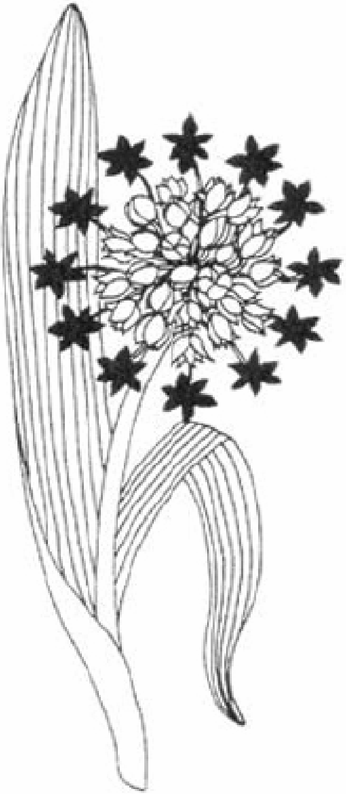

17th International Workshop European Vegetation Survey

Using phytosociological data to address ecological questions

1-5 May 2008
Masaryk University
Brno, Czech Republic

Abstracts and Excursion Guides

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Abstracts and Excursion Guides

Edited by Milan Chytrý

Excursion Guides by
Jiří Danihelka, Milan Chytrý, Jan Roleček and Vít Grulich

Brno 2008

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http://botzool.sci.muni.cz/EVS/

ISBN 978-80-210-4585-9

Contents

Remote sensing of plant communities of Failaka Island, Kuwait

Ghanim A. Abbadi [1], Hala Al-Gassar [2], Mohamed A. El-Sheikh [3] & Sandro Pignatti [4]

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LandsatTM imagery was applied at a regional scale to Failaka Island vegetation in Kuwait. We produced a map showing 12 clearly differentiated land-cover or vegetation types, and described the composition and structure of five major plant communities on an area of about 48 km^2. The use of LandsatTM images, a ground map and of the multivariate analysis of phytosociological data showed the potential of high accuracy mapping for land-cover or vegetation types on the study area. The results highlighted the utility of combining the satellite imagery and field data in arid regions, which is a very promising approach where other ancillary data are not available and a rapid acquisition of reliable vegetation data is required. This approach could be the starting point for an imperative and more extensive classification and mapping of the regions.

Adventization and invasibility of habitats in the Bashkortostan Republic

Larisa Abramova

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During recent decades there was an active adventization process in the Bashkortostan Republic as well as in other regions of Russia. About 300 adventitious species (17% of total flora) are recorded in the Bashkortostan flora. Over 180 species are neophytes, i.e. species that appeared on the territory of Bashkortostan in the last century. Annually about two new foreign species are found in Bashkortostan. According to our data 25 species are likely to be considered invasive, among them those of the genus *Ambrosia, Cyclachaena xanthiifolia, Hordeum jubatum, Echinocystis lobata, Impatiens glandulifera, Conyza canadensis, Oenothera biennis* and *Bidens frondosa*. Besides, about 40 adventitious species are potentially considered to be invasive.

Any vegetation community possesses some potential of invasibility or openness to the invasion of new species (Johnstone 1986). However, this parameter, which reflects the openness of community and presence of free plots in it, strongly varies. The resistance of abiotic and biotic environment reduces this parameter and raises the presence of available resources (Davis et al. 2000). Elton (1960) emphasized that the main reason of active spread of adventitious species is anthropogenic disturbance of ecosystems.

According to our synanthropization and adventization level analysis of the main vegetation types of the Bashkortostan Republic (Abramova 2007), ecosystems of the Republic are a scene of active process of anthropogenic vegetation transformation, which results in various types of synanthropic communities from adventitious and native synanthropic species. Thus along with communities of synanthropic classes (*Secalietea, Chenopodietea, Bidentetea tripartitae, Artemisietea vulgaris, Robinetea*) rather high level of invasibility is noted for communities of several types of natural vegetation, such as meadows (cl. *Molinio-Arrhenatheretea*), river valleys, ravine complex. Steppe communities (cl. *Festuco-Brometea*) are more stable to introduction of synanthropic species, but at strong grazing even they can be open for invasions. Communities of high mountains have a high abiotic barrier; they can be considered as resistant to invasions, as well as many forest communities (classes *Querco-Fagetea, Vaccinio-Piceetea, Brachypodio-Betuletea*), with an exception of floodplain forests. Several types of mountain meadows and forest edges (class *Trifolio-Geranietea*) are also resistant.

From agrophytocoenoses to thickets and woods: vegetation changes after the cessation of anthropopressure

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Plant succession on synanthropic sites after the cessation of direct human impact causes significant changes in the floristic structure of vegetation in short time. Character and scale of these changes can be captured on the basis of comparison of agrophytocoenoses and thickets and woods, which spontaneously developed in similar habitat conditions on neighbouring abandoned fields or under electric poles (pylons).

In the analysis, 85 phytosociological relevés (made according to the Braun-Blanquet approach) were used. Field investigations were carried out in 2002–2005 in the city of Poznań and its surroundings (western Poland). They documented agrophytocoenoses as well as *Sambucus nigra*-dominated thickets and woods with *Acer platanoides* or *Betula pendula* situated near them.

These investigations have shown that on the abandoned fields the spontaneous development of vegetation can initiate renaturalization of the plant cover already after 5–10 years of the secondary succession. This process found the strongest expression in the spectrum of life forms and geographic-historical groups of plants. The number of therophytes in the documented thickets and woods, as compared to that of agrophytocoenoses, diminished only of about 3–5 species, whereas their cover decreased significantly (from 58–79% to 1–4%). In these thickets and woods the number of hemicryptophyte species increased even 10–11 times and their share in the floristic list 2–5 times. The spectrum of life forms in the newly formed communities approached to that typical for Central Europe, where hemicryptophytes constitute about a half of all species.

Among geographic-historical groups of species in the documented thickets and woods native plants definitely predominated. They constituted about 70–80% of species and they had over 90% of the share in the plant cover. In woods that have overgrown the abandoned fields the number of spontaneophytes increased even 3–4 times and the share of them in the plant cover grew up 2–3 times (as compared to agrophytocoenoses).

On abandoned land species richness of vegetation grew up. In the *Acer platanoides* and *Betula pendula* woods the number of species was twice as high as on the examined fields. The changes of species richness on the 5–10 years old fallow land were manifested in the increase of the number of perennial plant species (especially hemicryptophytes and phanerophytes, to some degree also geophytes) while the number of species of short-lived plants (therophytes) decreased insignificantly.

Plant community heterogeneity deriving from abiotic and grazing impacts in wetlands

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Phytosociological descriptions of the humid grasslands of littoral wetlands in West of France have been sampled in order to investigate heterogeneity of the spatial organisation of vegetation. These grasslands were derived from reclaimed saltmarshes by polderisation since the 10th century, and present a toposequence zonation with three main levels: flooded depressions, intermediate slopes and upper flats. Each level could be characterised by a plant assemblage (or association). A particular feature was the presence on slopes of a sub-halophilous plant assemblage: the *Alopecuro bulbosi-Juncetum gerardii* association which includes halophilous plant species such as *Puccinellia maritima* and *Spergularia media.*

Plant assemblages were found to show a high floristic variability and patchiness. Analysis were conducted to distinguish between inter- and intra organisation levels of plant communities in relation with abiotic environmental parameters on one hand and grazing on the other hand. For this purpose, an experimental design was established *in situ* in 1995, with enclosures controlling for the grazing herbivore (cattle or horses) and the stocking rate, and an exclosure. In the ungrazed situation, interruption of grazing led to (1) development of competitive plant species (*Agrostis stolonifera, Agropyron repens*) and a decrease in plant species diversity; (2) decrease in soil salinity. In grazed enclosures, patch number and plant species composition depend on herbivore type and grazing intensity. In cattle-grazed enclosures, six plant patches were distinguished with plant species richness of 28.5 on average. These values were respectively 9 and 43.5 in horse-grazed enclosures and 9 and 42.5 in enclosure grazed by both herbivores together. Vegetation patches differed in their respective floristic composition, dominance pattern and vegetation height. Selective foraging and defecation behaviours of grazing animals explain a large part of the patchiness, i.e. the heterogeneous vegetation pattern in such wetlands together with abiotic conditions (flood and soil parameters). Horse and cattle showed synergic or compensatory effects of the plant species diversity, depending on the topographic level. Horses showed contrasting behaviour by consuming mainly the very short plants on slopes and neglecting those of the defecation patch vegetation which, conversely, was grazed by cattle in mixed enclosures. Study of reversibility of such plant community dynamics may contribute to define relevant range management systems.

The usefulness of phytosociological datasets in addressing community assembly rules and in forecasting impacts of environmental changes

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CIBIO and Faculdade de Ciências, Universidade do Porto, Portugal

Environmental changes (from global warming and sea-level rise to agricultural abandonment and shifts in wildfire regime) may induce dramatic modifications in multiple features of vegetation across landscapes. These modifications can range from shifts in taxonomic composition and structural complexity to changes in functional diversity with important consequences for ecological processes. In this context, the identification of assembly drivers is of the outmost importance if vegetation is to be used in the diagnosis, monitoring and forecast of ecological changes. In this presentation, we provide evidence concerning vegetation assembly and dynamics from both coastal areas and continental landscapes in order to discuss whether phytosociological datasets can be used to assess, model and forecast impacts of multi-scale environmental changes on ecosystems and landscapes. In continental areas, the study of community assembly in natural forests and herbaceous ecotone vegetation is providing insights on the possible impacts of land use changes on farmland plant diversity. Both taxonomic and functional assessments suggest that shifts in farmland practice may induce significant changes in the floristic structuring of fringe tall herb vegetation, with important consequences for ecosystem function and for the conservation of narrow endemic species. In mountain areas submitted to frequent wildfires related to extensive grazing, biogeographic bias has been detected in the dynamic responses of vegetation to fire regimes. In coastal sand dunes, numerical approaches to taxonomic and functional diversity have also been used to address community assembly driven by coastal dynamics, providing biological surrogates to assess vulnerability and to monitor and forecast the ecological impacts of sea-level rise. We argue that phytosociological datasets can be used for a multitude of applications other than describing and classifying vegetation, and that the contemporary concern devoted to many of those applications will promote phytosociology as a reference discipline in the assessment, forecast, and mitigation of impacts of environmental changes.

Bulgarian phytosociological database

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Due to historical reasons phytosociological studies in Bulgaria have been carried out following the Dominance approach up to the 1990s. Building national phytosociological database following the Braun-Blanquet approach started in the beginning of current century thanks to the TURBOVEG software provided by S. Hennekens. At the moment the database includes 3666 relevés. A large part of them was collected during the national grassland inventory. A great amount of information is stored in the older literary sources, but using them requires transformation to the quantitative data. A special tool for the purpose is offered by Meshinev & Apostolova (2002). The efforts to enlarge the data collected aim to stimulate the national vegetation survey and to provide information about southeast European vegetation within the European vegetation survey on a larger scale.

Patterns of bryophyte diversity in the space of alliances of classes *Querco-Fagetea, Vaccinio-Piceetea* and *Brachypodio-Betuletea* in the Southern Urals

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The distribution and participation of bryophytes in plant communities have been studied relatively little in the Southern Urals. In this study, the bryophyte flora of the forest communities of three classes: *Querco-Fagetea* (alliances *Alnion incanae, Lathyro-Quercion, Aconito-Tilion, Aconito-Piceion* and *Tilio-Pinion*), *Brachypodio-Betuletea* (alliances *Caragano-Pinion, Veronico-Pinion* and *Trollio-Pinion*) and *Vaccinio-Piceetea* (alliances *Dicrano-Pinion* and *Betulion pubescentis*) has been analyzed. Althogether 1800 samples were studied. The study area is located in the Bashkortostan Republic.

A total of 206 bryophytes (29 liverworts and 182 mosses) were found. It makes up 47% of the so far reported bryophyte flora of Bashkortostan. The most abundant genera are *Dicranum* (13 species), *Sphagnum* (9), *Bryum* (9), *Polytrichum* (8), *Brachythecium* (6), *Plagiomnium* (5), *Mnium* (5), *Grimmia* (5) and *Sciurohypnum* (4), the most abundant families are *Dicranaceae* (16), *Brachytheciaceae* (15), *Mniaceae* (15), *Polytrichaceae* (11), *Amblystegiaceae* (10), *Bryaceae* (10), *Plagiotheciaceae* (10), *Pottiaceae* (9), *Jungermanniaceae* (9) and *Sphagnaceae* (9).

The greatest bryophyte richness was found in the *Piceion excelsae* (145 species) and *Aconito-Piceion* (126 species), the lowest diversity in the *Lathyro-Quercion* (54 species). The increase of *Abies sibirica* and *Picea obovata* is accompanied by rising of total bryophyte richness, number of hepatics, acrocarpous mosses and species of *Dicranaceae*, *Mniaceae*, *Polytrichaceae* and *Hylocomiaceae*. The composition of bryophyte flora of the alliances *Aconito-Piceion* and *Piceion excelsae* was similar. The bryophytes of the alliances of *Brachypodio-Betuletea* were very similar too. The species *Stereodon pallescens, Sanionia uncinata, Dicranum montanum, Sciurohypnum reflexum, Ptilidium pulcherrimum* and *Plagiomnium cuspidatum* occurred in all alliances. Typical boreal species *Pleurozium schreberi, Hylocomium splendens, Dicranum polysetum, D. scoparium* and *Ptilium crista-castrensis* occurred in most of alliances (with increasing abundance in *Vaccinio-Piceetea* communities) and were absent only in *Lathyro-Quercion*. We could not found any bryophyte species that was characteristic for communities of only one alliance and had high constancy and abundance there. Probably, it is connected with high patchiness and complexity of forest vegetation in the study area. In spite of it, species such as *Abietinella abietina, Rhytidium rugosum, Rhodobryum roseum, Brachythecium oedipodium, Dicranum congestum* and *Polytrichum* spp. have been successfully used as differential species for distinguishing associations within alliances. It allowed to emphasize the differences in habitat conditions (atmospheric humidity, soil moisture, etc.). This research was supported by the RFFI (grant 07-04-00030-a).

Assessing the effect of landuse changes in beech forests – an example from central Apeninnes, Italy

Sándor Bartha [1], Roberto Canullo [2], Giandiego Campetella [2], Alessia Merolli [2], János Garadnai [1,2], Simone Gatto [2] & Stefano Chelli [2]

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In the mountain belt of the Marches region (Central Apennines, Italy), coppice management is applied to 70% of beech (*Fagus sylvatica*) woodlands. This method has long played an important socio-economic role, providing firewood and charcoal. Currently 4% of present beech woodlands are being converted to high forest, while in 21%, silviculture is being abandoned entirely. We aimed to answer these questions: (1) How does traditional management (short rotation coppice) affect beech forest plant diversity at different environmental conditions? (2) How is plant diversity influenced by an extension of the rotation cycle or by the abandonment of coppicing? Previous investigations on plant diversity relations in coppice woods focused on limited areas and small numbers of stands, while it would be much more useful for management applications to have diversity assessments on the scale of the landscape. After preliminary selection of a number of forest stands, stratified sampling was conducted according to 200 m elevation classes (starting from 1000 m a.s.l.), bedrock types (limestone and sandstone), and stand age (10-year classes, since the last coppicing), to identify 61 sites (0.3 to 35 ha) that would represent the landscape level heterogeneity. Within each stratum a proportional number of stands were randomly selected among those included in the forestry registers. Orthophotomaps and related cadastral information were derived using an Information System. Elevation was used as a proxy variable accounting for the main beech forest types reported in the regional forest inventory, which also stated soil and stand conditions. The beech forests belong to *Cardamino kitaibelii-Fagetum* and *Lathyro veneti-Fagetum* associations on neutro-basic limestone and *Solidagini-Fagetum* on acidic sandstone. Eighty plots of 20×20 m were assessed by phytosociological records, within the selected forests stands. Species were grouped into phytocoenological groups. Our results suggest that high spatiotemporal variability of forest management accompanied with high landscape-scale heterogeneity and complexity maintain rich regional species pool. On both bedrocks, in all elevation classes, the age after coppicing explained the majority of observed diversity changes at the stand level: forest specialists increased while non-forest species decreased. A relatively long time after coppicing (40–60 years), the contribution of the beech specialist species doubled, while non-forest and species from anthropogenic habitats decreased by about 50%. On sandstone, gap species also diminished over a long period, and the beech stands experienced stronger changes over time. We conclude that an extension of coppice rotation cycle or abandonment would result in lower local species richness but with higher contribution of beech forest specialists.

The mountain forests of western and central Crete and the grazing impact

Eva Bauer

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The mountains of the Aegean island of Crete are girdled (incompletely) with forests dominated by tree species such as *Cupressus sempervirens*, *Quercus coccifera*, and *Pinus brutia*. Together with phryganas and alpine pastures these forests represent an important part of the Cretan rangelands. Due to subsidies the numbers of sheep and goats have increased considerably since Greece became a member of the EU in 1981.

During this study about 200 relevés have been collected in the forests of the White Mountains and the Psiloritis. Together with the plot data on species composition, abundance and layer, parameters such as faeces abundance, shape of palatable trees and rate of flowering units of selected shrub species have been recorded. The following questions were addressed:

- What can the plot data tell us about grazing intensities in the forests?
- Does the grazing intensity affect forest regeneration and, if so, in which way?
- Which species indicate specific levels of grazing intensity?

A method for identifying grazing intensities in a Mediterranean context with changing land-use is presented. The setback of the forest regeneration by browsing is illustrated for a selected area. Different approaches for the identification of species indicating grazing intensity are discussed. Conclusions are drawn concerning forest management and nature conservation.

Distribution of non-native species in plant communities of Mecklenburg-Vorpommern (NE Germany)

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The invasion dynamics of non-native organisms and the effects of invasive species on biodiversity have become an important issue in ecological research as well as in species conservation. Here, we analyse the recently published vegetation classification of Mecklenburg-Vorpommern (Berg et al. 2001, 2004) with its solid data basis of 42207 underlying relevés to answer the following questions:

What is the distribution of non-native species (neophytes and archaeophytes) within the plant communities of Mecklenburg-Vorpommern? Which factors can be detected that explain the occurrence of non-native species?

The classification resulted in 34 synoptic vegetation tables with 284 associations. In total 273 archaeophytes as well as 187 neophytes are documented in the tables. We applied correlation and correspondence analysis to investigate ecological distribution patterns on class and association level.

Within the association level the non-native proportion ranges from 0 to 75%, based on proportion of non-native species to average species number. In 69 associations (24%) non-native species are more or less lacking with proportions less than 1%. Associations from the classes *Ruppietea maritimae, Charetea, Oxycocco-Sphagnetea, Parvo-Caricetea, Juncetea maritimi, Vaccinio uliginosi-Pinetea, Molinio-Betuletea pubescentis* and *Alnetea glutinosae* show the lowest amount of non-natives. In 132 associations (46%) non-indigenous species add up to more than 10%. Nearly all of them show a higher proportion of archaeophytes compared to neophytes.

