *brumatii*. We differentiate two subassociations, *Phyteumato-Adiantetum trichostomotosum crispulae* subass. nov., with differential species *Trichostomum crispulum* and *Didymodon fallax* on slightly drier sites, and *Phyteumato-Adiantetum cinclidotosum ripariae* subass. nov. in more frequently flooded rock shelters with differential species *Cinclidotus riparius*, *Cinclidotus fontinaloides*, *Lunularia cruciata*, *Hygrohypnum luridum* and *Phyllitis scolopendrium*.

## Renaturation of wetland vegetation in Mura oxbow lakes

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The section of Mura River in Slovenia is one of the most important sites for many animal species of Community interest in Slovenia. The belt of riverine forests are still preserved to a certain degree. The forests belong to the vegetation types of high conservation value, as *Erythronio-Carpinion*, *Alno-Padion*, *Alnion incanae* and *Salicion albae*. With past natural river dynamics, the aquatic and wetland habitats (oxbow lakes, side channels, river branches) along the main stream of Mura river were very dynamic, prone to vegetation succession processes. Especially oxbow lakes vegetation was very dynamic, represented with different successional stages of aquatic, swamp and wetland vegetation types. However, due to interventions in the river bed, as river regulations, canalization and drainage, which took place in the near past, hydrological conditions were changed. The changes caused a one-way process of natural succession of oxbow lakes, which led to irreversible terrestrialization of traditionally aquatic to wetland habitat. Thus, the formation of new oxbow lakes is very poor. Furthermore, inappropriate agricultural practices on bordering intensive meadows caused eutrophication of the oxbows, which is additionally accelerated by soil and waste deposition into them. All this had clear negative impact on biota and aquatic and swamp vegetation in particular. The main goal of LIFE+ Project WETMAN (LIFE 09/NAT/SI/00374), in Pilot area Mura – Petišovci was to revitalize three oxbow lakes (“Nagy Parlag”, “Muriša” and “Csiko Legelo” near Petišovci in NE Slovenia), with a clear intention to re-establish the succession process. By deepening of the oxbows and removal of nutrient-rich organic sediments, plus vegetation removal, we enabled the natural succession process from its beginning on two out of three oxbows. In one oxbow we only removed alien fish species and let all other conditions untouched. Here, the flooding regime still enable some of the previous river dynamics, which influence also the oxbow vegetation. Long term-monitoring of vegetation dynamics has just started in 2014. However, it is clear already at this point, that with a limited river capacity to support all needed hydrological conditions for creation of new oxbow lakes, side channels and river branches, active conservation management of targeted habitats is inevitable.

## **Is the IBMR macrophytic index a reliable tool for water quality monitoring?**

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Macrophytes contribute to the functioning of aquatic ecosystems, and their sensitivity to pollution allowed their use as biological indicators. It is in fact generally true that some of these species are very sensitive to biocidal products, organic compounds and excess of nutrients. Along riparian and lacustrine ecosystems, several types of plant communities dominated by aquatic macrophytes may be found with different structure and floristic composition, due to the interactions of biotic, abiotic and anthropogenic components. Most of them can be referred to the phytosociologic classes *Charetea* Fukarek ex Krausch 1964, *Potametea* Klika in Klika & Novák 1941 and *Lemnetea* O. Bolos & Masclans 1955, and to the Annex I Habitats 3140, 3150, 3260 of 92/43/EEC Directive. Following the enactment of the European Water Framework Directive (WFD, 2000/60/EC), studies on use of biotic indices have been widely developed and new methodologies have emerged in order to determine the ecological quality of water bodies, by calculating the Ecological Quality Ratio (EQR) or the ratio between the values of the biological parameters observed for a given water body and those detected at the reference conditions applicable to that. The indices based on the use of aquatic macrophytes give indications on the overall water quality and the level of alteration of water bodies, in particular due to organic pollution; they are now widely used in several European countries, especially Great Britain, France and Austria. Among the various methods, one of the most widely accepted is the *Index Macrophytique Biologique en Rivière* or IBMR, used to determine the trophic status of the continental part of natural and artificial rivers, essentially related to the content of ammonium, orthophosphate and events of organic pollution. The actual effectiveness of this index, however, has not been properly verified and some studies have reported the absence of a significant correlation between IBMR and nutrients (especially ammonium and phosphates!), highlighting various problems that emerged in using this index in the assessment of watercourses quality. In this scenario, and especially considering that the index IBMR has been identified by the Italian authorities as the official national methodology to be used to control water environments in accordance with the WFD, a study was conducted to investigate its effectiveness in general, and in particular in the Italian territory. The methodology has been applied to streams and rivers of Central Italy with different conservation status and rather diversified hydrological, physical and geolitical conditions, in order to represent the variability of a large territory. In the period 2011/13, 36 sampling sites along 15 water bodies belonging to 6 sub-basins of the River Tiber, covering a total