Communities with a high proportion of archaeophytes but low neophyte proportion belong to the classes *Stellarietea mediae, Molinio-Arrhenatheretea* and *Festuco-Brometea*. The opposite can be found only in seven associations of the classes *Bidentetea, Cakiletea maritimae* and *Salicetea purpureae*.

Indirect gradient analysis of all data reveals the degree of naturalness on the one hand and the anthropogenic disturbance on the other as main factors that determine the occurrence of non-native species. Within a subset of communities with high levels of naturalness, the level of natural disturbances (mainly water or wind dynamics) and the nutrient availability are positively correlated with the proportions of non-native species. Typical characteristics for these vegetation types are open vegetation cover and a short regeneration time. Except for some specialists, stress factors, like high water level or salinity prevent the establishment of most non-native species.

Biodiversity, ecology and biogeography of bacterial communities in *Sphagnum*-rich plant communities

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Little is known about bacteria communities associated with living plants in natural plant communities. To investigate which ecological factors affect the biodiversity of bryophyte-associated bacteria, and which role the geographical regions play, we analyzed the bacterial communities associated with two *Sphagnum* species, *S. magellanicum* and *S. fallax,* from six temperate and boreal bogs in Germany and Norway. The two *Sphagnum* species exhibit different ecological behaviors and plant communities with respect to abiotic conditions including moisture, soil pH and nutrient content.

To investigate the diversity in the ecto- and endophytic habitats of *Sphagnum* plantlets the whole eubacterial populations were investigated. Associated bacteria of both bryophytes were isolated and analyzed by a polyphasic approach. Molecular analysis of bacterial communities was determined by single-strand conformation polymorphism (SSCP) analysis using eubacterial and genus-specific primers for the dominant genera *Burkholderia* and *Serratia* as well as by sequence analysis of a *Burkholderia* 16S rRNA gene clone library.

SSCP gels showed that the diversity of 16S rRNA fragments amplified from *Sphagnum* community DNA is high. For both bryophyte species we found between 30–50 bands for the total bacterial and the *Burkholderia*-specific community patterns. About 20–30 bands were found for the *Serratia*-specific SSCP patterns. For eubacterial as well as group-specific community patterns dominant bands were detectable. The eubacterial community patterns of *S. magellanicum* from different geographical sites formed one cluster as well as the patterns of *S. fallax*. These two clusters indicate that the *Sphagnum*-associated eubacterial communities are specific for the moss species, irrespective the plant community. The similarity between the associated bacterial communities of *S. fallax* from German and Norwegian sites was up to 70%, whereas the similarity between the associated bacterial communities of *S. magellanicum* from both sites was up to 65%. In contrast to the high plant specificity no influence of the geographical site could be detected.

We found a high degree of habitat specificity for associated bacterial and plant communities of both *Sphagnum* species independent of the geographical region. The bacterial communities of *Sphagnum magellanicum* and *S. fallax* in Germany and Norway are more similar than the bacterial communities of the two species adjoining at the same site. We conclude that like plant communities, bacterial communities follow ecological laws, and that bacterial communities have restricted geographical ranges as well as all other biocoenoses of the world.

Vegetation regions by the classification of habitat lists of the MÉTA cells

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Landscape classifications are useful tools for scientific, nature conservation and administrational purposes. These classifications are usually made by using geographical approaches and are based on remotely sensed land-cover types or typical land-form types. Landscape classifications based on the actual vegetation types are rare, and mostly based on subjective judgement, despite of the fact that for several nature conservation actions or even for agrarian or industrial developments they could serve as good background maps at the stage of planning. At the same time the number of vegetation databases for large areas is increasing rapidly. The vegetation data of the MÉTA database offered us a good opportunity to test whether large vegetation databases can serve as more objective basis for creating vegetation regions.

The idea is coming from the well-known technique that maps are easy to create by automatic classification of the pixels of remotely sensed images according to their colour. We used the 35-ha hexagons of the MÉTA database as pixels or cells and instead of their colour we classified their habitat lists. All cells of the MÉTA database were selected where the summed cover of (semi-)natural habitats reached 3.5 ha. This selection yielded 84,000 cells. Then 1000 hexagons were chosen randomly and classified into 50 clusters. The other hexagons were assigned to these clusters *a posteriori* based on their similarity. This method is called the ‘clara’ algorithm. Random selection was repeated 50 times and the best clustering was selected. Then the average covers of habitats in the cells were calculated for each cluster. Clusters were named by the habitats reaching at least 10% cover on average in the cells belonging to the cluster. The clusters were visualised then in ArcView 3.2 and the borders of vegetation regions were drawn by hand based on the classification and supported by expert judgement. This new method for delineating vegetation regions seems to be promising, however, for the delineation additional data sources (satellite image, relief, soil maps and distribution of particular habitat types) are recommended to use. The created maps are thought to be useful both for scientific and conservation purposes.

Rare syntaxa of higher aquatic vegetation on the territory of Eastern Galicya (Western Ukraine)

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In 2005–2007 research on higher aquatic vegetation was done on the territory of Eastern Galicya, which according to physiographic division into districts includes such regions as Polissya, Western Podillya, Roztochchya, Opillya, Prykarpattya and eastern fringes of the Carpathians. According to our own investigation and taking into consideration literature data about 75 syntaxa which belong to the classes of *Potametea* R. Tx. 1955, *Lemnetea* Klika in Klika et Novák 1941 and *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941 have been recorded on this territory. 13 syntaxa, i.e. 42%, of this list are very rare and disappearing. The highest number of rare syntaxa is in the *Potametea* class. In comparison, the higher aquatic vegetation of the Ukraine (according to the Braun-Blanquet classification) is represented by 112 associations. 31 syntaxa of them are endangered.

All rare groups of higher aquatic vegetation which need to be protected are divided by us into four categories of rarity: group 1 includes plants which have already disappeared from the territory of the Ukraine (there are no such plants in our case); group 2 includes the plants which are nearly disappearing; group 3 contains plants which are under the danger of disappearing; group 4 includes plants the territory of which is shrinking fast nowadays. Two associations – *Cladietum marisci* Zobrist 1935 and *Trapo-Nymphoidetum peltatae* Oberdorfer 1957 belong to group 2. Group 3 includes four associations – *Riccietum fluitans* Slavnić 1956, *Potameto natantis-Nymphaeetum candidae* Hejný in Dykyjová et Květ 1978, *Salvinio-Spirodeletum* Slavnić 1956, *Trapetum natantis* Th. Müller et Görs 1960. The fourth category consists of seven associations – *Ceratophylletum submersi* Soó 1928, *Nymphoidetum peltatae* (All. 1922) Th. Müller et Görs 1960, *Wolffietum arrhizae* Miyaw. et J. Tx. 1960, *Nupharo lutei-Nymphaeetum candidae* Nowiński 1930, *Myriophyllo-Nupharetum* W. Koch 1926, *Lemnetum gibbae* Miyaw. et J. Tx. 1960, *Batrachio trichophylli-Callitrichetum cophocarpae* Soó (1927) 1960 and *Callaetum palustris* Osvald 1923.

Paying attention to low anthropotolerance of rare aquatic vegetation communities and unstability of ecological conditions, the state of their safety cannot be considered as positive one. The direct protection of higher aquatic vegetation on the territory of Eastern Galicya, as of the Ukraine in general, is accomplished only on the territory of nature and biosphere reserves, in nature reserve ‘Roztochchya’ in particular, and also in Halyts’ky and Javorivsky national nature parks. However, its protection on comparatively small territories does not suppose the protection of all its varieties, as it is not effective. That is why one of the most optimal methods concerning the higher aquatic vegetation is to include the corresponding territories into the national econet of the Ukraine.

Do specialists have narrower geographic range? Analysis of Hungarian flora based on the phytosociological database

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Although distinguishing specialists (species with narrow niche) and generalists (species with wide niche) has a long tradition, until recently calculation of niche width needed defining the considered environmental gradients. It may cause confusions, because the same species may have wide niche along one gradient and narrow along other one. Recently, Fridley et al. (2007; *J. Ecol.* 95: 707–722) developed a new method that overcomes this problem by using co-occurrence data from large phytosociological datasets. This new method was applied to study the relationship between niche width and geographic range in Hungarian flora. Niche widths were calculated based on the Hungarian Phytosociological Database (8437 relevés) for species with at least 100 occurrences (788 species). Species were classified into three categories according to their geographic range size, and the average niche widths of these categories were compared by linear models. The calculated measure of species niche width proved to be very sensitive to average local species richness of relevés where the species occur. Therefore average local species richness has to be included in the model as continuous covariate (otherwise there were no significant relationships between range size and niche width). After controlling the effect of local richness, we have got the expected positive relationship between niche width and range size, but the variance of niche width explained by range size was low (5.5%).

Habitat preferences of specialist with wide range and generalist with narrow range were compared to the expectation based on random selection from the species pool. Among specialists with wide range the species of wetlands are overrepresented, indicating that these habitats need ecological specialization, but the specific environmental circumstances are repetitive and occupied the same species in large geographical areas. On the other hand, among the generalists with narrow range species of dry grasslands and of dry, open forests were overrepresented.

Plant communities dominated by *Abies alba* in the Czech Republic

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Forest vegetation dominated by *Abies alba* in the Czech Republic was classified using the Cocktail method (formalized and supervised phytosociological classification method). All relevés with at least 25% proportion of *Abies alba* and less than 25% proportion of *Fagus sylvatica* in the tree layer were chosen for analysis from the Czech National Phytosociological Database. A geographical and ecological stratification of the relevés was performed. The definitions of associations were created by combination of sociological species groups and the dominance of species using logical operators. Data processing follows the approach applied in the project ‘Vegetation of the Czech Republic’.

Six associations were distinguished within four alliances. *Vaccinio vitis-idaeae-Abietetum albae* (*Piceion excelsae*) is an oligotrophic, species poor spruce-pine-fir forest with the dominance of *Vaccinium myrtillus* in the herb layer. It occurs mostly on podzols. *Luzulo-Abietetum albae* (*Luzulo-Fagion*) comprises oligo-mesotrophic spruce-fir forests with dominant graminoids (*Luzula luzuloides, Calamagrostis arundinacea*) in the herb layer; it occurs especially on cambisols. Nutrient-demanding species are typical of the stands of herb-rich mesotrophic *Galio rotundifolii-Abietetum albae* (*Fagion*) occurring also on cambisols. It is possible to distinguish subassociations reflecting soil water supply within all above-mentioned associations. The dominance of silver fir was recorded within scree forests (*Tilio-Acerion*) on leptosols as well. *Aceri-Carpinetum betuli* is a scree forest of lower altitudes with abundant *Carpinion* species, while the stands of *Fraxino excelsioris-Aceretum pseudoplatani* with a high proportion of *Fagion* species mostly occur at higher altitudes. *Arunco-Aceretum* is typical of ravine habitats with dominance of *Aruncus vulgaris* and/or *Lunaria rediviva* in the herb layer.

Silver fir forests were recorded at the altitudes of 300–1000 m especially in the southern and eastern part of the Czech Republic. Silver fir forests occurring on soils with no influence of ground water are considered to constitute semi-natural vegetation depending both on natural processes and human impact.

Terricolous cryptogams: role in vegetation description and diversity

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After a very short survey of actual methods and *status quo* of the description of lichen and bryophyte vegetation in Europe, results of a rather extensive study of terricolous lichen vegetation with 693 plots from four European countries (Austria, Germany, Denmark, Finland) and Greenland are presented.

The relationship of ‘microcoena/synusia’ and the surrounding phytocoena is compared on different syntaxonomic levels. Terricolous microcoena on the association level are rarely confined to specific phytocoena. Many occur in several countries, even climate zones. Therefore it is suggested to be careful with lichens and bryophytes as character species of associations especially when evaluating vegetation data bases from single countries or certain vegetation types.

Lichens and bryophytes are excellent differential species (subassociations, succession stages etc.) and they can be good character species of higher syntaxa. Two main reasons are the probable cause for the deviating behaviour of lichens and bryophytes in comparison to vascular plants: they usually have larger areas of distribution and they are rootless and poikilohydric thallophytes, thus being affected differently by habitat.

Species richness of the studied lichen vegetation was correlated with species pools and with measured or estimated habitat factors (vegetation height, cover, altitude, inclination, exposition, pH, specific conductivity, loss on ignition, soil depth, wind exposure, snow cover, anthropogenic, zoogenic and non-biogenic disturbance, gap number, substrate number).

Lichen richness was found completely unrelated to species pools. The correlations of richness and habitat factors were mostly rather weak, with two exceptions. Scatter plots showed that the weak correlations were not due to hump-shaped relationships. The two exceptions with strong and positive correlations to lichen richness are the number of very small gaps within the homogeneous plots and the number of substrates preferred by the lichens in the plots (the latter from independent literature). Richness differences in terricolous lichen vegetation thus can be explained by variation in habitat heterogeneity. The results also stress the importance of including such factors in macroecological studies, which integrate effects of those acting on smaller scaled gradients like disturbance.

Finally there will be a short comment about the most diverse plots found in the study (Greenland with 71 species/0.25 m^2 and Austrian alpine zone with 82 species/1 m^2) compared with a choice of 500 species/rich plots from literature all over the world which shows that arctic and alpine vegetation rich in lichens and bryophytes is at least on par with European calcareous grasslands and limestone pavements, even subtropical grasslands, which are famous for high richness.

Calciphilous thermophilous grasslands in South Bohemia – a comparison of variability between two periods

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The region of South Bohemian limestones hosts specific grassland vegetation having character of terrestrial islands in the otherwise agricultural and forested landscape. The proceeding management changes are followed by successional changes within grasslands, the most apparent being the impoverishment of small-scale diversity. For the region studied, we gathered representative phytosociological data recorded mainly in the early 1980s. No matter the old records suffer from certain degree of spatial imprecision, such data are invaluable for assessing the ecosystem development. We resampled the majority of remaining habitats of open semi-natural vegetation in South Bohemia and evaluated several composite characteristics with clear outcomes for the ecological status of the vegetation complex studied. A set of 133 old records (made before 1990) and 62 new records (made after 1990) was used. The methodology consists of comparative approach employing four types of information: interspecific associations, ecological indication (Ellenberg values), Mantel tests of similarity matrices and biological traits (BIOLFLOR database).

(1) Separate cluster analyses show different patterns of beta-diversity. The same is confirmed by the shifts in the composition of interspecific associations as revealed by Cocktail analysis in the JUICE program. The most significant in the old dataset is the group of *Anthyllis vulneraria, Carlina acaulis, Linum catharticum, Plantago media* and *Briza media*; in the new dataset it is group of *Koeleria pyramidata, Sanguisorba minor, Potentilla tabernaemontani, Helianthemum grandiflorum* and *Thymus pulegioides.*

(2) Comparison of ecological indication shows only slight trends, without statistical significance. Apparent is the decrease of light demands and increase of nutrient demands of plants, the common feature in similar studies.

(3) There is a close correlation between geographical distance and vegetation similarity in the new dataset, but it is rather an artifact in the data sampling. Important difference holds for the significant correlation between potential irradiation of stands and vegetation similarity in the new dataset, which does not hold for the old dataset. It refers to strong dependence of surviving traditional vegetation on the microclimatic conditions after cessation of local management.

(4) Analyses of selected biological traits behave similarly as under (2). They were performed only for species with significant frequency change between two periods. Apparent changes are for (a) type of reproduction (tendency to vegetative reproduction in the new dataset), (b) life span (strong retreat of short-lived plants), (c) phenological period (shifts to early phases), (d) storage organs (retreat of plants with pleiocorm) and (e) vegetative propagation (increased abundance of rhizomatous species).

Vegetation mapping and database in Taiwan – introduction and phytosociological results

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Due to the altitudinal variation of 4000 m and the location on the tropical-temperate transitional zone, Taiwan is inhabited by a unique forest ecosystem with floristic elements of both areas. After intensive exploitation of natural forests for decades, detailed vegetation data with ecological meanings are urgently needed for forest resource management and the establishment of natural reserves. The National Vegetation Diversity Inventory and Mapping Project has been launched under this circumstance since 2003. The aims of the project are to: 1) set up the Taiwan Vegetation Classification System (TVCS), 2) map island-wide vegetation distribution at the scale of 1:5000 and 3) establish the Taiwan Vegetation Information System (TVIS) for data management and dissemination.

Due to the enormous scale and complexity of the project, the government forestry authority, a forestry organization and seven universities have got involved. Vigorous protocols for vegetation surveys and mapping procedures were set and training courses were launched prior to the implementation of the project. Vegetation data were collected through field survey and literature review. With the availability of vegetation data, data for environmental factors and aerial photographs, the distribution of vegetation was mapped.

The web-based TVIS has been established and started to perform the functions of data management. So far vegetation has been investigated in 3,564 permanent plots and vegetation data of 9,678 historical plots were extracted from literature. 2,496 vascular plant species, including 770 woody species and 1,726 herbaceous species, were recorded in this project, accounting for 59% of native plant species listed in the last version of Flora of Taiwan. Vegetation has been mapped on 3,016 aerial photographs at the scale of 1:5000. The preliminary analysis identified a strong altitudinal pattern of vegetation distribution. The final version of the TVCS at the formation level has been released. With more vegetation data analyzed, the TVCS at the association level is expected to be released soon.

Using of data bases and digital maps of species for investigations of distribution patterns at the local scale.

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Features of plant population spatial structure at the local scale depend on numerous factors and are difficult to investigate. Nowadays there are many methods for spatial structure analysis. One of them is mapping species individuals taking into account their ontogenetic age with subsequent analysis of such maps.

Departments of General Ecology and Ecosystems Modeling of Kazan State University created geoinformational data bases which describe plots (GPS location, climate features, etc.) at the local level of communities/populations and contain coordinates and ontogenetic age of all individuals mapped in each plot.

There is a data base on woody communities: it contains coordinates of all tree individuals mapped in each plot and their diameter at breast height (main dominants – *Pinus sylvestris, Picea ×fennica, Tilia cordata, Betula pendula, B. pubescens*). It also contains abundances of understorey species for each herbaceous patch in the plots. The patches were determined visually by species composition. The base is related with these digital maps. It was used in investigations of how the local coenotical structure of understorey reflects species and spatial structure of overstorey populations of trees. Forest community heterogeneity and species relationships were examined using point pattern analysis (Ripley function), permutation Mantel test, ANOSIM and ordination.

Also there are data bases on populations of long-rhizome species: *Vaccinium myrtillus, V. vitis-idaea, Asarum europaeum*; short-rhizome orchid species: *Cypripedium calceolus, Epipactis helleborine*; clonal species: *Adonis vernalis, Pulsatilla patens*; tuberiferous orchid species: *Dactyloriza fuchsii, D. incarnata, D. maculata, Liparis loeselii, Neottianthe cucullata, Orchis militaris, Platanthera bifolia*; efemeroid tuberiferous species: *Corydalis bulbosa, C. intermedia*.

Analyis of spatial structure of *Adonis vernalis* revealed that prereproductive individuals as usual form aggregations independently of climatic and community conditions or type of land use. Reproductive individuals forming clone in a greater degree define pattern of spatial distribution and spatial structure of population as a whole irrespective of climatic conditions and vegetation cover. It is connected with greater competitiveness of reproductive individuals which leads them to repulsion on distances till 25–50 Sm. On greater areas casual distribution of individuals can be observed too, which is caused especially by homogeneous habitat conditions. Formation of the precise uneven-age aggregations is connected with insufficient humidity, intensity and type of anthropogenic influences.

Analysis of spatial structure of tuberiferous orchid species revealed that contagious spatial structure of populations is conditioned mainly by species features and less so by abiotic factors of ecotopes.

Spatial relationships of ecological-coenotical groups

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The effect was explored of (i) quantitative and qualitative data (presence-absence vs. abundance) and (ii) detail of phytocenosis inspection (local scale of phytocenoses vs. large scale of forest inventory map) on ordination results and on co-occurrence patterns of some ecological-coenotical species groups. Three indirect ordinations were compared: (a) the ordination of herbaceous patches mapped on the local scale of phytocenoses using information on ecological-coenotical spectrum which is computed as ratios of summary cover of species belonging to each ecological-coenotical group (quantitative data, small scale of exploration); (b) the ordination of herbaceous patches mapped on the local scale of phytocenoses using information on ratios of number of species belonging to each ecological-coenotical groups (qualitative data, small scale of exploration); (c) the ordination of large-scale forest inventory map patches using information on ratios of number of species belonging to each ecological-coenotical groups (qualitative data, large scale of exploration).

At the local scale it was mapped 15 50 × 50 m plots which are located along the gradual change of environmental conditions of Raifa part of Vozhsko-Kamsky State Nature Biosphere Preserve and fall into different types of phytocenoses: broad-leaved, mixed and coniferous forests. At the broader scale information was used about species composition of forest inventory map patches. This information was derived from Flora geobotanical (phytosociological) base which was created by researchers from Departments of General Ecology and Ecosystems Modeling of Kazan State University.

Ordinations of patches (a) and (b) were compared using Procrustean test. Co-occurrence patterns of different ecological-coenotical species group at each spatial level of phytocenosis exploring and for each type of data (cover vs. number of species) were analyzed using ANOSIM technique.

Procrustean correlation between ordinations of patches (a) and (b) was 0.79 ($p < 0.001$). Generalization of phytocenosis exploration level led to somewhat different co-occurrence pattern of ecological-coenotical species groups. Correlation between ANOSIM coefficients of coenotic group similarities computed for patches of local level exploration and for forest inventory map patches (broader scale) was 0.37 and 0.48 (using number of species or summary cover at the local level of exploration respectively). Nevertheless this inconsistency is mainly due to two discrepant ecological-coenotical groups – forest border species group and ruderal species group. Anologous correlation coefficients computed without ANOSIM similarity coefficients of these two coenotical groups were 0.72 and 0.73. It was concluded that ecological-coenotical species groups’ spatial relationships are stable to generalization of information about phytocenoses and reveal some kind of self-similarity.

Small-scale and large-scale spatial abundance variations of some ecological-coenotical species groups

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This is an attempt to examine contribution of small-scale and large-scale processes forming spatial variations of species abundance of boreal and nemoral coenotical groups at the landscape scale.

Plot descriptions used were from Flora geobotanical (phytosociological) base which was created by researchers from Departments of General Ecology and Ecosystems Modeling of Kazan State University. The research was done using over 530 geobotanical descriptions made on Raifa part of Vozhsko-Kamsky State Nature Biosphere preserve. These samples cover maximal variation of environmental conditions and fall into different types of phytocenoses: broad-leaved, mixed and coniferous forests.

As factors controlling large-scale spatial pattern of nemoral and boreal species abundance data on temperature and wetness derived from Landsat-5 satellite-imagery were used. Y-coordinates of plots were also used because it was assumed that latitude of samples can bring some indirect information about unaccounted environmental factors, e.g. soil texture. Generalized additive models were used for linking nemoral and boreal species abundance with large-scale spatial trend of climatic factors and latitude on the studied profile (mgcv package in R environment). These models of large-scale spatial trend accounted for 45% of boreal and 58% of nemoral species abundance spatial variability. Assuming that unaccounted spatial variability is caused by small-scale autocorrelation processes, at the next stage of investigation the parameters of autocorrelation processes were examined through variogram analysis using tools implemented in geoR package.

It was concluded that autocorrelation processes are less pronounced for spatial variability of nemoral species abundance (the nugget-effect is huge). They control almost 12% of spatial variability. Spatial abundance distribution of this group has less discrete patches, being more smoothed. This is concerned probably with plasticity of nemoral coenotical group species; their abundance is controlled more by climatic factors. The small-scale spatial variation of boreal species richness is more pronounced, it is more discrete: autocorrelation processes comprise almost 25% of spatial variability (nugget-effect is lower than for nemoral species abundance). It suggests that nemoral coenotical species group is more stable, more viable in space than boreal species group, because stable conservative climatic factors control bigger ratio of spatial variability of nemoral species abundance (58% vs. 45% of boreal species richness spatial variability). This fact also to some extent confirms vulnerability of boreal species coenotical group.

Nevertheless, unexplained spatial variation of species richness was almost equal for both ecological-coenotical groups. It comprised nearly 30% of all spatial variation of their abundance.

The plant-pollinator interactions in xerothermic habitats using phytosociological data

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In sites with steppe-like and grassland vegetation situated in south-eastern Poland phytosociological and faunistical research was carried out aiming at recognition of the patterns of coexistence of vascular plant species and entomofauna. The chosen sites were basically located within nature reserves with well-preserved semi-natural vegetation, where in total forty 10 × 10 m permanent plots were laid out. The vegetation units studied were classified according to the Braun-Blanquet system as the *Inuletum ensifoliae* and *Adonido-Brachypodietum pinnati* associations and transitional phytocoenoses of the *Festuco-Brometea* class. These plots were characterized by the presence of rare xerothermic species, on the scale country, as dominants i.e. *Adonis vernalis, Anemone sylvestris, Inula ensifolia, Linum hirsutum* and *Carlina onopordifolia*. During investigations on entomofauna special attention was paid to pollinators and other insects which visited flowers. Both vegetation data using percentage intervals of visible estimated cover and data on activity of insects: butterflies, bumble-bees, beetles and weevils expressed as numbers of specimens were subjected to co-correspondence analysis. The analysis showed high contribution of insects considered as thermophilous species and impact of adjacent habitats including woodland and meadow vegetation on species composition of insect associations. The most frequent turned out to be honey-bee *Apis mellifera* and peacock caterpillar *Inachis io*, present in more than 60% of plots. The most abundant insect both within and among plots was the former species. In the paper the role of species richness, species diversity and niche vs. null model of both plant and animal community assembly in mutual interactions are discussed.

Level of invasion and invasibility of European habitats, assessed on the basis of large phytosociological databases

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Habitats vary considerably in the level of invasion (LI), i.e. the number or proportion of alien plant species. To determine typical LIs for different habitats, we compiled a database of 52 480 relevés from three contrasting regions: Catalonia, Czech Republic and Great Britain. We classified plants into neophytes, archaeophytes and native, and calculated the proportion of each group in 33 EUNIS habitats. Only 8 of 545 aliens found in the relevés occurred in all three regions. Despite this large difference in alien species composition, habitat LIs were consistent among regions. Few aliens were found in nutrient-poor habitats, e.g. mires, heaths and alpine grasslands. Many aliens were found in frequently disturbed habitats with fluctuating nutrient availability, e.g. in man-made habitats. Neophytes were also frequently found in coastal, littoral and riverine habitats.

Besides local habitat properties LI depends on propagule pressure of aliens. To determine real susceptibility of habitats to invasions (invasibility), it is necessary to factor out the effects of propagule pressure on the LI. We did it by statistical modelling based on phytosociological data and digital maps. Using regression trees, the proportion of aliens was related to variables representing habitat properties, propagule pressure and climate. Propagule pressure was expressed through urban, industrial or agricultural land cover and human population density in the region. Urban and industrial land use positively affected the proportion of both archaeophytes and neophytes. Agricultural land use and higher population density positively affected the proportion of archaeophytes. After removing the propagule pressure effect, some habitats with intermediate LI had very low relative proportions of aliens. This indicates that these habitats, e.g., dry, wet and saline grasslands, base-rich fens or deciduous forests are invasion-resistant. Overall, habitats explained much more variation in the LI than propagule pressure.

Our findings that (1) habitat LIs are consistent across contrasting parts of Europe, and (2) LI mainly depends on habitat type and less so on propagule pressure, enabled us to extrapolate our data to wider Europe. By plotting the quantitative information on the LIs from Catalonian, Czech and British data on the CORINE land cover map of Europe, we produced the first European LI map.

Local and regional factors determining species composition of Central European weed vegetation

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Determinants of local species composition and species richness of arable weeds include local site factors (e.g. climate, soil, crop, and agricultural management) and species pool effects, i.e. immigration of propagules from the surrounding landscape. Recent studies of large-scale variation in central European weed vegetation showed that of the local factors, climatic variables have the strongest effect on species composition. Species pool effects were demonstrated through the effects of landscape context, indicating that arable land may contain more weed species per unit area if the surrounding landscape has more heterogeneous land cover. Previous studies also demonstrated that native and alien weeds differ in their environmental affinities, but it has been unknown whether local richness of these groups also responds differentially to the landscape context.

In the northeastern Czech Republic, we recorded 174 relevés (20 m^2 each) of weed vegetation on the field edges, along with data on altitude, annual precipitation, mean annual temperature, soil type, soil pH, crop type, and date of sampling. We also quantified the landscape context for each relevé as a proportion of different land-cover types and landscape heterogeneity (Shannon index based on land-cover types) in the circles of radii from 100 to 5000 m around each sampling site.

Patterns of weed species composition were mainly associated with local site factors, especially with crop types, followed by altitude, climate, seasonal changes, soil types and soil pH. Weed species richness and richness of native and alien species was influenced by seasonal changes, local factors and landscape context. Of the local factors, it was influenced by climate (both groups of aliens being richer in warm low-altitude areas), crops, and to a lesser extent, by soil characteristics. More heterogeneous landscapes positively affected local richness of arable weed communities through the species-pool effects. Heterogeneous landscapes with more patches of grassland and forest supported more native species on arable land, but richness of alien species was not significantly influenced by the landscape context. Effects of landscape context on arable weed diversity can be unnoticed if all weed species are analysed together, irrespective whether they are native or alien. Landscape context should be considered in any conservation plans focused on arable weed diversity.

Diagnostic species groups in coniferous forests of the *Vaccinio-Piceetea* class in Lithuania

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Classification scheme of Lithuanian coniferous forest communities is largely based on syntaxa described from neighbouring countries, particularly Poland and Scandinavia. However, the diagnostic species provided for these communities often show different distribution patterns in Lithuania. The aim of research was to reveal the diagnostic species groups most suitable for identification of coniferous forest communities in Lithuania and to analyze the differences among the corresponding syntaxa occurring on regional scale.

Coniferous forests were investigated in four transects crossing Lithuania in north-south and east-west directions, where vegetation sampling was performed each 20 km. Additional data from other investigated territories were also employed. Only the pre-selected relevés of the *Vaccinio-Piceetea* class were used for analysis. 993 relevés collected in 1997–2003 were used for syntaxonomical classification and distinguishing of diagnostic species groups. TURBOVEG and JUICE software were the main tools for data handling and processing.

Syntaxonomical classification was performed using combined methods of cluster analysis, co-occurring species analysis, and manual adjustment of distinguished groups. The classification resulted in distinguishing of eight associations of the *Dicrano-Pinion* and three associations of the *Piceion abietis*. Species fidelity was estimated using phi coefficient and the species with highest diagnostic potential were defined for each unit.

The revealed differences among diagnostic species groups provided in the surveys of corresponding syntaxa in the neighboring countries are mostly related to different classification approaches and phytogeographical differences among the regions. However, statistical analysis of relevé datasets can reveal diagnostic species that are difficult to detect using traditional methods of plant community classification, thus providing better tools for distinguishing vegetation units in particular regions.

Progress in classifying native Irish woodlands

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A five-year national survey of native Irish woodlands is nearing completion. The objective of this survey was to establish the extent and character of the woodlands and to attempt to refine the existing classification. The results will be of value to ecologists, conservationists and foresters.

A GIS-based forest inventory was used to establish the area and distribution of native woodland. It is estimated that there are *c*. 77,000 ha of native woodland, plus an as yet undetermined area of scrub (woody vegetation under 5 m in height), which may cover an additional 10,000 ha.

Using a subjective stratified sampling procedure, 1320 sites were surveyed and 1667 relevés recorded. For each site the following information was recorded: a general description of the stand, including soil and other physical parameters, species and management; one or more relevés; tree size, abundance and quality. All species, including bryophytes, were recorded and the presence/absence of lichens indicative of old woodlands was noted in the relevés.

Species groupings were produced using Hierarchical Polythetic Agglomerative Cluster Analysis. For each vegetation type Indicator Species Analysis was used to identify important indicators species which characterised the vegetation. Non-metric Multidimensional Scaling was used to illustrate the relationships between relevés and environmental variables. In this respect the analytical procedures closely followed that adopted in Great Britain by Rodwell (*British Plant Communities, Vol. 1*, 1991), with classification being based on the vegetation rather than the habitat.

The existing classification of Irish woodlands using the Braun-Blanquet nomenclature recognises 14 groups of associations or sub-associations. Much of this work has been done over a 30 year period typically sampling particular woodland types. There are, however, major gaps in this work, with certain geographical areas and woodland types underrepresented.

The new provisional classification recognises four major groups:

- *Alnus glutinosa – Filipendula ulmaria*
- *Fraxinus excelsior – Hedera helix*
- *Quercus petraea – Luzula sylvatica*
- *Betula pubescens – Molinia caerulea*

Each of these is further subdivided into a total of 22 sub-groups. There are close affinities between some of these new groupings and the Braun-Blanquet classification but other groups have less obvious affinities and may represent previously undescribed woodland types. This is particularly applicable to the birch woodlands, one of the fastest expanding and previously least surveyed of Irish woodland types.

New synthesis of the Hungarian vegetation I. Freshwater aquatic vegetation of Hungary

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The last syntaxonomical synthesis of the Hungarian freshwater aquatic vegetation was published by Borhidi (2003). Although this work listed and described 48 association of four classes (*Lemnetea, Utricularietea intermedio-minoris, Charetea fragilis* and *Potametea*), it is without any synthetic table or numerical analyses of large databases.

According to the methodology and nomenclature of the Hungarian Phytosociological Database (Lájer et al. 2007) we selected approximately 1200 relevés of the 48 syntaxa mentioned in Borhidi (2003). Most of the collected relevés are new, not older than 10 years.

Using the SYN-TAX (Podani 1997) and JUICE (Tichý 2002) programs we attempted to classify the relevés into statistically objective groups and to define the character of these ‘clusters’ in association and higher level.

Collecting Osyris's fragments in the desert: from syntaxonomy to community assembly in natural Portuguese forests

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Northwest Portugal, which biogeographicaly is the Portuguese part of the Galicean-Portuguese sector, is a very interesting intersection of two bioregions: the Euro-Siberian and the Mediterranean. Its vegetation presents a unique profile. Totally different species in terms of ecology, such as *Arbutus unedo* and *Lilium martagon*, can be found naturally occurring within a radius of only a dozen miles. This natural vegetation has not been consciously used; it has in fact undergone a dramatical diminishing with an overintensity of essential human activities such as agriculture, forestry and livestock management. Most of forest area of Northwest Portugal is occupied with two forestry species, *Pinus pinaster* and *Eucalyptus globulus*. Many areas dominated by these species face problems such as desertification, land-slides and unnatural fires. The Peneda-Gerês National Park (PNPG) is a Natura 2000 site located in Northwest Portugal, where most of the Northwest biodiversity can still be found. We selected PNPG as our study area.

The core of this study was to identify assembly rules and addressing the syntaxonomy of forest diversity in PNPG. We used phytosociology as a tool to answer these questions: what is the biodiversity of Northwest Portugal pristine forests, how is it organized and which are the rules of this organization? With phytosociology, the patches that originate the relevés work as fractals, and so from the remaining fragments of natural vegetation we were able to build a complete picture of the forest vegetation of Northwest Portugal (lacking only the *Alnetea glutinosae* marshy alder forests, which do not occur in PNPG), validating these results statistically.

For phytosociological studies, we used the Braun-Blanquet method; for statistical validation, we used ordination carried out by DCA and cluster analysis. A joint interpretation of both methods was carried out in order to distinguish major forest types belonging to caducifoliate climatophyllous woodlands (class *Querco-Fagetea*), edaphohygrophyllous woodlands (class *Salici-Populetea*) and laurifolious woodlands (class *Quercetea ilicis*).

We aim, in a next step, to analyse the extent of withdrawal of the original biodiversity in silvicultural sites, analysing the understorey of planted stands. These stands occupy nowadays most of the area that once belonged to *Quercus* forests. In order to do so, we need a clear image of what was and still is the post-glacial natural forest vegetation of Northwest Portugal, which we obtained with this work. Further ahead, we intend to propose new models of forestry practices which allow silviculture to co-exist harmoniously with natural vegetation, aiming the renewal and restoration of Northwest Portugal forests.

Reproduction of expert-based phytosociological classifications using a multivariate analysis approach

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During the recent years there has been a renewed interest in the classification of vegetation types, even in parts of the world with little phytosociological tradition. Nature managers are in urgent need of consistent systems of vegetation classification. Recent improvements of the JUICE program provide capabilities for automatic vegetation classification on the basis of the Cocktail algorithm. Supervised classification methods have also been suggested as a good methodological framework for the automatic assignment of plots to a priori established vegetation units. However, traditional vegetation classifications suffer from several inconsistencies and usually contain loosely defined classes. Under this scenario the efficiency of supervised classification methods may be lower if expert-based classes are not previously validated. We propose here to perform a numerical validation of the expert-based classes using unsupervised methods, and to take the resulting classes to perform supervised classification.