area of 11,707 km<sup>2</sup>, were investigated. The values obtained were compared with the chemical and physical data collected in the same period at the same sampled sites and subjected to correlation analysis. Only a handful of considered chemical and physical parameters were significantly related to changes in the value of IBMR. In particular, it is remarkable the absence of significant correlations of IBMR with some parameters related to trophic status, such as P, nitric N, nitrous N, Nitrites, Ammonia. Moreover, it was shown that the correlation is particularly weak when some stations have chemical or physical parameter values markedly differing from the others. This could mean that the IBMR has been calibrated over a range of physical and chemical parameters with less variable values than those found in the rivers and streams of Central Italy. On the basis of the obtained results, it seems that IBMR is a rather weak tool to rely on, for water quality monitoring in the considered territory.

## **How many ordination axes should be interpreted?**

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It is widely accepted that Euclidean distance is not suitable for ecological data. Unfortunately the theoretically most developed ordination method, the principal component analysis (PCA) is based on this distance measure. This problem can be solved by using metric or non-metric multidimensional scaling that can be combined with dissimilarity measures developed for analyzing ecological data.

Lot of methods developed to estimate the number of important ordination axes in PCA. Unfortunately most of them related to multivariate normal distribution or Euclidean distance, thus they cannot be applied in multidimensional scaling. The only method applicable in metric multidimensional scaling is the comparison of eigenvalues with expectation based on broken stick model. We first show that this method is sensitive to database size, and over-estimate the number of important axes in large datasets. Then we propose a new method that based on stress value (and thus applicable also in non-metric ordination) and test it using artificial and real data.

## **Improving classification of plant assemblages with environmental constraints: A simulation study**

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The structure and dynamics of plant assemblages has a major importance on biodiversity and landscapes. Despite the recent development in exploratory methods of ecological data analysis, there is still lack in classification algorithms that consider environmental variables as constraints.

Multivariate classification tree algorithms, which are able to identify homogeneous groups of sites using recursive splits in environmental data, can be good candidates for constrained classification algorithms for phytosociological data. We tested a conditional inference tree method based on recursive partitioning. On basis of simulated data, the method was used to detect community patterns. Classification tree models were fitted on the data sets with positions along the environmental gradient as constraining variables, and the simulated species abundance data used as multivariate response.

We tested the influence of certain parameters on the data set by the (i) number of locations along the environmental gradient, (ii) number of sites at each specific location sampled, (iii) distance between neighbouring locations along the gradient. The performance of the classification model was measured by chi-square and Goodman-Kruskal's lambda values, comparing the predicted classification with the a priori classes determined by the sampling locations along the underlying gradient.

In general, the conditional inference tree model performs well in finding the underlying clusters coded into the simulated artificial data. The number of sampling locations did not influence the quality of the classification method whenever this parameter was within a certain interval. The best partitions were given for 2, 3 and 4 groups. If the number of sites at each sampling location was high enough (>20), model performance was not influenced by this number. A low separation of sampling locations also resulted in poor performance, but if the distance was higher than a specific threshold, then it did not affect model performance anymore.

Based on these preliminary results, conditional inference trees seems to be a promising method for the classification of phytosociological data based on environmental constraints, thus in creating basic environmental "assembly rules" for the resulting classification in the same step. Future work is the application to real-world biological data and simulations using additional alternative scenarios.

## **Polish Vegetation Database as a source of information on biodiversity – structure, resources and development**

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Polish Vegetation Database (PVD) has been established in 2007 at the University of Wrocław and is a part of rapidly evolving network of databases around the world. Although the total number of relevés made in Poland is unknown, there is a belief that Poland belongs to the group of countries with the largest resources of phytosociological data in Europe. The aim of the PVD is to gather and digitalize available data on various vegetation types found in Poland.