We took the phytosociological vegetation classification in Catalonia (Spain) as expert-based classification. We selected eight distinct syntaxonomical orders including grasslands, forest margin vegetation, riverine vegetation, oak forests, mixed forests and beech forests. Relevé data was taken from the Catalan Biodiversity Data Bank. Phytosociological assignments given by the authors of relevés had been specified at the association or subassociation level. We tried to create an independent numerical vegetation unit for each low-level expert class. However, expert classes were not blindly accepted as in an unsupervised approach, but they had to be successfully reproduced using the Possibilistic C-means clustering algorithm. That is, whenever possible we built a cluster for each association or subassociation described. All the relevés accepted as belonging to numerical clusters formed the ‘training’ set, while those relevés which had been excluded from the training set were compiled into a ‘test’ set. We then performed a supervised classification using distance-based discriminant analysis, where relevés belonging to the ‘training set’ were classified using a leave-one-out approach. Overall results indicate a 77% average percentage of correct classification for the first choice of the classifier. Percentage values range from a minimum of 63% (*Fagetalia sylvaticae* beech forests) to a maximum of 89% (*Quercetalia ilicis* oak forests). If we take as correct the first or second choices of the classifier, then percentages range from 76% to 94% with an average of 87%. The proposed methodology has been implemented in a server-client system called ARAUCARIA that provides automatic online classification of relevé data. The program QUERCUS, which is part of the VEGANA package, acts as a client application of the system.

Challenges of syntaxonomical reviews in underexplored areas: a case study based upon ephemeral wetland vegetation in South America

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In contrast to Europe, where phytosociological data of similar quality and with consistent floristic nomenclature are available for broader geographical ranges, the situation in other continents is different. Synoptic vegetation classification over large areas is facing several problems, which are demonstrated and analyzed by the example of ephemeral wetland vegetation in Andean and extratropical regions of South America: 1) Floristic nomenclature changes according to national floras and to publication date. 2) Taxonomical treatment of important diagnostic taxa such as *Isoetes*, *Lilaeopsis*, *Limosella* etc. is outdated. 3) The vegetation data are published in journals of national distribution and access is difficult. 4) The description of syntaxa is based upon local data sets. 5) Authors have a strong tendency to units of regional or national relevance, based on endemic vicariants and infraspecific taxa. 6) Syntaxa of higher rank are created hasty. These general problems are strengthened by peculiarities of seasonal wetland vegetation: 1) The high intra- and interannual fluctuation of the floristic composition results in an ecosystem-specific variability. 2) Restricted size and fragmentation of the stands, embedded into a matrix of puna of pampa vegetation, has strong effects of vicinism as a consequence. Efforts to overcome some of these problems such as classification at a supraspecific level or downweighting of the matrix species are discussed.

Confouding effects of the species-area relationship on vegetation classification

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Most properties of vegetation are scale-dependent. While it is well-know that species richness is a function of plot size, it is not generally recognised that the same must be true of constancy. In preparing vegetation classifications, many authors use varying plot sizes as long as these exceed the so-called ‘minimal area’; they then proceed to classify their data based on the comparison of constancy values between different units. This is equally true for more traditional concepts of fidelity, character or differential species and for ‘modern’ statistical fidelity measures. However, from a statistical point of view, it is not correct to calculate constancy values for plots with varying size or to compare these between units sampled using different plot sizes.

In our study, we use nested-plot relevé data from dry grasslands on the Baltic islands of Saaremaa (Estonia) and Öland (Sweden) to assess how extensive the effect of plot size is on constancy, fidelity (measured with different approaches), and resulting classification schemes. The compared plot sizes cover six (Saaremaa) and five orders of magnitude. We found that the scale-dependency of constancy values is generally well described by a model of the form C (A) = 1 – (1 – C0) (A/A0) ^d with C being the constancy, A the plot size, and d a parameter accounting for spatial autocorrelation. For the studied grasslands, on average, a two- to fourfold increase in the plot size resulted in a change of the constancy class. We show that the determination of diagnostic species and consequently classification results are markedly influenced when combining and/or comparing relevés from plot sizes which differ by such a factor. When the plot size difference is ten and more, such as in many monographic studies and nearly all regional and large-scale syntaxonomic overviews, the classification becomes seriously biased.

We urge vegetation scientists to be aware that the scale dependency of constancy causes major artifacts in vegetation classification. Thus, we suggest not to use plot sizes differing by more than a factor of five in comparative studies. Moreover, standardised plot sizes for certain structural vetetation types should be applied in the future to allow for good comparability and joint assessment. Finally, we point out that as a consequence of our results woodlands on the one hand and herbaceous and cryptogam vegetation on the other hand cannot reasonably be classified within a single system but that at least these two structural types need to be separated a priori as it seems impossible to apply the same plot size for low-growing cryptogam communities to forests. Thus, the diagnostic value of species can only be determined within a priori delimited major structural vegetation types for which similar plot sizes are applied, while the determination of ‘absolute character species’ is rendered impossible with the usually available data.

The use of the Markov Chain Model for the stand growth prognosis in the Oranienbaum Park

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The increasing attention to urban forestry encourages the study of temporal changes in green zones and parks close to the cities. The study of stand dynamics and the prognosis of their structure in the future provide a knowledgeable base to improve the stand quality and structure with the focus among the other aspects on their value as recreation areas. The aim of our study was to analyze the dynamics of the broad-leaved stand growth and development on the northern border of the area of their distribution.

We studied the Oranienbaum Park (161 ha) in north-western Russia. The first study was completed in 1981 and the other in 2003. The park is located in the southern coast of the Gulf of Finland, 40 km west of St.-Petersburg. The broad-leaved species (lime, oak and ash) were dominant in the stands. The basis for the study was the total enumeration and inventory of 13256 trees that were measured (height, DBH, vitality class) and mapped at scale 1:500 twice – in 1981 and 2003.

Using the Markov Chain Model we studied the development of the lime stands in the Park. The Markov Chain Models were based on the empirical data, which provided the information on the transition probabilities for some events. ‘Vitality-class changes’ and ‘diameter-class changes’ sub-models were used as the basis for modeling to predict the vitality-diameter combined changes.

For input data we used (1) the actual distribution of the trees that had a certain vitality and diameter class; (2) the empirically obtained transition probabilities of transition of trees over the 22-year time step. The 22 year time-step was dictated by the time period between two consecutive inventories.

According the modeling results for all the vitality class groups of trees, increase in DBH in two diameter classes (5–8 cm) through the 22-years time period was the most realistic. The temporal patterns of changes in vitality classes of lime-trees showed the high probability of the shifting from 1st and 2nd vitality classes to 2nd vitality class. The probability of the transition from the 3rd vitality class to the 2nd strongly increased when the diameter class increased. The transition probability from the 3rd vitality class to the 4th (dead trees) increased with the decreasing of the initial diameter.

Based on present mortality figures, the model predicted that the amount of presently living *Tilia* trees would be reduced by 50% in the next 70 years and less than 8% of the present living trees would live up to 200 years. It also indicated that the annual mortality rate for *Tilia* trees would increase during the next 50 years and probably would stabilize in the area of 1.3% per year.

By the use of the model results with empirical experimental data it was shown that the model realistically reflected the stand tendency in the future and could be a useful tool for the park management under different silvicultural scenarios.

Classification of *Corynephorion* vegetation

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In many earlier studies *Corynephorion* vegetation was locally studied in small areas (e. g. nature reserves). This resulted in controversial classification systems of local value. Moreover, the International Code of Phytosociological Nomenclature was not thoroughly considered in many cases.

The main theme of the present study is a review of the syntaxonomy and variation of the *Corynephorion*-vegetation in its total distribution range, with special attention to habitat, climate, distribution, land use and succession. An effective Europe-wide classification will be achieved.

From 2004 to 2006, 238 relevés were made according to the Braun-Blanquet approach. They are situated along a west-east (from the Netherlands to Slovakia) and a north-south gradient (from the North Sea Island Spiekeroog to Bavaria in Germany). In addition a database was created including 4322 unpublished and published relevés from international literature. After screening the dataset 3014 relevés were selected for the final syntaxonomical survey. Including the literature dataset, the whole study area has an extension from the north of France to the Ukraine and from the south of Sweden and Norway to the south of Germany and Slovakia.

The *Corynephorion* vegetation can be divided in four associations (here with preliminary nomenclature): the '*Violo-Corynephoretum*' on coastal dunes, the '*Spergulo-Corynephoretum*' and '*Agrostietum coarcatae*' mainly on inland dunes and the '*Veronico-Corynephoretum*' on inland dunes affected by continental climate. Indicator values, soil parameters and correspondence analysis were used in the ecological characterisation of these associations. Special attention is paid to the role of the lichens as phytocoenological indicator species.

Formalized vegetation classification of alder carrs and floodplain forests in the Czech Republic – an ecological interpretation

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Formalized and supervised phytosociological classification of *Alnion glutinosae* and *Alnion incanae* in the Czech Republic is presented. Three associations of *Alnion glutinosae* (*Thelypterido palustris-Alnetum glutinosae, Carici elongatae-Alnetum glutinosae* and *Carici acutiformis-Alnetum glutinosae*) and seven associations of *Alnion incanae* (*Alnetum incanae, Stellario nemorum-Alnetum glutinosae, Pruno-Fraxinetum, Carici remotae-Fraxinetum, Piceo-Alnetum, Ficario-Ulmetum campestris* and *Fraxino pannonicae-Ulmetum*) were distinguished by the Cocktail method using sociological species groups. Ellenberg indicator values were used to show the main ecological gradients responsible for the vegetation variability of these communities. The most important factors conditioning the variability were temperature (for *Alnion incanae*) and soil reaction, nutrient availability and moisture (for *Alnion glutinosae*).

Altitudinal zonation of Arctic vegetation

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Arctic mountain vegetation is still unexplored to a great extent. For instance, an altitudinal zonation hypothesis was used for the illustration of mountain vegetation in the Circumpolar Arctic Vegetation Map (CAVM). In this map it is hypothesized that latitudinal Bioclimate Subzones are reflected in altitudinal vegetation belts based on similarities between environmental conditions along the altitudinal and latitudinal gradient (e.g. summer temperatures, growing season; cf. CAVM Team 2003, Walker et al. 2005). In order to test this hypothesis and to enhance the knowledge of arctic mountain vegetation a research project on the altitudinal zonation of vegetation (AZV-Project) was initialized. The investigations were carried out in the non-carbonate mountain complexes (reaching elevations up to 1330 m a.s.l.) of the Søndre Strømfjord region (continental West Greenland). A comprehensive characterisation of mountain vegetation with regard to flora, vegetation types, vegetation pattern, and habitat conditions is accomplished (cf. Sieg & Daniëls 2005, Sieg et al. 2006, Drees & Daniëls, in prep., Sieg et al., in prep.). Main focus of the ongoing work is on the development of an altitudinal vegetation belt model. Borderlines between the four altitudinal belts occurring in the study area are identified and detailed criteria for their delimitation are provided. With reference to this, concepts of altitudinal indicator species and plant communities based on limited altitudinal distribution or changes of habitat-type spectra are presented. Vegetation pattern are considered as idealized toposequences and representative, detailed vegetation maps of different altitudes. The conspicuous differences between south- and north-facing slopes are considered. At large, the provided comprehensive data on arctic mountain vegetation and its ecology reflect the present status of the ecosystem and can be used for monitoring approaches and nature conservation as well as for further studies and extrapolation purposes.

The effect of historical landscape structure on secondary forest vegetation

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Newly formed woody stands differ in species composition from ancient ones, which can be due to differing ecological preference of species under altered abiotic conditions in secondary stands or a limited ability of species to spread into newly formed habitats. Forest species are generally considered to be slow colonisers that prefer old forests. Not only forests but also local ancient hedges can serve as refugia for forest species, as they can serve as a source of forest-species propagules after a landscape is abandoned by humans. Shrubby stands of differing age can therefore serve as a suitable model for the study of dispersal of forest species and the relative importance of abiotic factors and biological traits of individual species for the development of the forest ecosystem. Areas in which large-scale changes in land use have occurred are suitable for the study of processes in hedges. Military areas in the Czech Republic are a good example.

This study has been carried out in the Doupovské hory hills in West Bohemia, where a military practice area was founded in 1953, bringing an end to farming. Secondary shrubby vegetation colonised vast parts of the area. The objective of this study was to establish the differences in species composition in the herb layer of hedges with different continuity, the importance of other environmental variables and the ability of forest species to colonise newly formed habitats. We have excerpted data on vegetation continuity from maps of the stable cadaster from 1842 and from aerial images from between 1952 and 1999 and thus derived three different continuity classes. We determined the species composition of individual vegetation types using phytocenological records. In order to establish the migration ability of forest herbs, we surveyed in detail an area of 500×500 me in which both ancient and newly formed woody stands were present.

We discovered that true forest herbs are mostly represented in the oldest stands. Our second finding was that stands of moderate and the largest continuity are the closest to each other in terms of vegetation. Of the remaining habitat variables affecting vegetation, the most significant are: altitude, wetness index and potential annual radiation. Migration of forest herb species is successful in the area under study. We have established speeds of migration between 1.2 m per year in *Impatiens parviflora* and 2.5 m per year in *Lapsana communis*.

Bioclimatic forest types in Southern Siberia

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The aim of this study is to link forest vegetation units to climatic factors in the Altai-Sayanian mountain region. The study was carried out in three phases: 1) creation of a relevé database; 2) classification of forest relevés using the Braun-Blanquet approach and the identification of plant communities within a formal phytosociological framework; and 3) ordination of relevés using DECORANA and investigation of climatic relationships using correlation analyses.

Climatic parameters for all relevé sites were calculated from the GIS climatic map of southern part of Middle Siberia with resolution 90 m. Climate and geographic variables used were: mean annual air temperature, mean temperature of the warmest month (July), mean temperature of the coldest month (January), mean of total annual precipitation, mean precipitation of the coldest period, mean precipitation of the warmest period, Conrad's continentality index.

The first two axes of the DCA ordination explain the relationships between boreal forests and climate. Axis 1 can be seen as a kind of distribution of the altitudinal forest types and it is correlated with altitude, temperature and precipitation. Axis 2 strongly correlated with the Conrad's continentality index and relates to the integrated macro-climatic factor – oceanity-continentality.

Six bioclimatic types of forests were distinguished as a result of ordination and correlation analyses:

1. Zonal hemiboreal forests
1.1. Small-leaved deciduous and light coniferous grass forests of the South Urals-West Siberian type occurring in moderately warm and humid climate of cyclonic regime (*Brachypodio-Betuletea pendulae*)
1.2. Light coniferous deciduous (*Larix sibirica*) grass forests of South Siberian-North Mongolian type occurring in moderately cold and semi-arid climate of ultra-continental regime
2. Relic Siberian subnemoral dark coniferous small-leaved forests occurring in moderately warm ultra-humid climate of cyclonic type (*Querco-Fagetea, Abietetalia sibiricae*)
3. Zonal taiga forests
3.1. Dark coniferous (*Abies sibirica, Pinus sibirica*) forests of European-West Siberian type occurring in moderately cold ultra-humid and humid climate of cyclonic regime (*Vaccinio-Piceetea, Vaccinio-Piceetalia abietis*)
3.2. Light coniferous (*Larix sibirica*) forests of East-Siberian-North Mongolian type occurring in moderately cold continental and ultra-continental climate of anti-cyclonic regime (*Vaccinio-Piceetea, Lathyro humilis-Laricetalia*).
3.3. Light coniferous and mixed coniferous (*Larix sibirica, Pinus sibirica*) forests of North and East-Siberian type occurring in cold ultra-continental climate of anti-cyclonic regime (*Vaccinio-Piceetea, Ledo-Laricetalia sibiricae*).

Analysing shade tolerance of tree species using phytosociological relevés and Ellenberg values

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The ecological niche is a central concept in vegetation ecology and its application in silviculture. While the fundamental niche focusses on the physiological constraints of survival and growth, the realised niche takes competition in real communities into account. For long-lived plants like trees, the regeneration niche and the niche of adult trees may differ considerably. The database BERGWALD contains 4,934 phytosociological plots from mountain forests of the Bavarian Alps. The relevés have so far been used for deriving vegetation units, site types and groups of indicator species. In the present study they were analysed with regard to the ecology of tree species in general and their regeneration niche in particular.

The availability of light as a crucial resource that changes during forest succession was estimated by calculating average Ellenberg indicator values (mL) based on total field and bryophyte layer composition. The relative frequency of plots across the mL gradient in the total database was juxtaposed to the occurrence of the 16 most common tree species in the tree and in the regeneration layer, respectively, resulting in profiles of preference across the light gradient. Based on the matrix of preferences, tree species were clustered into shade tolerance groups. As expected, the realised niches of tree species on the light gradient corresponded broadly to Ellenberg's L-value of tree regeneration. As the regional climax, *Abies alba* and *Fagus sylvatica* have coincident optima of tree layer and juvenile occurrences in closed, mature stands.

Ulmus glabra and *Fraxinus excelsior*, as species of lower altitude, exhibit niches most similar to these climax species, followed by *Acer pseudoplatanus* and *Picea abies*, two of the most frequent species that occur across all elevations. The intermediate role of these four species is confirmed, as regeneration occurs mostly at light levels higher than those found under adult trees of the same species. Against expectations, *Taxus baccata* clearly prefers stands with moderate to high light, as do *Sorbus aria, Sorbus aucuparia* and *Alnus incana*. While *Larix decidua* and *Pinus cembra* occupy very similar overall niches, tree layer and regeneration niches of *Larix* differ markedly, whereas coincident layer niches in *Pinus cembra* underpin its status as a climax species at tree line.

Pinus sylvestris and *Salix eleagnos* are typical shade-intolerant pioneers, of which regeneration is practically restricted to non-forest vegetation.

Pinus rotundata and *Juniperus communis* are small trees that are entirely restricted to open stands subject to geomorphological activity. The results demonstrate the potential of phytosociological databases for studying the niches of tree species. To be sure, such analyses are no replacement for physiological and experimental studies. The research community is invited to use this source as a reference framework and an empirical validation for more specialised research.

Species diversity and ecological functioning of Atlantic and Mediterranean coastal dune ecosystems: a comparison

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Many recent developments in coastal science have gone towards the demands of EU legislation. The three habitat types corresponding to 1210-Annual vegetation of drift lines, 2110-Embryonic shifting dunes and 2120-Shifting dunes in the EEC Directive 92/43 are commonly used to describe the European beach and foredune systems. In order to compare Atlantic (Dutch Mainland) with Mediterranean (central Tyrrhenian and Adriatic Italian coast) dune vegetation, their floristic composition and ecological functioning were studied. Plant communities of the following coastal sand dune morphological units were analyzed: beach and foredunes, transition dunes, fixed dunes and moist slacks. Then, the habitat types of the beach and foredunes were deeply studied. Species composition, Ellenberg indicator values and life forms were analysed on the basis of TURBOVEG vegetation tables compiled for each morphological unit and habitat type.

Major trends of plant species distribution in coastal dunes were identified through detrended correspondence analysis (DCA). Then the numbers of exclusive and shared species were considered. Ellenberg values and life forms were described both considering their behaviour on a canonical DCA space and through the classical spectra. After that, beach and foredune habitats types were studied applying the former procedure. High floristic diversity with low number of shared species (86) and clear differences between the Atlantic and the Mediterranean coast were found. The samples of Dutch and Italian plant communities did not overlap except for the beach and foredunes ones. Mediterranean fixed dunes were characterized by high Ellenberg values for temperature and high abundance of phanerophytes. On the other hand Atlantic fixed dunes were associated with a high percentage of hemicryptophytes and high Ellenberg values for nutrients. This is probably related to regional macroclimatic features that regulate this sector of the coastal zonation on both compared coasts.