Presently, about 60,000 relevés are digitally captured and held in the data management programme Turboveg. The resources are stored in several data sets, which are divided according to the cover abundance scale of relevés. All the data sets have a uniform standard header data, from which the most important features are geographical coordinates and environmental data. Most of data come from published papers, however, large number of relevés were handed over to PVD by authors as unpublished materials. The resources represent most of plant communities identified hitherto in Poland. Majority of relevés represent meadows and pastures from *Molinio-Arrhenatheretea*, broadleaf forests from *Carpino-Fagetea*, arable land communities from *Stellarietea mediae*, coniferous forests from *Vaccinio-Piceetea* and eutrophic reed communities from *Phragmito-Magno-Caricetea*. The resources assembled are intended to use in large scale vegetation analyses, ranging from individual species analysis to classification of vegetation in national and worldwide surveys. The poster shows detailed information on current PVD's resources, data applications and progress of the database since its establishment.

Further development of PVD is directed toward collection of phytosociological data from a certain vegetation types and data from regions of Poland with the smallest number of relevés stored in the database. Another angle concerns participation in the ongoing and future European and worldwide projects.

## National vegetation databases: the case of VegItaly

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In the last decade, vegetation scientists were increasingly attracted by the use of huge data sets, in order to address emerging issues such as the severe risk of species, habitats and biodiversity loss. Indeed, large databases became crucial for any nature conservation programme. VegItaly (<http://www.vegitaly.it>; GIVD ID EU-IT-001) is a web geo-database built on opensource software, designed to archive, retrieve and analyze vegetation data as well as to publish them on the web. It was born under the aegis of the Italian Society for Vegetation Science (SISV) as a collaborative project, thanks to the cooperation of a large group of scientists (currently more than 20 Italian Universities and Research Institutions are involved). At present, more than 30,000 published or unpublished, public or private vegetation plots are stored in VegItaly, still far from being an exhaustive sample of the whole Italian biodiversity: some vegetation types are better represented than others (i.e. forests 34.68%, shrublands 5.68%, herbaceous vegetation 55.99%, unclassified 3.57%) and furthermore they are not homogeneously distributed across the national territory. However, the number of vegetation plots is rapidly increasing. As concerns taxonomic aspects, VegItaly is based on an Archive taxonomic Checklist, an on-line synonymized list of botanical species names, developed to support the botanical data banking and vegetation analysis, currently including 23,463 valid names and synonyms. Bibliographic sources are linked to LISY, the national bibliographic archive online developed in the 1990s, storing the syntaxonomic units

of the Italian vegetation and the related published sources (currently including almost 3400 bibliographic entries and more than 33,200 *syntaxa*, including synonyms). Some user-friendly tools have been developed to facilitate data upload (*archiver*, *VegImport* and *TabImport*). Designed for floristic and phytosociological data, VegItaly's main aim is to contribute to data archiving and sharing, offering the possibility to manage large data sets for statistical analysis on a wide geographic scale. Currently, it represents a milestone in Italy in the field of vegetation science and stands as a standard management system for botanical data at the national level.

## **Habitat diversity within the agricultural landscapes of three neighbouring countries– a legacy of three political systems?**

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Our aim was to assess the habitat diversity and habitat structure in a traditional agricultural landscape of three neighbouring countries (Austria, Slovenia and Hungary) which were historically always associated to each other regarding their political systems prior to 1<sup>st</sup> World War. Then, the three countries were divided into three political entities and developed differently, especially after the 2<sup>nd</sup> World War. We believe that changes in political system have strong impact to agro-economic policies which have further impact on habitat structure and diversity. Detailed analysis with emphasis on assessing the diversity, proportion and distribution of important semi-natural habitat types (e.g. semi-dry and wet meadows, meadow orchards) has shown little differences between countries though. However, the analysis on the proportion of abandoned and afforested habitats, which is a good measurement for observation the short-time land-use changes, has shown significant differences between countries, especially between Austria and Hungary.

## **Predicting moss species richness at landscape scale**

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Bryophyte species richness is usually investigated at local scale as the diversity of microhabitat is believed to be of superior importance. Still little is known about environmental factors affecting species richness at landscape scale. In this study we ask, whether moss species richness can be predicted at landscape scale? We used results of detailed mosses survey in 1 km squares in Bialskie Mts (the Sudetes, SW Poland). For each square we calculated a set of 9 predicting variables related to river network, topography and diversity of forests and protected habitats. Multiple regression was used to test the significance of variables. The analysis showed that total length of rivers in square, mean topographic ruggedness index (TRI) and relative altitude (difference between highest and lowest altitude within square) were significant and together explained 28.9% of the total variance in species richness. We conclude that, to some extent, mosses richness can be predicted at landscape scale by rapid and easy to calculate, GIS-derived environmental variables. This landscape approach to moss species richness predicting may improve protection plants and biodiversity management.

## Experiences and results of the Pannon Seed Bank Life+ project

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The Pannon Seed Bank Life+ project runs between 2010 and 2014 and aims to preserve the seeds of the wild vascular flora of the Pannonian biogeographical region in order to assist and complement *in situ* species conservation activities. In addition to the increased safety in case of accidental loss or degradation of endangered populations of rare species in their native habitats, *ex situ* seed banks provide additional possibilities for monitoring genetic changes in wild populations, facilitate access to research material without increasing the disturbance of the original habitats, and assist multidisciplinary studies on factors involved in the maintenance of diversity and stability in plant associations.

During seed collecting, focus is given to Pannonian endemic, endangered and/or protected species; to ecologically important species of the region (e.g. character species of unique plant communities, indicator species); to species with high potential of economic significance (e.g. crop wild relatives, medicinal plants, drought-tolerant species) and to plant populations of scientific interest. Storability of seeds is another important aspect: orthodox (desiccation tolerant) and probably orthodox species are to be selected for storing.

Registered data during field works include e.g.: name of collected taxon, size and geographical location of the population, habitat type, abiotic features of the habitat, characteristic species present in the habitat. Data gained during preparation for storage (e.g. morphometric data of seeds, germination details and result) and photographs taken of the seeds are also collected and arranged in a database.

By the end of 2013, 1238 samples of 682 species have been collected, out of which 25 taxa are strictly protected and 158 taxa are protected in Hungary. The most frequently sampled regions are the surroundings of Budapest, the Balaton Uplands National Park and southern part of the Great Hungarian plain. The project aims to evenly cover the micro regions of Hungary and seeks opportunity to collaborate in seed collecting beyond the borders but within the ecoregion.

The project is funded by the LIFE+ Biodiversity program of the EU and by the Ministry of Rural Development of Hungary.

## **Invasive grasses reduce arbuscular mycorrhizal colonization of roots of resident species**

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Recent research indicates that the soil microbial community, particularly arbuscular mycorrhizal fungi (AMF), can influence plant invasion in several ways. We tested if 1) invasive species are colonized by AMF to a lower degree than resident native species, and 2) AMF colonization of native plants is lower in a community inhabited by an invasive species than in an uninvaded resident community. The two tests were run in semiarid temperate grasslands on grass (Poaceae) species, and the frequency and intensity of mycorrhizal colonization, and the proportion of arbuscules and vesicles in plant roots have been measured. In the first test, grasses representing three classes of invasiveness were included: invasive species, resident species becoming abundant upon disturbance, and non-invasive native species. Each class contained one C3 and one C4 species. The AMF colonization of the invasive *Calamagrostis epigejos* and *Cynodon dactylon* was consistently lower than that of the non-invasive native *Chrysopogon gryllus* and *Bromus inermis*, and contained fewer arbuscules than the post-disturbance dominant resident grasses *Bothriochloa ischaemum* and *Brachypodium pinnatum*. The C3 and C4 grasses behaved alike despite their displaced phenologies in these habitats. The second test compared AMF colonization for sand grassland dominant grasses *Festuca vaginata* and *Stipa borysthénica* in stands invaded by either *C. epigejos* or *C. dactylon*, and in the uninvaded natural community. Resident grasses showed lower degree of AMF colonization in the invaded stand compared to the uninvaded natural community with *F. vaginata* responding so to both invaders, while *S. borysthénica* responding to *C. dactylon* only. These results indicate that invasive grasses supposedly less reliant on AMF symbionts have the capacity of altering the soil mycorrhizal community in such a way that resident native species can establish a considerably reduced extent of the beneficial AMF associations, hence their growth, reproduction and ultimately abundance may decline. Accumulating evidence suggests that such indirect influences of invasive alien plants on resident native species mediated by AMF or other members of the soil biota is probably more the rule than the exception.