Ordination of the beach and foredunes habitat types showed a clear floristic and ecological gradient: each habitat type is floristically and ecologically distinctive, except for the Mediterranean Shifting dunes (2120) that overlapped both with the Atlantic and with the Mediterranean Embryonic shifting dunes (2110). Surprisingly, floristic composition of the Italian Shifting dunes along the shoreline with *Ammophila arenaria* (2120) was more similar to the Dutch Embryonic shifting dunes (2110) than to the same habitat (2120) on the Dutch coast.

In the two countries the role of morphological units and habitat types discussed in terms of the Ellenberg indicator values and life forms turned out to be much more informative than the simple comparison of species composition.

Distinguishing between the effect of drainage and sheep grazing in an island ecosystem

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In 1987, an area of 21 km^2 in an island ecosystem was drained in order to exploit the water for hydroelectric production. In 2007, the area was investigated in order to see if the drainage had any effect on the ecosystem. A neighbouring area of approximately the same size was also sampled as control. The vegetation and soil were sampled in both areas with six sites in each area. Each site had 16 macroplots of 0.25 m^2. The vegetation was classified into four plant communities. The dominant plant community on the drained site was the *Calluna vulgaris-Empetrum nigrum-Vaccinium myrtillus*-community, whereas the *Carex bigelowii-Racomitrium lanuginosum*-community was dominant on the non-drained site. The two other communities were found in approximately equal numbers of plots. These two communities were the *Scirpus cespitosus-Eriophorum angustifolium*-community and the *Narthecium officinalis-Carex panicea*-community.

The two areas differed according to the following functional groups: grasses, herbs, mosses, lichens, sedges and woody species. The frequencies of woody species and lichens were significantly higher on drained site, while the frequency of graminoids and sedges were found to be significantly higher on the non-drained site. The frequencies of herbs and mosses, on the other hand, were not significantly different in the two areas.

On the drained site the diversities woody species and mosses were found to be significantly higher while the diversities of graminoids and sedges were found to be significantly higher on the non-drained site. The diversities of herbs and lichens were not significantly different in the two areas.

In addition to drainage, the whole area is grazed by sheep with various grazing pressure. Criteria for distinguishing between the effects of these two land use activities are discussed.

Phytodiversity monitoring and land-cover change simulation in protected area of tropical rain forests and its measurement by satellite remote sensing and GIS

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The study of land-use and land-cover changes and associated impacts on phytodiversity is of paramount importance for biodiversity monitoring and conservation. Analyzing changes and its causes is one of the most challenging areas of landscape ecology especially due to the absence of temporal ground data and comparable space platform based data. The present study simulated the changes in land-cover using satellite images over a period of three decades for Kalakad-Mundanthurai Tiger Reserve, Tamil Nadu (India), an ecological hotspot. We have formulated a methodology to estimate the land-cover change and forest type transitions using the comparable reflectance property of the vegetation types and species similarity in the absence of the past ground data. The land-cover change has been modelled using GEOMOD for the study region and predicted for 2020 year using the current level of disturbance. The core areas have been identified based on the identification of remnant intact patches of evergreen forest and their likelihood of sustenance in the coming decades. Results showed that 47% of evergreen vegetation cover has undergone type transition. The patch dynamics with respect to different landscape metrics have shown that the drivers of the change are more active in the areas undergoing type transition. Analyses of vegetation composition in these patches have shown that the endemic seedlings of the primary species are being replaced by the edge species showing type transition still in process. The study demonstrates the role of remote sensing and GIS in monitoring of area and type transitions, patch dynamics, and species diversity loss in the ecologically sensitive biodiversity hotspots.

Phenotypic plasticity of *Quercus ilex* L.: relationship between seed size, germination and seedling growth phases

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Phenotypic plasticity is the capacity of a given genotype to express different phenotypes in different environments. Plasticity for physiological and life-history traits may allow plant species to grow and reproduce in spatially or temporally variable environments; moreover, the timing of plant development can itself be plastic. The main objective of this research was to analyse phenotypic plasticity of *Quercus ilex* L. Seedlings were germinated from seeds of parent plants from three different localities in Italy: Nago, in the Garda Lake region, at the Northern limit of holm oak distribution area in Italy; Castelporziano, near Rome, at sea level, at the centre of the distribution area; and Frassanito, near Lecce, at sea level, in a dry area of Southern Italy. *Q. ilex* is an evergreen sclerophyllous species widely distributed in the Mediterranean Basin; thus, knowledge concerning individuals from different climates is important to forecast the species potential productivity to increasing drought stress. The results of the present research underline the relationship between seed size (length, diameter, mass) and the germination rate. Larger seeds from the sites characterised by a higher drought stress (southern origin) have a higher germination rate than smaller ones (northern origin), characterised by a higher cold stress. Moreover, the results underline the relationship between seed size and seedling traits of the considered ecotypes: in particular, seedlings from larger seeds have a higher relative growth rate (RGR) than those from smaller seeds, especially during the first developmental stages, so that they may be provided with sufficient reserves to grow before air temperature and soil water are not limiting factors. In fact, the highest RGR in the first seedlings developmental stages allows the highest seedling height, leaf area, and total leaf area per plant. The effect of seed size could be of adaptive significance in establishing and maintaining populations in natural environments. Moreover, the response of the considered ecotypes to experimentally imposed water stress underlines that seedlings from Frassanito seeds, evolved under naturally prolonged drought stress, seem to be more tolerant to water stress and they might provide a substantial advantage in drier sites. After the imposed water stress, the calculated leaf damage is the greatest in the ecotype evolved in the centre of the distribution area, characterised by the lower drought and cold stresses. The plasticity index for physiological *Q. ilex* leaf traits is higher for physiological traits than for morphological and anatomical ones. Because plasticity influences environmental tolerance, different plastic responses may contribute to differences in the range of environments that species inhabit, and in the specific capability to maintain functioning in contrasting conditions, including global change.

Beta diversity of the Black Sea coast rocky-slope vegetation

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The classification of petrophytic vegetation of coastal steep slopes is proposed for the Northwest Caucasian coast of the Black Sea using the Braun-Blanquet approach. The main factors that influence the development of this vegetation are abrasion and denudation sea-coast processes. The coastal steep slopes in the investigated region are formed by carbonate flysch. The plant communities occur on rocky slopes with poorly developed soil cover, fine stone particles as well as rock crevices. In the proposed classification the Northwest Caucasian coast vegetation is included in the class *Onosmo polyphyllae-Ptilostemonetea* Korzhenevsky 1990 that originally integrated only petrophytic phytocoenoses of the Crimean Peninsula. The vegetation of the Caucasian Black Sea coast is assigned to the order *Seselietalia ponticae* ord. novus. Within this order vegetation of coastal steep slopes in the area with subarid climate (Anapa – Gelendzhik) is assigned to the alliance *Onosmion tauricae* all. nova and vegetation of more humid climatic area (Gelendzhik – Tuapse) to the alliance *Psoraleion ponticae* all. nova. The vegetation of ecotopes with higher moisture caused by subsoil water outlet to the surface or by subsoil water high level is included in the alliance *Periplocion graecae* all. nova. Seven associations and five communities without syntaxonomic rank are documented in the table and described with respect to their phytosociological affinities, ecology, and geographical location. Diagnostic species of syntaxa were established using the phi coefficient calculations of fidelity and Fisher's exact test. In addition, the results of relevé ordination are given using the algorithm of non-metric multidimensional scaling (NMS) that is embedded in the PC-ORD 5.0 software package.

Some results of studies of raised bog vegetation of Belarus

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Raised bogs occupy 424,500 ha, or 17.8% of bog area of Belarus. The largest bogs are concentrated in the northwestern part of the country. Zonal division of Belarussian raised bogs is expressed not only in reduction of their area from the north to the south, but also in a change from very convex bogs with well advanced hummock-lake and hummock-hollow complexes to convex pine-shrub-sphagnum bogs. On the basis of botanical-geographical classification the map of Belarusian bogs was made, where raised bogs are divided into four types incorporated into two groups. For each type of raised bogs characteristic are given of vegetation, flora, ecological conditions, morphology and peat.

Prodromus of syntaxa of vegetation of oligotrophic bogs of Belarus is made. Their vegetation is assigned to three Braun-Blanquet classes on the basis of 700 geobotanical descriptions: 1) *Scheuchzerio-Caricetea* (Nordh. 1937) R. Tx. 1937; 2) *Oxycocco-Sphagnetea* Br.-Bl. et R. Tx. 1943; 3) *Vaccinio-Piceetea* Br.-Bl. 1939. Eight associations are distinguished in these classes, and some of them are divided into subassociations, variants, phases and races. Association tables of species structure with the indication of constancy and cover are presented, along with synonyms, descriptions of structure, productivity and ecology.

Various forms of anthropogenic influence on raised bogs (drainage, exloitation of peat deposits, recreational trampling, pollution, fires and other) and their consequences leading to full or partial destruction of bog vegetation are considered. It is important to note, that from the general area of raised bogs 3.4% are exploited; 11.0% are completely drained for various use. The share (56.3%) of drained bogs preserved in natural sites is still great.

The economic estimation of vegetation resources of Belarussian raised bogs is carried out. Leading position in structure of vegetation resources is occupied by wild-growing berries and medicinal raw material.

The inventory of protected bogs of raised type is made. The area of protected oligotrophic bogs is 107,990 ha (25.4% of the general raised bogs area) or 33.1% of the general protection area of peat deposits. Maps are created of bog vegetation which has Ramsar’s territory status.

Strategy of protection and use of raised bogs of Belarus which contains four basic directions (ecological, cultural-recreational, agrarian and power-technological) is developed.

Is the Sahel greening? Response from the local communities of the Burkina Faso Sahel

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Recent literature, essentially based on remote sensing analyses, suggested a “recovery” of the vegetation in the Burkina Faso Sahel, which is contradictory to the general decreasing trend revealed by most of the ground studies on the Sahelian vegetation.

Using ethobotanical methods based on semi-structured interviews, we carried out an inventory of the main ligneous species that are put to use, as well as we assessed the perception of land-users concerning the dynamic of those woody species in the Burkina’s Sahel. Afterwards, we studied the population structure of five multipurpose species and we compare them with the locals perception of the vegetation dynamics.

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Using phytosociological data from mires in testing biogeographical hypotheses

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We present two examples of utilising phytosociological data from mires of two distant regions (West Carpathians and Bulgaria) supplemented by basic measurements of water pH and conductivity. First, we explored the relationship between mire species richness and pH, an important environmental variable in mires. Mire habitats in both regions demonstrate support for the prediction that habitats with more common pH values host more species. We also explored the influence of habitat history by examining the distribution of generalists and specialists along the gradient of habitat pH. We found a striking pattern with the distribution of pH-specialists having three distinct peaks in both regions, whereas the total species pool peaked in near neutral pH habitats in both regions.

Because the peaks in specialist richness do not correspond to regional pH distribution patterns, we hypothesize that historical explanations may be important, and that habitats currently rich in pH-specialists may have historically acted as pleniglacial refugia for many mire species. This finding suggests that historical processes such as patterns of glacial refugia may significantly influence contemporary species distributions and the diversity of plant species in mire habitats. As Bulgaria represents a range margin for many mire species, we further explored whether species exhibit similar or different ecological behaviour in the two regions and found striking extension of species tolerances towards mineral-poor acid habitats in Bulgaria. Generally, our findings support the general predictions of the evolutionary species pool hypothesis that historically more common habitats have had greater opportunity for the evolution of suitably adapted populations. On the other hand, we did not confirmed prediction about narrower niches at species range margin.

Phytosociological data revealed shifts in the ecological behaviour of plant species between two distant regions

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We present an example of using phytosociological data to study ecological behaviour of mire species in two distant regions (West Carpathians and Bulgaria), of which Bulgaria represents a range margin for many mire species. Most of the 41 frequently occurring species showed a significant response to water pH and ln-transformed conductivity in both regions. Eight species showed a shift in pH optimum greater than one unit, while 12 species showed the same or a larger shift along the conductivity gradient. Nearly all these striking shifts were connected to an extension of species tolerance towards mineral-poor acid habitats in Bulgaria. Regarding ecological amplitude, 24 species exhibited a wider tolerance to water conductivity in the West Carpathians, whereas 17 species exhibited a wider tolerance in Bulgaria. Niche shifts between local populations of the same species were similar to those of closely related vicariant species. Ecotypic adaptation within species is a possible explanation for this pattern. The local populations of rich-fen species may have adapted to mineral-poor acid conditions in the high crystalline mountains of Bulgaria during dry periods of pleniglacials.

Construction of a vegetation map derived from topographic predictors of vegetation types: how realistic can it be?

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Vegetation maps can be constructed by field mapping or indirectly using some predictors of vegetation types. In this paper, we attempt at constructing a map of semi-natural (forest) vegetation types based on a set of topographic predictors, employing GIS techniques. The map is a map of potential natural vegetation, i.e. excluding human-dependent vegetation. In the given conditions (see below), we assume topography being a complex factor driving the irradiation-moisture conditions, which constitute the main environmental gradient along which the semi-natural forest types are distributed. Traditionally, maps of potential vegetation in fine resolution have been the field-constructed maps, employing mainly the personal experience of the researcher. We pursuit with GIS-based construction of such a map, which can be i) faster and ii) more objective, but depending on the selection and use of the vegetation predictors (and various other factors) also iii) less realistic than field-made maps. A comparison of GIS-constructed map and field-made map will help to elucidate the latter question. We aim at analysing the potential of a local database of phytosociological relevés for construction of vegetation cover maps, namely maps of potential vegetation. Quantitative information about selected topographic predictors for vegetation types will be derived using a set of sites with relevés distributed in the study area.

Study area is in a lowland karst SW from Prague, in a hilly landscape with scattered forest patches. Series of forest vegetation types from xerothermic oak forests over mesophilous oak-hornbeam forests to beech and ravine forests has developed there. In a landscape section of 3×4 km, we sampled about 180 relevés of 15×15 m in 2007, distributed evenly in the forested parts of the landscape. A 1:3000 map of the actual vegetation is available, created in 2006 by the field mapping. It includes mainly semi-natural vegetation types mentioned above.

The procedure consists of: (1) Derivation of topography-based parameters for the sampled plots (slope, aspect, position on the slope, landform, erosion conditions, moisture, irradiation), subtracting the variability given by the bedrock types. (2) Classification of relevés of semi-natural vegetation types (excluding plantations and clearings), based on cluster analysis or expert-knowledge methods (Cocktail). (3) Creation of a statistical model using the topography variables that would best discriminate the relevés to vegetation types. Half of the relevés will be used for model construction, the other half for its validation. (4) Interpolation of the model to the whole area, creating a map of predicted semi-natural vegetation types. (5) Comparison of the predicted and field-constructed maps.

Diversity and classification of mountain grasslands of the alliance *Polygono-Trisetion* in the Slovak Republic

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The mountain meadows of the alliance *Polygono-Trisetion* in the Slovak part of the Western Carpathians are distributed at altitudes 600–1500 m a.s.l. Meadows with diagnostic species of this alliance, including *Geranium sylvaticum, Crepis mollis, Phyteuma spicatum, Crocus discolor, Cardaminopsis halleri, Pimpinella major, Lilium bulbiferum, Primula elatior, Senecio subalpinus, Heracleum sphondylium, Knautia maxima, Trisetum flavescens, Vicia sepium, Campanula serrata, Alchemilla vulgaris* s. lat., *Hypericum maculatum, Cruciata glabra, Campanula glomerata* agg., *Rhinanthus pulcher*, and dominant species *Alchemilla vulgaris* s. lat., *Geranium sylvaticum, Agrostis capillaris, Trisetum flavescens, Festuca rubra* agg., *Trifolium pratense* and *Hypericum maculatum* occur mainly in small patches over calcareous bedrocks (Starohorské vrchy Mts, Veľká Fatra Mts, Belianske Tatry Mts, Nízke Tatry Mts, Slovenský raj Mts, Muránska planina Mts, Spišská Magura Mts, Levočské vrchy Mts, Poľana, Bukovské vrchy) at wetter and colder sites of saddles and slopes with mainly northen aspect, rarely on the non-carbonate substratum. Associations of these alliances have tight relationships to the alliances *Arrhenatherion, Bromion erecti* and *Nardo-Agrostion.*

Phytocoenological material was analyzed by cluster analysis processed by the PC-ORD 4 program where Ward's linkage method and the relative Euclidean distance as a resemblance measure were applied. Optimal number of clusters was determined by the Crispness method. Diagnostic taxa for individual clusters were determined by calculating the constancy and fidelity of each species to each cluster, using the phi coefficient of association in the JUICE program. The CANOCO 4.5 package was used for running indirect gradient analyses. Detrended correspondence analysis (DCA) defined major gradients in the spatial arrangement of species of the analysed data set. Average Ellenberg indicator values for relevés were plotted onto a DCA ordination diagram as supplementary environmental data. For identification of syntaxa electronic expert system was also used. Syntaxa were formally defined and characterized by diagnostic, constant and dominant species, ecology and distribution. Based on the analysis four associations can be recognized: *Campanulo glomeratae-Geranietum sylvatici* Ružičková 2002, *Geranio sylvatici-Trisetetum* Knapp ex Oberd. 1957*, Crepido mollis-Agrostietum capillaris* Ružičková 2004 and *Geranio-Alchemilletum crinitae* Hadač et al. 1969. Some syntaxonomical problems were also discussed.

The Rengen Grassland Experiment: effect of long-term fertilizer application on diversification of plant communities

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Species composition of semi-natural grasslands varies across landscapes, and phytosociology reflects this variation in the system of associations and alliances. However, it is often unclear whether diversification of semi-natural grasslands is due to variation in abiotic site factors or management. Management experiments designed to disentangle the effects of these two factors are often running over few years only, which is not sufficient for the full development of species composition that would correspond to sites where certain management is applied for decades.

A unique long-term fertilizer experiment (Rengen Grassland Experiment) was established in 1941 in the Eifel Mts. (Germany) on a low productive *Calluna vulgaris-Nardus stricta* grassland. Six treatments with combinations of Ca, N, P, and K fertilizer were applied annually under two-cut management: control, Ca, CaN, CaNP, CaNP-KCl, and CaNP-K_2SO_4. In 2006, species composition and cover were recorded to detect changes in plant communities caused by long-term fertilization. Vegetation developed in individual plots was compared with synoptic tables from Oberdorfer’s *Süddeutsche Pflanzengesellschaften*. This comparison was done using the ASSOCIA method designed by O. van Tongeren and Ellenberg indicator values (EIVs).

Control treatment supported oligotrophic *Nardus* grassland of the *Polygalo-Nardetum* association (*Violion caninae*). Vegetation in the Ca and CaN treatments corresponded to montane meadow of *Geranio-Trisetetum* (*Polygono-Trisetion*), with *Dactylorrhiza maculata* and *Platanthera bifolia*, indicating that some orchids are able to withstand long-term nitrogen application if phosphorus availability is limited. Transitional types between *Poo-Trisetetum* and *Arrhenatheretum* (*Arrhenatherion*) developed in the CaNP treatment. In the CaNP-KCl and CaNP-K_2SO_4 treatments, vegetation corresponded to the mesotrophic *Arrhenatheretum* meadow. Major discontinuity in species composition was between the control, Ca and CaN treatments on the one hand, and treatments with P application on the other hand. EIVs for both nutrients and soil reaction were considerably higher in P-fertilized plots than in Ca and CaN plots. Control plot exhibited the lowest EIVs not only for nutrients and soil reaction, but for continentality and moisture as well, although these factors were not manipulated.

Rengen Grassland Experiment is an example of nutrient-driven shift in plant species composition induced by long-term fertilization. Long-term fertilization can create plant communities that belong to different phytosociological classes and have no overlap of dominant species even within spatial scale of a few m^2.

Use of quasi-neutral models to interpret large-scale patterns in database data

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‘The wealth of data contained in phytosociological databases has an unrivalled potential for addressing various research questions spanning from population ecology through community ecology to macroecology.’ (a quote from the conference mission statement). However, these data contain a multitude of signals, spanning from purely statistical patterns over meaningful ecological relationships to artifacts due to preferential sampling. Therefore interpretation of such data requires a series of ‘null’ hypotheses that successively take into account different processes that have to be examined, and compare the database patterns against the patterns produced by these hypotheses. This can be done using randomization tests, but the complex correlation structure in the data typically does not permit clear-cut separation of processes to be tested from those to be screened off before testing with the resulting inability to detect the signal even when it is present. Ideally, patterns from database data should be compared with parameterized but independent community models based on these null hypotheses. In order to minimize difficulties due to the large number of unknown parameters, general models with as-low-as-possible number of parameters should be used. This is well served by a family of quasi-neutral models that capture essential elements in the plant community assembly and dynamics while requiring rather a low number of key parameters. In particular, a Gaussian gradient extension of the neutral framework is used here. Here we are exploring major large-scale patterns such as mean alpha and beta diversities and species abundance distributions generated with such models, and use them to interpret patterns of large sets of phytosociological relevés.

Is species richness and composition of spring fen vegetation dependent on contact communities?

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This study is devoted to vicinism/edge effect on non-forest calcareous spring fens and their contact communities on the western margin of the Western Carpathians. The study area is in the Carpathian flysch zone. The bedrock is variable in its chemistry with calcium-rich flysch beds supporting travertine (tufa) formation in the south. There is an obvious climatic gradient from south-west to north-east, with increasing mean annual precipitation and decreasing mean annual temperature. The studied spring fen vegetation belongs mainly to the *Caricion davallianae* alliance. The contact vegetation mostly belongs to wet meadows (*Calthion*), mesic meadows and pastures (*Arrhenatherion, Cynosurion*) and dry grasslands (*Bromion erecti*).

The spring fen vegetation in the north-eastern part of the study area harboured more species typical of contact communities and displayed higher similarity with contact vegetation than the vegetation of mostly tufa-forming fens in the south-west. Species richness of spring fens correlated significantly with neighbouring species richness in the north-eastern part of the study area, whereas no correlation was found in the south-western part. South-western fens are characterized by tufa formation which is connected with extreme ecological conditions. There is also a large contrast in moisture conditions between spring fens and neighbouring vegetation in the SW regions. Hence, species from extremely species-rich contact communities cannot grow in tufa-forming spring fens. The results have demonstrated that vicinism not always plays a significant role in shaping species composition of island habitats and that total species pool in the landscape may not influence species composition of extreme habitats. The result that greater difference in ecological conditions between target habitat and its surrounding means less pronounced mass effect could be utilized in designing ecological studies in which vicinism/mass effect could act as a confounding factor.

Analysis of semi-dry *Bromus erectus* and *Brachypodium pinnatum* grasslands of Hungary

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Semi-dry grasslands are of high nature conservation interest both on national and European scale due to their high biodiversity and species richness. For effective conservation, however, characteristic types and patterns of distribution of the semi-dry grasslands need to be revealed. In Hungary there is no comprehensive survey and classification of semi-dry grasslands so far, however, the severe deterioration of these grasslands is rapidly ongoing mainly due to the changes in the agricultural system in the last few decades, and the quality and quantity of semi-dry grasslands is decreasing fast. Therefore in this study we aimed to reveal the distribution and patterns of floristic composition of semi-dry *Bromus erectus* and *Brachypodium pinnatum* grassland. For this analysis 699 relevés were selected where the percentage cover of *Brachypodium pinnatum, Bromus erectus, Danthonia alpina, Avenula adsurgens, A. pubescens* and *A. compressa* reached at least 10%. Geographical stratification was performed and then the dataset was split into two equal parts randomly (TRAINIING and TEST datasets). Following outlier exclusion and determination of relevant axes with the help of PCoA clustering was performed for both datasets separately. By validation the optimal number of clusters was determined. The most valid clusters were found at the level of 10 clusters, where 7 clusters appeared to be valid. The geographical separation of the clusters is highly expressed, while there are considerable overlaps in the species composition. The main types are the following: *Brachypodium* grassland of the higher altitudes of the north-eastern hilly regions, recently developed secondary grasslands, typical Pannonian type of the *Brachypodium* grasslands, grasslands of the Gödöllő Hills (north-middle Hungary, right side of the Danube) and grasslands of the north-eastern Mezőföld (north middle Hungary, left side of the Danube).

What are the factors affecting the naturalness of semi-dry *Bromus erectus* and *Brachypodium pinnatum* grasslands of Hungary?

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Habitat loss and fragmentation of semi-dry grassland habitats are recognised as a serious threat to biodiversity throughout Europe. These grassland habitats are an integral part of the landscapes of Central Europe and are of major importance for maintaining biodiversity. Effective conservation of semi-dry grasslands requires an understanding of the factors affecting naturalness (i.e. the actual quality of a habitat or vegetation patch) and the importance of the particular factors. Both local, or intra-patch, and landscape, or matrix, variables affect habitat quality, and the proportions of the effects need to be identified. Therefore, we performed a hypothesis generating and testing analysis with generalised linear models for the semi-dry *Bromus erectus* and *Brachypodium pinnatum* grasslands with the use of the MÉTA database. Our results show that naturalness depends upon both intra-habitat and matrix attributes: presence or proportion of other habitat types in the surrounding landscape, threatening factors and landscape ecological attributes, though the effect of matrix attributes doubles that of intra-habitat ones. Higher numbers and proportions of (semi-)natural habitats in the landscape, as well as surrounding habitats, have significant effects: presence of other grassland types similar in ecological demands positively affects the naturalness, while presence of invasive alien species has negative effect. In the case of fragmented grasslands, matrix factors seem to be even more important than intra-patch or local factors.

Classification and habitat characteristics of plant communities invaded by the non-native *Rosa rugosa* Thunb. in NW Europe

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The Japanese Rose (*Rosa rugosa*), an invasive neophyte in Europe, builds up large dominant shrublands especially in coastal areas. To describe the vegetation invaded by *R. rugosa* 383 relevés with *R. rugosa* from NW Europe were collected from literature and from vegetation databases. Different plant communities were evaluated by TWINSPAN classification, and two main groups were distinguished: woodlands and shrublands, grasslands and heathlands. *R. rugosa* builds up dominant stands that are assigned to the corresponding higher syntaxon. The main variation in vegetation composition was studied with detrended correspondence analysis and related to Ellenberg indicator values. Furthermore, Ellenberg indicator values were used to compare the environmental conditions in different plant communities containing *R. rugosa*. Environmental conditions changed with the development and spread of *R. rugosa*. Effects of *R. rugosa* invasion on species richness of different life-form groups, native species and neophytes were analysed.

The study shows, that the expansion of *R. rugosa* changes the species composition of the invaded vegetation. Species richness, especially of herbaceous plants, decreased with increasing cover of *R. rugosa*. Furthermore, *R. rugosa* dominated plots had higher percentage number of neophytes and lower percentage number of native species than the corresponding not invaded plant communities. In comparison to its native range, *R. rugosa* establishes in various plant communities, at a wide range of environmental conditions. Therefore it appears that this shrub has a broader environmental niche in its new range. According to the presented environmental gradient, moderate conditions of nutrients, soil pH and water content, and both lighter and drier sites are preferred. Considering environmental requirements, open dry grasslands as well as heathlands, especially with bare patches, are probably very endangered by *R. rugosa* invasion.

Using vegetation databases to scale up results from ecosystem functioning experiments

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A vegetation database project is presented, which was launched at the beginning of this year. The project is part of the DFG Biodiversity Exploratory Programme (SP 1374), which aims at analysing the interrelationship of biodiversity of different taxa and ecosystem processes und different land use scenarios. All of the 32 projects participating in this programme will gather data on the same plots, and thus, will produce an unprecedented wealth of ecological information on 300 plots of different types of grassland and forest vegetation in three different landscapes (Schorfheide-Chorin, Hainich, Schwäbische Alb). The objective of our project is to assess the geographical distribution of the Exploratories' vegetation types in Germany and to describe temporal trends, to identify indicator species for species richness, to predict results of planned experiments on biodiversity manipulation such as enrichment seeding, to assess the probability of occurrence of so far lacking species, and to relate this probability to species traits and functional diversity of plots.

To achieve these goals we will (1) compile a database for the relevant vegetation types of the three Exploratories, (2) apply stratified resampling strategies to remove geographical bias (3) analyse these species co-occurrence data to reveal where and when particular species combinations occur or have occurred elsewhere (4) and predict the probability of potential occurrences for absent species in the Exploratory plots.

In this presentation we will show first results on the distribution of some of the Exploratories' land use types. Grassland types mainly belong to the alliances *Mesobromion, Arrhenatherion elatioris, Cynosurion cristati, Molinion caeruleae* and *Phramition australis* but also *Polygono-Trisetion*, *Calthion palustris* and *Magnocaricion elatae* are involved. Forest land use types belong to the alliances *Fagion sylvaticae*, *Luzulo-Fagion*, *Quercion pubescenti-petraeae*, *Carpinion betuli, Dicrano-Pinion* and other related types.

Species diversity of the Exploratory plots will be compared to diversity of the equivalent types in the nationwide dataset.

Survey of Slovak grassland vegetation

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This presentation is a short introduction of newly appeared publication Janišová et al. 2007: *Slovak grassland vegetation – electronic expert system for identification of syntaxa*. Institute of Botany, Bratislava, 200 pp. The book embodies the first national synthesis and review of grassland vegetation elaborated by a broad team of authors with a long phytosociological experience. The publication presents a formal classification of grassland communities of classes *Molinio-Arrhenatheretea, Festuco-Brometea* and *Nardetea strictae* (alliances *Nardo strictae-Agrostion tenuis* and *Violion caninae*). It is based on a critical revision of traditionally accepted classification system and it was performed on a geographically stratified dataset of 16 640 relevés stored in the Slovak Central Phytosociological Database. The revision confirmed the occurrence of 76 associations within 17 alliances. Two associations (*Carici albae-Brometum monocladi, Violo sudeticae-Agrostietum capillaris*) were newly described, one association was newly recorded (*Crepido paludosae-Juncetum acutiflori*) and the names of numerous associations were proposed for validization. All syntaxa were formally defined and characterized floristically (diagnostic, constant and dominant species), ecologically and chorologically (distribution maps of all associations are included). The attached DVD contains an electronic expert system for a prompt grassland identification in the JUICE program and the photographs of the defined associations.

Trends in Dutch roadside vegetation related to management measures

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In The Netherlands, the national network of highways measures approximately 3000 km. The adjacent areas such as roadside verges measure proximately 20,000 ha. About 5000 ha is planted with small woodlands and groups of trees, the rest are grasslands. The Ministry of Transport is responsible for the management. The mowing of the grasslands is out-contracted to commercial companies. In the roadside verges 1600 plots of 3 × 3 m size in various vegetation types were sampled with four-year interval. The results show a slight increase of species numbers and 'natural value'. These might be explained by the 'observer effect'. Rare and endangered species mainly occur in the eastern part of the country, indicating more favourable abiotic variables, mainly dry acidic sandy soils. Problems with the management include late, incomplete or even absence of removal of the grass cuttings. They cause an increase of ruderal species in the vegetation. About 50 plots were destroyed due to works in roads and roadsides.

Consideration on critical syntaxa of the xerothermic non-forest vegetation – a case study from the Czech Republic

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Some syntaxa of the xerothermic non-forest vegetation of the Czech Republic are classified as ‘critical ones’ due to their (1) unclear syntaxonomic value, (2) sporadic but probable occurrence, (3) unconfirmed occurrence despite repeated investigation, (4) absence of any or sufficient phytosociological data from various localities resulting in lack of information on variability of syntaxa, (5) insufficiently known distribution, (6) no basic data on synecological characteristics, and (7) no provable stability in time and/or unclear position in succession. These conditions are fulfilled for certain syntaxa of the classes *Koelerio-Corynephoretea, Festucetea vaginatae*, *Sedo-Scleranthetea, Festuco-Brometea,* and *Trifolio-Geranietea*. To a small extent, attention is paid to selected syntaxa of the classes *Asplenietea trichomanis* (incl. *Parietarietea*), *Nardo-Callunetea*, and associated units with succession transitions to the vegetation of classes *Pulsatillo-Pinetea* and *Molinio-Arrhenatheretea*.

The ruderal vegetation of the Dąbrowska Basin (Silesian Upland) Poland

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The ruderal vegetation of the Dąbrowska Basin (Silesian Upland), one of the most destroyed and polluted region in the southern Poland, was examined. The field research was carried out in the plant communities of the *Artemisietea, Stellarietea mediae, Polygono-Poetea, Bidentetea tripartiti* and *Molinio-Arrhenatheretea* classes. 120 phytosociological relevés which were made in the field were stored in the Profit 2.0 data base (Balcerkiewicz & Sławnikowski 1998). Then they were exported to the JUICE 6.5 program (Tichý 2007) in order to make some analyses.

The cluster analysis was performed in the MULVA 5.1 program (Wildi & Orlci 1996) taking into account both the presence/absence of species and the cover/abundance. Minimum variance clustering method and Euclidean distance were applied. On the basis of the distinguished clusters, the relevés were arranged in synoptic tables. A fidelity measure was applied in order to show concentration of species in the groups. 28 plant communities were recognized: 12 of the *Artemisietea* class, 6 of the *Stellarietea mediae* and 3 of the *Polygono-Poëtea*, 5 of the *Trifolio-Plantaginetalia* order and 2 of the *Bidentetea tripartiti* class. Phytocoenoses of the *Onopordion acanthii* alliance (*Dauco-Melilotenion* suballiance) such as *Echio-Melilotetum, Poo-Tussilaginetum, Artemisio-Tanacetetum, Dauco-Picridetum* and the *Arction lappae* alliance (*Arctietum lappae*) were the most differentiated and widespread in the investigated area. The relevés were ordinated to detect the main environmental gradients in the data set. The DCA analysis was made in the CANOCO package (Jongman et al. 1995). Because the properties of soils were not analyzed, Ellenberg indicator values were correlated with the scores of the 1st and 2nd DCA axes. Some significant correlations with moisture and nutrients content in the soil were found.

Climate as determinant of forest composition in the Czech Republic

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The objective of this study was to quantify influence of climate on forest composition in the Czech Republic. For this purpose, I used large data set extracted from the Czech National Phytosociological Database and high resolution climatic data (WorldClim Database). I explored relationships between forest composition and climatic factors with canonical correspondence analysis. While forward selection procedure was used for building the model, significance of the whole model was verified with independent data set. The role of spatial autocorrelation was assesed by variation partitioning procedure, which was also used for quantifying the relative importance of particular climatic variables. Annual mean temperature, isothermality, annual mean precipitation, precipitation seasonality and annual water deficit were determined as significant factors in forward selection procedure. Importance of these variables was confirmed by Monte Carlo permutation test of the whole model with independent data set. The whole climatic model accounted for 4.9% of total variation in overstory and for 3.4% of variation in herb layer composition. Inclusion of spatial covariables into model resulted in minor decrease of explained variation but overall significance remained high. Mean annual temperature was determined as the most important climatic variable. Precipitation seasonality explained slightly higher part of variation than mean annual precipitation. Annual water deficit accounted for the lowest part of explained variation.

The most important climatic gradient in Czech forest vegetation is associated with mean annual temperature. This variable closely (at least in the Czech Republic) correlates with available energy and also with extreme temperatures, i.e. variables which determine competition ability and range limits of particular species. Therefore, it is very probable that any future changes in mean annual temperature will cause substantial changes in vegetation composition of Czech forests. My work also highlighted great potential of large vegetation databases for studies searching for links between climate and vegetation composition at, so far very rarely studied, national scales.

Ecological differentiation of the steppe meadow ecosystems in the plain part of the Ukraine

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The problem of ecological meaning of the syntaxa of floristic classification of vegetation is the discussion issue in Ukrainian phytosociology. We make an attempt to recognize the main factors which determine the differentiation of the *Galietalia veri* order of steppe meadow. Phytocoenotic data were elaborated with FICEN software. Ecological characterization was made on the basis of relevé legends. In the plain part of the Ukraine phytocoenoses of this order occur mainly in the river floodplains in forest-steppe zone. In the zone of deciduous forest steppe meadows have restricted distribution, because of climate humidity. In the steppe zone such communities are practically absent as far as the floodplains have been converted into arable land and their distribution is limited due to the rise of soils salinity. The *Galietalia veri* contains two alliances – *Agrostion vinealis* and *Potentillo argenteae-Poion angustifoliae*. The main factor of their differentiation is the structure of soils. The communities of the first alliance are formed on light sandy substrata, and those of the second alliance on heavier substrata. Each alliance is represented by three associations. In the border of *Agrostion vinealis* the decisive factor of ecological differentiation is the degree of substrate development. The *Festuco valesiacae-Agrostietum vinealis* community is formed on more developed soils, compacted under influence of pasture, *Koelerio-Agrostietum vinealis* community is found on the soils of medium development and *Agrostio vinealis-Calamagrostietum epigeioris* community is typical of younger, underdeveloped soils. At the border of the *Potentillo argenteae-Poion angustifoliae* alliance the main factor of differentiation is the relative height of microrelief elements, on which the communities are formed, and accordingly the depth of soil water *Festuco valesiacae-Poetum angustifoliae* occurs on the highest elements, *Poetum angustifoliae* on the middle and *Bromopsietum inermis* on the lowest elements. On the level of syntaxa, lower of association, ecological differentiation is determined by a variety of ecologic factors (stability of hydrological regime in the floodplain, structure and richness of substrata, the place in succession seres etc.), but on subassociation level, especially the regional peculiarity is revealed, and on variant level – the anthropogenic disturbance degree. Thus, the syntaxa of steppe meadow of *Galietalia veri* order have enough sharply defined ecological meaning and on each level of classification it is fully possible to determine the factor which is decisive for their differentiation. However, this approach has some subjectivity and direct dependence on initial data. Therefore, application of more objective methods of ecological analysis (phytoindication, ecological scales etc.) will allow obtaining more exact results.