## **Palinological Reconstruction of Vegetation in the Sárrét Basin of Fejér County (western Hungary)**

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The Sárrét marshland is situated along the northeastern foothills of the Bakony Mountains, located between Várpalota and Székesfehérvár. The basin was created due to a depression process during the Late Pleistocene and this area is still depressing in the present.

In 2004 a 500 cm long core was deepened in the area, and after that in the spring of 2011 we had an opportunity to drill another 11 meters long core. Our aim was to detect the changes in the vegetation history of this marsh and – if it is possible – the biological history of the marshland.

The drilled sample was divided by 5–10 centimeters long intervals and 41 samples were selected among them for analyzing. According to these samples 5 pollen zones (LPAZ) could be defined. The first two zones reflect the climate change happened during the Pleistocene and the Holocene in the investigated area. This data helped us to reconstruct the former vegetation and understand the details of the climate changes occurred in the recent thousands of years. Since we could not date the samples by radiocarbon methods each zone was dated back based on previous palinological and malacological studies (Willis *et al.* 1997, Sümegi *et al.* 2007).

The goal of our research was to extend previous analysis carried out in this area earlier with newer data sets. In the future we are also intending to perform more detailed analysis regarding to the climate change and the former vegetation based on the recently drilled out core samples obtained from the same area.

## **Shifts in plant traits along a stress gradient: harsher environment results stronger convergence**

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The central issue of community ecology is to find general laws in species assembly. To know the rules that explain or predict the species composition and abundance of a local community is a long held goal of ecologists. Habitat filtering concept is a widely accepted tool that can help to explain and predict species co-existence in a given locality. It postulates that the environmental conditions of a locality forms a filter that determines which species of the regional species pool can persist. This mechanism selects species with functional traits most adaptive in the given habitat, and functionally dissimilar species are excluded, thus it results in functional trait convergence among co-occurring species.

We studied community assembly rules along an environmental gradient ranging from marshes through meadows to open sand grasslands, using the trait-based approach, i.e. concentrating on plant traits instead of species identities. We sampled the vegetation in 103 (size 2 m × 2 m) plots. The environmental conditions (productivity) of the plots were characterised by their NDVI values. Cover of the plant species was visually estimated, their traits were partly measured in the field, partly collected from databases. The following vegetative and regenerative traits were studied: vegetative height, leaf size, specific leaf area, leaf dry matter content, growth form, shoot growth form, leaf distribution, life span, lateral spread, time of first flowering, seed dispersal height and seed weight.

We have found strong evidence for trait convergence when all traits were used in the analysis, and in case of vegetative height, leaf size and specific leaf area. Trait convergence proved to be stronger in the more arid, less productive end of the gradient.

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## Using remote sensing in order to determine the impact of embankment construction on natural vegetation (the Sava River example)

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The riverbanks of the Sava River and its tributaries in the surrounding area of the town of Zaprešić (NW Croatia) have been regulated in the 1960s as part of a nationwide flood prevention project. These interventions resulted in direct or indirect changes to the natural vegetation in the floodplain of the Sava River. As part of the Nature Impact Assessment (NIA) for the construction of an embankment on the left bank of the Sava River, our task was to estimate the potential impact to the natural vegetation. Using remote sensing methods to overlay various types of maps (historic, digital orthophoto, vegetation and habitat maps) and fieldwork, we established the historic and present distribution of natural vegetation categories (grasslands, forest and shrub, agriculture, aquatic habitats). Digitising various maps enabled us to overlay historic vegetation data and map its distribution over a large period. The results showed an expected decline of the natural vegetation in favour to settlement and agricultural areas. The decline is more the result of the spread of settlements and agricultural areas than the consequence of changes in the riverbanks and flooding regimes. The presentation will show how, by using remote sensing and historic distribution data for vegetation, it is possible to estimate the potential impact of river regulations to an acceptable level appropriate for the NIA process, especially when the timeframe doesn't allow for substantial fieldwork or when recent vegetation data is lacking.