Plant communities of grey dunes as ecological indicators in Latvia

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Plant communities of grey dunes can be used as ecological indicators to assess changes in the condition of the coastal environment. Vegetation composition, structure and function of these dunes is sensitive to natural and anthropogenic stresses, responds to stress in a predictable manner, predicts changes that can be averted by management actions and is easy to evaluate. Characteristics of the indicators within the habitat type can be various for the different coasts. The grey dunes of Latvia, due to the dominance of the advancing depositional coasts, and the character of present-day coastal geological processes and the former land use are among the most diverse dune systems in the Boreal biogeographical region of Europe. To improve monitoring methods, management and protection of grey dunes, data on habitat mapping (2000, 2004, 2007), vegetation (1996–2007) and coastal processes (1993–2007) for several key locations on the Baltic Sea coast of Latvia were analysed. The results show, that ecological indicators must be specific for the particular site. Our case studies were carried out in the grey dune area (40 ha) of Pāvilosta, the west coast of Latvia, in different periods from 2002 to 2007. This habitat was characterized by a large number of species (53 vascular plant species, 17 moss species, 44 lichen species) and the highly patchy vegetation cover (*Violo-Corynephoretum, Festuco-Thymetum, Festucetum polesicae* var. *Dianthus arenarius*, as well as *Carex arenaria* plant community, *Calluna vulgaris* plant community, *Calamagrostis epigeios* and *Leymus arenarius* plant communities). Our findings suggest that the spectrum of plant communities is one of the most important ecological indicators for assessment of changes in this type of dune ecosystem and for their effective management. It is necessary to show the plant cover mosaic on habitat maps on a micro-level, because even small patches of different vegetation and their surface area can indicate the first changes taking place in the dune system. Due to relatively high resilience of the semi-fixed dunes, changes in the vegetation cover occur gradually. The vegetation structure can be one of the easiest indicators to identify for local people (non-scientists) involved in dune monitoring and management.

Effect of water level control on plant species diversity of a shallow lake

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The aim of the study was to evaluate the effect of lowering water level on plant species composition in the Niepruszewskie Lake (western Poland). It is a shallow, freshwater lake with average depths of 3.05 m, regulated at the outlet by a weir. The water level was artificially increased from 1974 to 2002. In 2002 water level was reduced by 0.35 m during winter time and by 0.55 m in summer time. This situation has an impact on the nutrient cycle and species composition, particularly in the littoral zone. The vegetation survey was carried out during the vegetation seasons in 1999–2000 and 2006 according to phytosociological approach; 239 and 185 relevés were recorded, respectively. For the classification of the data, the TWINSPAN (Two-way Indicator Species Analysis) method was used with five cut levels.

The TWINSPAN hierarchical classification for macrophytes has given number of divisions although the dominance of five phytosociological associations was recognised: *Caricetum acutiformis, Caricetum ripariae, Glycerietum maximae, Phragmitetum australis* and *Typhetum angustifoliae*. In 2006, dominance of six associations and one alliance was found: *Phragmitetum australis, Typhetum angustifoliae, Caricetum acutiformis, Alopecuretum pratensis, Salicetum pentandro-cinereae, Potamo-Najadetum marinae* and *Convulvulion sepium*.

There was a significant difference for macrophyte diversity, base on Shannon-Weiner index, among both studied periods and within dominating communities ($F=4.69$, $p<0.05$; $F=11.64$, $p<0.001$; respectively). Community with *Glyceria maxima* and *Carex riparia* were successively replaced by *Phragmites australis* and *Calystegia sepium*. Pairwise comparisons in 2006 showed an increase of species number in the zone adjacent to shoreline. It was a result of succession of terrestrial species such as *Deschampsia caespitosa* and *Cirsium arvense*. Strong development of *Calystegia sepium* in *Phragmitetum australis* patches (dominating in the littoral) was also observed during the recent period. The undertaken research proved that lowering the water level of the lake stimulates species richness, however, it is result of terrestrial species development, indicating degradation of the lake body.

How do accidental species influence multivariate analysis?

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Phytosociological data from old data sources often suffer from several weaknesses which may doubt their usefulness. Due to technical and conceptual reasons, absence of the rare species in phytosociological tables is a typical shortcoming of data published a few decades ago. In this study we examined whether relevés from tables not containing accidental species can be used for large-scale vegetation analysis by multivariate statistical tools. We consider a species accidental if it has a relative frequency not higher than 0.2 in a phytosociological table.

A dataset of 561 forest relevés from the Hungarian CoenoDat phytosociological database was analysed after different modifications, and results were compared statistically. Four matrices were created from the basic dataset, each containing the same 561 relevés. The first matrix, called CONTROL, consisted of complete relevés without any modifications. In three TEST matrices relevés were grouped by tables and occurrences of accidental species were deleted from each table. TEST matrices differed in how tables were organized: by expert judgment (TEST1), random arrangement (TEST2) or clustering methods (TEST3). Jaccard index was applied as similarity measure. Distance matrices, PCoA ordinations and classifications by the Ward's method based on the significant ordination axes were generated. Correlations of distance matrices were estimated by Mantel test. Comparison of ordinations was performed by Spearman's rank correlation of the first four axes. This decision was based on the assumption that two axes reflect to the same ecological gradient if relevés have their positions in the same sequence. Similarities between pairs of classifications were measured by Goodman-Kruskal's predictability for different hierarchical levels. Statistical significances of Mantel tests and predictabilities were estimated by permutation tests.

Mantel tests and rank correlations showed very high similarity among CONTROL, TEST1 and TEST3 matrices. In both cases, difference between matrix TEST1 and TEST3 was the lowest, while these ones most differed from matrix TEST2. However, even the lowest correlation values in both types of test were strongly significant ($p<0.001$). The case was more complicated if classifications were compared at different hierarchical levels. Predictabilities of TEST ones concerning CONTROL classifications were measured asymmetrically. At small group numbers TEST1 and TEST3 presented high similarity, while TEST2 presented much less successful prediction to CONTROL classification. The lower the hierarchical level under examination, the lower the differences among efficiencies of predictions. However, even the lowest of the estimated predictabilities were highly significant ($p<0.001$).

We conclude that absence of accidental species does not result in significantly different outcomes of the examined multivariate tools.

Species richness pattern along the elevation gradient: is the mid-domain effect the only reason?

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Empirical studies often show a hump-shaped pattern of species richness along the elevation gradient. No matter the studies were made by vegetation scientists, ornithologists, mammalogists or others, the highest species richness was usually observed at mid-elevations, and this pattern consistently occurred in different areas. There are various ecological explanations of this pattern, which depend on specific properties of the studied ecosystems. Examples include the land-area assumption, habitat heterogeneity hypothesis, climate (or energy) hypothesis and evolutionary history. However, this pattern can simply results from non-biological processes, which have been summarized as the mid-domain effect.

The mid-domain effect is a null model. It is caused by stochastic processes operating within geometrically constraining boundaries (Colwell et al. 2004). In mountainous islands such as Taiwan, the sea level and the highest mountain peaks are obvious constraining boundaries along the elevation gradient. All hump-shaped patterns of species richness along the elevation gradient can be, to some extent, explained by the mid-domain effect. The main question of this study is whether there is also some ecological meaning for the hump-shaped pattern in addition to what can be explained by stochastic non-biological processes.

We used multivariate regression analysis to detect relationships between species richness and factors which might influence it. Species richness, used as dependent variable in this model, is defined as a pool of species occurring within particular elevation interval. Five explanatory variables were used: the ‘null model with the hard boundary concept vs. elevation’ calculated from the Taiwanese vegetation database, ‘area vs. elevation relationship’, ‘temperature vs. elevation relationship’, ‘topographic heterogeneity vs. elevation relationship’ and the ‘sampling effort vs. elevation relationship’.

Grazing effects on plant and mollusc diversity in woodland and grassland habitats in north Clare and south Galway, Ireland

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Grazing animals are known to have significant impacts on biodiversity. It is often unclear however, whether these impacts are positive or negative, and whether this applies to single species or communities, or indeed to whole habitats. For example, fenced exclosures have been used in Killarney in southern Ireland to confirm that oakwood biodiversity may be threatened by either high grazing levels or the absence of grazing. It is also difficult to make general statements based on isolated studies and findings due to the amount of variability possible in such studies – not least in relation to number and species of grazer. It is agreed, however, that there is a lack of experimental data in general on the effects of grazing on Irish woodlands/scrub on base-rich soils, and on species-rich grassland. The Burren, and adjacent limestone areas in north Clare and south Galway, are famous as some of the most botanically interesting and biodiverse areas in Ireland. Although the Burren covers only 1% of the surface area of Ireland, it contains more than 75% of its plant species. And it is in the Burren that many of Ireland’s rarest and most fascinating mixtures of plants can be found. In relation to the bryophyte flora, hazel scrub and woodland are known to support characteristic bryophyte communities, including a number of rare and local species. With regard to the molluscan fauna, about 70 of the 100 Irish land snail species occur within the study region.

This project aims to investigate experimentally the impact of grazing on biodiversity in woodland, grassland and scrub in the Burren and adjacent areas. This will be done through a network of permanent plots and fenced exclosures. These exclosures have been erected at 12 sites and the study will monitor responses among the communities of vascular plants and molluscs.

Native and alien weed species richness and diversity under different regime of disturbances

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Understanding of processes which promote species richness and diversity of weed vegetation has been a major focus of interest in weed ecology. Changes in weed species richness and beta diversity are partly attributable to different regime and intensity of disturbances and partly to broad-scale variation in environmental conditions. We compiled a data set of 434 vegetation plots of weed vegetation in root-crop and cereal fields from Moravia (eastern Czech Republic) to compare effects of different disturbance regimes on species richness and beta-diversity between these two arable field habitats. To detect changes in species richness we related the variation in species richness to different environmental characteristics. To assess differences in beta diversity between vegetation of cereal and root-crop fields we used Whittaker's measure of beta diversity. All analyses were done for all vascular plant species and separately for native species, archaeophytes, and neophytes.

Comparison of weed vegetation of root crops and cereals shows a distinct dichotomy between these two types of weed vegetation. There is no significant difference in total species richness and native species richness; however, cereal fields are richer in archaeophytes and root-crop fields are richer in neophytes. Beta-diversity of weed vegetation is higher in root-crop fields. Environmental factors explain significant part of variability in richness of both natives and aliens. While with increasing precipitation richness of native species increases, beta-diversity of these species decreases. The opposite relationship between richness and beta diversity was found for archaeophytes, in both cereal and root-crop fields.

Halophytic communities of the steppe zone in the Volga region (Russia)

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The investigated area is located in the south-east of the European part of the Russian Federation. It includes Samara, Orenburg, Saratov, Volgograd and Astrakhan regions. The territory lies in the steppe zone and has a continental climate which is characterized by hot, dry summers and cold winters with little snow. The halophytic communities are associated with solonchaks, solonetzes and the salinized soils and they can be found mainly on the left bank of the Volga. They are primary and secondary and can be found on river terraces and in deltas, depressions, and in the places where the salinized bedrock lies close to the surface. The plants of the families *Asteraceae, Poaceae* and *Chenopodiaceae* are dominant in the communities. The prevailing life form is hemicryptophyte, but the role of chamaephytes and therophytes is increasing. The halophytic communities of the steppe zone belong to the classes *Thero-Salicornietea, Festuco-Puccinellietea* and *Salicornietea fruticosae*.

Species richness analysis at landscape level based on species pool concept

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One of the main goals in ecology is to explain patterns of species diversity. Over the past decade a lot of attention has been paid to the species pool concept. This states that the actual species composition at a site is largely determined by the size and composition of a larger species pool.

We used three theoretical approaches (environmental, functional and phytosociological similarity) to detecting size and composition of species pool proposed by Zobel to the area of the Raifa section of Volzhsko-Kamsky State Nature Biosphere Reserve. The area of investigation is considerably heterogeneous.

Environmental similarity was determined through the recognition of habitat type similar to a plant community. Characterization of habitat conditions was provided by foundation plot position in its habitat space through calibration with using Ellenberg indicator values for following analysis in the PC-ORD 4.

Following the statement that functionally similar species are supposed to share a higher probability to co-occur in certain plant communities, functional similarity was detected using species DCA ordination with visualization by ecological-coenotic groups and Grime's CSR-species classification.

Species pool is related to a target community by the community pool. We determined the community species pool through a vegetation type with a characteristic species combination and structure that are spatially delimited. Target communities were defined using the Braun-Blanquet phytosociological system.

Prodromus of forest syntaxa includes two classes, three orders, five alliances and nine associations. Cartographical layers of spatial differentiation of syntaxa were created for classes and associations. Total Raifa's species pool of vascular plants of the study area includes 702 species. The size of the community species pool varies from 9 to 103, with a mean of 32 species.

Gradient analysis of Raifa's vegetation reveals main ecological factors that define species composition of a regional species pool, its general structure and vegetation variability for the Raifa area. Phytodiversity correlation with environmental conditions shows that the most significant climatic factor is light intensity. Among soil factors nutrient supply, pH, moisture and salinity play an important role. These environmental factors are abiotic filters restricting species dispersal at regional level and define the pool size of available species, i.e. the size of regional species pool. Mutual orientation of species to the clusters points to continuality of plant cover.

Thus, both ordination methods and phytosociological data analysis permit to detect not only main abiotic factors influencing species pool at different organization levels, but also let to draw habitat types and enable to predict biodiversity degree and to build maps of potential floras.

The biodiversity of the Shannon Callows (flood meadows) in Ireland with reference to land management practices and hydrology

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The River Shannon is the longest river in Ireland and Britain and the Shannon Callows are the most extensive flood meadows in Ireland (the word ‘callow’ comes from the Irish ‘caladh’ which means river meadow), with an estimated 5,000 continuous hectares occurring in the middle stretch between Athlone and Portumna. The Shannon Callows are designated SAC and SPA and two of its habitats, the *Molinia* meadows and lowland hay meadows, are listed in Annex 1 of the EU Habitats Directive. While much work has been undertaken on callow avifauna and vegetation, little information exists concerning the effects of current farming practices on plant and associated invertebrate communities. This study focuses on the effects of different farming practices on plant and Dipteran communities. Fourteen study sites were selected to include examples of traditional and improved hay meadows and so far over 90 plant species have been recorded from 78 relevés. Digital surface models have also been produced (in ArcMap) for each site to determine the influence of elevation and hence flooding patterns on the callow ecosystem. Dipteran communities will be investigated during 2008, with particular reference to marsh flies (*Diptera*: *Sciomyzidae*) – known sensitive indicators of environmental change – and hoverflies (*Diptera: Syrphidae*) which are particularly sensitive to flowering plant species diversity. In addition, *Sciomyzidae* respond to vegetation structure and therefore it is thought that both hay meadow management and hydrology will influence their distribution and diversity. Furthermore, as hay meadow management and hydrology affect plant species diversity it is planned to examine how the distribution and diversity of *Syrphidae* respond to this. The results of this study will inform callow management, with a view to protecting the biodiversity of the callows, while allowing for their sustainable use as a natural farming resource.

Invasive alien and expansive native plant species in agrocoenoses of Slovakia

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We have studied the actual distribution of invasive alien and expansive autochthonous vascular plant species in the plant communities growing on fields in Slovakia. The arable fields (root-crops, cereals and stubbles) and 1–2 years abandoned fields were evaluated. The study was based on phytosociological material consisting of 379 relevés obtained in 2002–2007 from various parts of the Slovak Republic. In the group of 338 taxa that were not intentionally grown by man, recorded in the segetal communities, 54 species belong to invasive alien and expansive species, representing 16% of the analysed material. 20 species are invasive plants (9 neophytes and 11 archaeophytes), 10 are potentially invasive species, 4 are frequently escaping from cultivation, 5 are occasionally escaping from cultivation, 5 species are naturalized, 2 are data deficient and 8 are expansive autochthonous species.

The most frequent species in the studied biotopes were: *Tripleurospermum perforatum* (invasive archaeophyte), *Cirsium arvense* (expansive species), *Veronica persica* (naturalized species) and *Apera spica-venti* (invasive archaeophyte).

Phytosociological study for a floristic-ecological comparison among vegetation types in the *Quercus ilex* belt of Mt. Etna (Southern Italy)

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Since some years we are carrying out phytosociological studies on the *Quercus ilex* belt of Mt. Etna. This belt is located on the volcano between 300–400 m and 1000–1200 m a.s.l. In some sites it can reach 1400 m. The vegetation of this belt, since long time, is largely disturbed by human intervention.

The aim of this study is to use phytosociological relevés for a comparison among some vegetation types of such belt. The study areas have been selected in different vegetation structural types: thick and open forests and gaps between forests. On the selected areas more than 100 phytosociological relevés were carried out following the Braun-Blanquet method (Braun-Blanquet 1964). The data were processed by multivariate analysis.

The data collected allowed to distinguish some plant communities. They change according to the structural type, altitudinal gradient, side exposure and human intervention. The forest types belong to *Quercetea ilicis* and *Querco-Fagetea* classes. Moreover they contain some species of the *Rhamno-Prunetea* class. On sites where disturbance is high the forests contain some species of herbaceous vegetation of the neighbouring areas. In the gaps there is herbaceous vegetation characterized by communities belonging to the *Lygeo-Stipetea* and *Helianthemetea guttati* classes or to the *Stellarietea mediae* class. Different plant communities belonging either to forest types or to herbaceous vegetation types had been compared based on their floristic composition and particularly on the phytosociological species groups. This comparation allowed to point out ecological significance of different communities in relation to community structure, altitudinal level, slope exposure and human intervention.

Research regarding the alien plant species in the surrouding of Satu Mare town (Satu Mare county, North-West Romania)

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Alien species invasions are widely recognized as a serious threat to environments and economies throughout the world. In this paper, a list of alien plant species recorded from Satu Mare town and surroundings (Satu Mare county) in the last five years is presented. These species are disscused regarding their impact on the ecosystems, immigration modes, invasive status, geographical origins, dispersal mechanism, their distribution, principal infestation sites etc. The most dangerous alien species for semi-natural habitats in the investigated territory were identified.

The installation of primary vegetation on tailings ponds from non-ferrous ore mining area in the North Carpathians

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The paper presents the diversity of cormophyte species and mushrooms from non-ferrous ore Bozanta tailing ponds, resulting from the mining activities, under 20th year preservation. Investigations realized in 2007 identified above 52 vascular plant species. The cormophyte flora was analyzed from the perspectives of bioforms, floristic elements, caryology and species ecological requirements. Aspects related to soil characteristics (structure, particle size, porosity, texture, minerals composition, etc.) are presented. Chemical reactions that occur due to chemical composition of pond's dam and their pollutant impact on environment are also presented. Results of pond's biological rehabilitation are discussed.