## **Adopting and adapting the EUNIS Habitat Classification for Scotland's vegetation and habitats**

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Scottish Natural Heritage (SNH), the agency responsible for nature conservation, is in the process of creating a Habitat Map of Scotland using a combination of existing habitat data and new survey. The creation of the habitat map will provide a valuable tool to inform land management such as deer management planning, habitat connectivity analysis, woodland expansion and peatland restoration. It will also help meet a number of statutory, policy and educational needs. Importantly, it will allow better monitoring of the condition of habitats of European importance (those listed on Annex I of the Habitats Directive) both within designated sites and the wider countryside. Habitats will also be identified according to the European Nature Information System habitat classification (EUNIS) so that we can share our habitat information with the rest of Europe.

Habitat data for the map is being derived from datasets held by SNH, others parts of government and its agencies, the NGO community and the commercial sector. This will be translated to EUNIS from various national classifications, notably the National Vegetation Classification (Rodwell, 1991–2000). For those areas not covered by existing data SNH is implementing a systematic survey programme, which involves the development of aerial photography and satellite imagery analysis. A pilot is underway in the uplands to examine the use of stereo colour infra-red aerial imagery, with targeted field survey.

The EUNIS habitat classification is being adapted to enable Scotland's full range of habitats to be mapped, but also allowing Annex I Habitats to be mapped individually. This is involving the creation of a number of new and modified EUNIS types for Scotland. Translation tools and crosswalks are being developed. As with other classifications, EUNIS has advantages and disadvantages but the link to phytosociological work across Europe is of key importance.

## **A biotic and abiotic frame of references for the conservation of Natura 2000 habitats in Flanders (N-Belgium)**

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The ecological characterisation of Natura 2000 habitats is a prime condition for a proper implementation of the Habitats Directive. Such characterisation permits the assignment to distinguish habitat types, the development of restoration measures, the assessment of local conservation status, the evaluation of the effectiveness and efficiency of policy decision tools, and the underpinning of environmental impact assessments.

Since 2012, a research project is trying to pin-point the range (from degraded over favorable up to reference condition) of habitats, by combining biotical and abiotical data. The FlaWet 1.0 database (NICHE Flanders) contains linked vegetation, soil and hydrology data and is used as a basis for further research. The present-day focus is mainly on fertilization and drought sensitive vegetation types. Three case studies are being investigated since 2012: Petrifying springs with tufa formation (Cratoneurion; HT 7220), Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*; HT 6510), and Northern Atlantic wet heaths with *Erica tetralix* (HT 4010).

Determining Natura 2000 habitats occurs iteratively. First a biotic typology is established, after which it is linked to the corresponding abiotic conditions. Driving abiotic factors are delineated, and used in regression analyses to determine the site conditions of the well-developed Natura 2000 habitats. Ultimately, the presence of habitat types will be related to environmental conditions, and ecological ranges for specific habitat types will be drawn (reference values).

## **Red List of European Habitats Project**

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Under contract from the European Commission, DG Environment, a project is being carried out for assessing the Red List status of European terrestrial and marine (semi)natural habitats. The geographical scope of the project is the EU28 and Norway, Iceland, Switzerland and the Balkan countries for terrestrial habitats and the EEZs and territorial waters for marine habitats. The main product is a fact sheet on which information on a habitat type is given, including the Red List status.

The project is co-ordinated by a consortium of Alterra, IUCN, NatureBureau, John Rodwell ecologist and Susan Gubbay marine ecologist, while more than 50 subcontractors from different countries are co-operating as subcontractors.

For the typology the EUNIS level 3 is the basis for terrestrial habitats. It will be adapted where EUNIS-types overlap, are very broad in their definitions or where splitting corresponds better with HD Annex I habitat types. For marine habitats EUNIS level 4 habitats are the basis. The result is a red list typology for this project.

The project works with thematic Working Groups for terrestrial habitats (coastal, freshwater, mires/bogs/fens, heathlands/shrubs/tundra, grasslands, forests, rocks/screes) and regional working groups for marine habitats (Northsea/Atlantic, Baltic, Mediterranean, Black Sea). The experts in these terrestrial working groups will be provided with national data on status and trends in habitat types, from territorial experts. The working groups will prepare a draft fact sheet and assessment for each red list type, which will be reviewed in a later stage, in order to guarantee consistency between assessments.

The criteria will cover negative trends in quantity, negative trends in quality and small distribution ranges in combination with threats and negative trends.

The project will end in spring 2016. During the EVS-workshop an example of an assessment of a habitat type will be presented.

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