The reflection of the ecotone effect by the high-rank syntaxa of the South Urals forest vegetation classification

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The ecotone effect at regional scale determines the diversity of the South Ural (SU) natural forests, which are represented by three classes: *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937, *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl., Siss. et Vlieger 1939 and *Brachypodio pinnati-Betuletea pendulae* Ermakov et al. 1991. The ecotone effect of the SU forest vegetation is caused partly by the altitudinal zonality (vegetation belts from steppe to mountain tundra), and also by the position of the region in the contact of steppe and forest climatic zones, and on the borders between Europe and Asia. Influence of these factors is strengthened by the Pleistocene and Holocene history of this vegetation. The ecotone effect of the SU forest vegetation is reflected by the number of high-rank syntaxa.

1. The ecotone between nemoral forests (*Querco-Fagetea*) and boreal forests (*Vaccinio-Piceetea*) is represented by the alliance *Aconito septentrionalis-Piceion obovatae* Solomeshch et al. 1993 of the order *Abietetalia sibiricae* Ermakov 2006.
2. The ecotone between nemoral forests (*Querco-Fagetea*) and Siberian herb hemiboreal forests (*Brachypodio-Betuletea*) is represented by the alliances *Veronico teucrii-Pinion sylvestris* Ermakov 2000 and *Trollio europaeae-Pinion sylvestris* Fedorov ex Ermakov et al. 2000 of the order *Chamaecytiso ruthenici-Pinetalia sylvestris* Solomeshch et Ermakov in Ermakov et al. 2000.
3. The ecotone between classes *Querco-Fagetea*, *Vaccinio-Piceetea* and *Brachypodio-Betuletea* is represented by the suballiance *Tilio cordatae-Pinenion sylvestris* suball. nov. prov. of the alliance *Querco roboris-Tilion cordatae* Solomeshch et Laivinš ex Bulokhov et Solomeshch 2003 of the order *Fagetalia sylvaticae* Pawłowski et al. 1928.

Most of the alliances of the studied vegetation have a nature of an ecotone; as a result syntaxonomical decisions for this vegetation are particularly complicated. Low species richness is found in the communities not influenced by the ecotone effect having a simple phytosociological spectrum. For example, species from the class *Vaccinio-Piceetea* prevail in the suballiance *Eu-Picenion* Kielland-Lund 1981, and species from class *Querco-Fagetea* prevail in the alliance *Aconito septentrionalis-Tilion cordatae* Solomeshch et al. 1993. Communities from other alliances are influenced by the ecotone effect and their richness is higher.

The increase of species richness is determined in many respects by the presence of species with low constancy which are on the limits of their ecological range and are vulnerable to human-induced environment change (increasing temperature, pollution etc.). For these reasons, series of sample plots representing main associations of the SU forest vegetation are needed for monitoring.

This investigation is supported by the Russian Fund of Fundamental Science (grant 07-04-00030-a).

Vegetation change in UK Priority habitats

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The Countryside Survey of Great Britain has been collecting vegetation data since 1978. A number of 1km squares have been sampled at intervals of approximately eight years, all habitats within the square have been mapped and a series of vegetation plots sampled. This is an extremely useful resource for studying changes in vegetation. The UK Biological Action Plan identifies Priority habitats e.g. blanket bog, lowland and upland dwarf shrub heath that we need to monitor for changes in extent and condition and this talk will use spatial and vegetation plot data to identify changes in plant community composition and link them to common drivers of change.

Hedgerow and woodland plant diversity in North County Dublin, Ireland

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The landscape of Ireland is largely characterised by small fields which are surrounded on all sides by hedgerows, giving rise to the country's characteristic checkered pattern when viewed from the air, as well as creating the misleading impression of being well wooded. Ireland, in fact, is one of the least forested countries in the EU, with approximately 10% of the land surface supporting woodland, of which less than 1% is native broad-leaved woodland. Hedgerows, on the other hand, have been estimated to cover an area roughly three times that of deciduous woodland on an island-wide basis (Webb 1985). In regions where little broad-leaved forest remains, such as in County Dublin, an area of rapidly expanding population, hedgerows may be critically important as surrogate habitat for native woodland plant species. But just how effective are they as a replacement for native woodland cover? They have long been though of as 'linear strips of woodland' but hedgerows are in fact, artificial structures in which plant species groupings tend to be as much a product of local history, management and land use patterns as they are of edaphic and biogeographical factors. However, hedgerows are important habitats in their own right, and merit greater recognition as such, as well as protective legal measures to safeguard their contribution to biodiversity in agricultural regions.

What are the main drivers of species richness in European steppes?

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Productivity and soil pH are commonly recognised as influential determinants of grassland vegetation diversity. Various grassland types have been studied across Europe to test whether they differ in their productivity-pH-species richness relationship. Much of this inconsistence can be explained by variable sizes of species pools linked with geographically and ecologically distinct grasslands. Also, differences in studied productivity and pH ranges or confounding effects of other intercorrelated factors may explain dissimilarities between reported trends.

So far, little has been known about factors influencing local richness of vascular plants in steppes of subcontinental and continental areas of Europe. Here, we try to get an insight into the relationship between their productivity, soil depth (surrogate for water availability) and pH. We sampled steppe vegetation in two regions: the Southern Ural Mts, situated within the Euro-Siberian steppe zone, and the Czech Republic, situated at the margin of the forest-steppe zone. By simultaneously studying these contrasting regions we hoped to recognize general patterns occurring in European steppes.

Steppe vegetation types varying in soil depth, pH and productivity were sampled in both data sets. Total vascular plant species richness and its components (graminoid and forb richness) were determined for 100 m^2 plots.

Species richness increased with productivity and soil depth in both regions. In the Uralian steppes soil depth was a markedly better predictor of species richness than their productivity, while in the Czech steppes the effect of both predictors was comparable. Increase in species richness along the pH gradient was a dominant trend common for both regions. However, in Uralian steppes, there was a peak at pH 6.8 followed by a decrease towards highest-pH soils. In Czech steppes, such indication of unimodality appeared only when soil depth was included in the model at the same time. To conclude, in European steppes the highest species richness occurs on deep, productive soils with pH of 6–7.5.

Trends in Latvian bryophyte and epiphytic lichen diversity in Moricsala nature reserve

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Moricsala nature reserve is the first specially protected nature area in Latvia and second oldest in the Baltic States. This reserve is an island in west Latvian Usmas lake. Specific microclimatic conditions and relatively undisturbed nature ensure wide biological diversity on the island. Broad-leaved forests are distributed on the island, representing nemoral plant species communities.Vascular plants have been studied for a while, however cryptogams have not been studied enough in Latvia. Bryophyte and epiphytic lichen flora have been investigated. Additionally, factors influencing species occurrence on the Moricsala were analysed and discussed.

Numerical classification of Central European steppes

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The steppes of Central Europe represent the westernmost variants of the steppes in Russia and the Ukraine, which is the core area of distribution of the class *Festuco-Brometea*. Central European steppes have been developing under similar ecological conditions since the Pleistocene, and recently they face similar successional trends. In the individual Central European countries, steppe vegetation has been studied separately in the past. This study attempts to interpret the topic comprehensively and illuminate some peculiarities of the Central European vegetation classification.

A numerical analysis was performed using a geographically stratified data set comprising 2 600 published and unpublished phytosociological relevés. The survey concerned dry grassland vegetation of the alliances *Festucion valesiacae* (narrow-leaved continental steppes) and *Bromo pannonici-Festucion pallentis* (dry grasslands of limestone and dolomite outcrops). The study area included the Western Carpathian Mountains and neighbouring Pannonian region (Slovakia, northern Hungary, southern Moravia in the Czech Republic and north-eastern Austria). The analyses were performed using the JUICE, PC-ORD and CANOCO software. Preliminary results of classification are presented, including floristical and ecological characterization of the distinguished associations. Some problems in nomenclature of vegetation units are solved.

Endangerment and its quantification for the Hungarian (semi-)natural habitats

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Endangerment of natural vegetation increases with global change. During the actual vegetation survey of Hungary (MÉTA program) we documented the local threatening factors in each mapping unit, for each occurring vegetation type: effect of grazing, mowing, drainage, afforestation, invasion, shrub encroachment, forestry, ploughing, construction, pollution etc. (27 types altogether), but we have also documented indirect theratening factors (fragmentation, patch size, regeneration potential etc.).

Based on our data 12 indicators were developed to assess semi-quantitatively the overall endangerment of the Hungarian (semi-)natural habitats. Our results show that the most endangered habitats in Hungary are the forest steppe oak woodlands, the tussock-sedge beds, closed lowland woodlands, some of the extansively used man-made habitats (old orchards, wooded pastures), tall herb vegetation, loess cliff vegetation, fen meadows (rich fens and also *Molinia* meadows), mountain meadows, fen woodlands and *Brachypodium* grasslands. The least endangered habitats are: stone habitats (grasslands and woodlands), some alkali and marsh habitats, secondary scrub and zonal beech woodlands.

Classification of vegetation: ten years down the line

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In 1997 I have published a reasonably well-cited paper entitled ‘Classification of vegetation: past, present and future’ (Mucina 1997, *Journal of Vegetation Science* 8: 751–760) in which I have analyzed the status of the topic and analyzed the development of the approaches to the classification of vegetation using bibliometric tools and screening several major journals in the field. I have recognised several major trends, summarized under the headings such as formalism, pluralism, functionalism, pragmatism, and indeterminism, and I have dared suggesting some predictions of the further development. Here I shall revise all these ‘-isms’ by re-analysing the same sources, using the same methods and focusing on the period spanning 1997 and 2007. I want to test if my predictions came true or if the methodology of the classification of vegetation made unpredicted turns and found new avenues.

Using phytosociological relevés for characterizing wetland flora along an altitudinal gradient of dry slopes of Alborz Mts., N Iran

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The Alborz Mts., the second largest range in Iran, is, on its southern slopes, mainly covered by steppe vegetation. These dry slopes also include ‘green islands’ of wetland with wide range of vegetation. The wetland habitats are sharply embedded within vegetation of the Irano-Turanian steppes that are more characteristic of this region and are of interest both in themselves and for wider comparison with Euro-Siberian wetlands. 542 phytosociological relevés collected across 45 of these little-studied wetland sites were utilized. The floristic and environmental characteristics of these habitats have been assessed along an altitudinal gradient using TWINSPAN classification, one-way ANOVA, Pearson r and DCA/CCA analyses. Multivariate analysis of collected relevés resulted in the subdivision of the wetland vegetation of the Alborz Mts. into two large groups, referable to aquatic and telmatic wetlands. The latter were further sub-divided broadly into wet meadow, mire and spring vegetation. Predictably, and consistent with the phytosociological classification of Klein (2001), there were parallel changes in vegetation both within wetlands and the surrounding steppes and in DCA/CCA analyses altitude appeared to be the primary determinant of floristic composition. Upper mountain wetlands are particularly species-rich and contain many endemics and other species of a narrow phytogeographical distribution and consistent with the work of Raunkiaer (1934), hemicryptophytes are mainly restricted to upper mountain areas. Despite the high presence of many pluriregional plants across all the telmatic wetlands studied in Alborz, very many species of the Irano-Turanian and adjacent areas are also found.

Markov chain model describing the dynamics of the boreal forest vegetation under the influence of forest fires

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The field survey of the vegetation and soils and the vegetation mapping were carried out in Lapland (L) and Verhne-Tazovskiy (VT) nature reserves and Leningrad region (LR). L is situated at the Kola Peninsula, VT in the Western Siberia. The time and the intensity of forest fires for the territories of L and VT were restored. It was found out that the most part of pine and birch forests in L and VT were damaged by fires or appeared on the burnt areas. The frequency of fires for all the forest types and for the whole areas of the reserves was established. It appeared to be higher in VT due to its continental type of climate. Geobotanical and soil descriptions of sites with the various landscape position and with various remoteness and the intensity of fires allowed to establish and characterize the stages of the post-fire dynamics of vegetation and soils in the different land types. Each stage had a certain specific floristic composition. In this connection the presence of various stages of the post-fire dynamics in plant cover was concerned to be the important element of the biodiversity maintenance.

The the character of vegetation change after the fires essentially depended on the granulometric composition of soils, climate and the surrounding vegetation. Therefore the plant communities with similar floristic structure and physiognomy on sand and loams were attributed to the different forest types.

It was established that forest fires were the main factor of the maintenance of forests with the prevalence of lichens and pine. The simultaneous existence of lichen-rich and moss-rich forests on the well-drained sands was caused by the variation of intensity of fires and their frequencies. So the fire induced divergence of plant communities. The pulse stability of pine lichen-rich forests is caused by the periodically repeating fires.

The Markov chain model describing the dynamics of the boreal forest vegetation under the influence of forest fires depending on climate parameters was compiled. On the basis of simulation with different fire frequencies it was established that the greatest variety of vegetation of all layers was expected at a moderate frequency of fires similar to the fire frequency in VT. The lowest diversity was expected at full elimination of fires. The substantial growth of fire frequency also resulted in the decrease of biological diversity of vegetation. The total elimination of fires in northern taiga did not result even in 1000 years in full disappearance of the derivative pine and birch forests and the forests with lichen cover. That was caused by the low rates of succession in the conditions of poor sandy soils and a cold climate.

The project was supported by Interreg-TACIS program ‘Northern Boreal Forests’ and by the Program of Russian Ministry of Science and Education RNP.2.2.3.2.8296.

The forest vegetation of the Kuronian Spit (Kaliningrad Region, Russia): the history, diversity and dynamics

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The Kuronian Spit is located at the north-west of the Kaliningrad Region, separating the Kuronian Gulf from the Baltic Sea. It is 98 km long and from 400 m to 4.2 km wide. It was formed 5–6 thousand years ago. The territory of the region is situated at the border of the hemiboreal and the nemoral zones. The climate is temperate with mild winter and warm summer. Four types of landscapes are distinguished at the Spit: marine beach, deflation-accumulative plain; zone with the degraded sand dunes; high dune ridge; coast of the gulf. The forest vegetation was formed 4300–4500 years ago. According to palaeobotanical data the virgin forests at the Spit were formed by pine, oak, lime, ash, elm, spruce, birch and black alder. The forest cover was undisturbed until XV century. In XV–XVIII centuries the forest exploitation increased significantly. Forest fires and clear-cutting led to destruction of the natural forest cover. As the result, moving sand dunes formed. They produced a great amount of blown sand, which buried the forests. In the end of XVIII century the forest cover of the Spit was destroyed completely. In XIX–XX centuries the fastening of dunes was carried out and reforestation began. The modern forest vegetation of the Kuronian Spit is represented by natural and semi-natural Scotch-pine forests at the dunes and sandy soils, birch forests at the plains and black alder forests at the lowlands. At the moraine outlets the fragments of broad-leaved forests dominated by lime (*Tilia cordata*) and ash (*Fraxinus excelsior*) remained. At the loam-sandy soils the spruce forests (*Picea excelsa*) are found. Forest cultures of *Pinus sylvestris, P. mughus, P. montana, P. nigra, P. banksiana* and *Picea pungens* are widespread at the dunes. The forest succession on sandy soils was characterized. The prodromus of the forest vegetation of the Kuronian Spit was compiled: I. *Vaccinio-Piceetea* Br.-Bl. 1939; I.1. *Cladonio-Vaccinietalia* K.-Lund 1967; 1. *Dicrano-Pinion* (Libbert 1932) Matuszkiewicz 1962: Ass.: *Leucobryo-Pinetum* Matuszkiewicz 1962; 2. *Phyllodoco-Vaccinion* Nordh. 1936: Ass. *Cladonio-Pinetum* (Cajander 1921) Kielland-Lund 1967; *Barbilophozio-Pinetum* Br.-Bl. & Siss. 1939 emend. *K.-Lund* 1967; *Bazzanio-Pinetum* K.-Lund 1981. I.2. *Vaccinio-Piceetalia* Br.-Bl. 1939 emend. K.-Lund 1967; 3. *Piceion excelsae* Pawłowski ap. Pawłowski et al. 1928: Ass.: *Linnaeo-Piceetum* (Cajander 1921) K.-Lund 1962. II. *Alnetea glutinosae* Br.-Bl. et R.Tx. 1943; II.1. *Alnetalia glutinosae* R. Tx. 1937; 4. *Alnion glutinosae* Malcuit 1929: Ass.: *Carici elongatae-Alnetum* Koch 1926. III. *Querco-Fagetea* Br.-Bl. et Vlieger 1937 ap. Vlieger 1937; III.1. *Fagetalia sylvaticae* Pawłowski ap. Pawłowski et al. 1928; 5. *Alnion incanae* Pawłowski ap. Pawłowski et Wallisch 1929: Ass. *Alno glutinosae-Fraxinetum* Mikyška 1943; *Ulmo-Fraxinetum* Sjőgren 1971; *Lysimachio vulgaris-Alnetum* K.-Lund (1971) 1981; 6. *Tilio-Acerion* Klika 1955: Ass. *Ulmo glabrae-Tilietum cordatae* K.-Lund ap. Seibert 1969.

Small-scale species richness of Mediterranean vegetation on the highland of Bitti-Buddusò (NE Sardinia, Italy)

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Vascular plant species richness of communities or formations is an important part of the biological diversity and can be examined using vegetation relevés. Our aim was to study the small-scale floristic diversity of five different vegetation formations on the silicate highland of Bitti-Buddusò (NE Sardinia). The vegetation in our study site consists mainly of cork oak stands, pastures and Mediterranean shrub formations. The landscape is a mosaic of different degeneration-regeneration vegetation stages influenced by the land use history and actual management regimes of the land owners.

We determined the alpha-index sensu Hobohm of the vegetation formations using species numbers of plots of different size. The highest alpha-index was found in the garigas (0.11) and dehesas – sparse cork oak stands – (0.06), whereas the lowest values occurred in the forests (-0.09) and macchia (-0.17). The grasslands showed a middle position (0.01). The examination of the influence of grazing intensity on the species richness revealed a negative correlation, especially for the grassland relevés.

Although the species richness of both the garigas and dehesas is high, the chorological spectrum of the sparse cork oak stands contains more species with Eurasian and broad distribution range (cosmopolits, subcosmopolits), whereas the highest number of endemics can be found in the garigas and macchias.

Chalk grasslands on Lozenska mountain

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Lozenska Mountain is situated southeast of Sofia and covers about 80 km^2. The potential natural vegetation is *Querco-Fagetea*. Secondary grasslands occupy a n area of forests cleared long ago. The study area is situated on the top of three chalky peaks at elevation between 1012 and 1181 m. It has southern aspect and shallow soils with rock outcrops. The grassland vegetation was studied based on 79 relevés. Two associations bound to the calcareous terrains were determined as new for the country: *Humileto-Stipetum grafianae* R. Jov. 1956 and *Potentillo-Caricetum humilis* R. Jov. 1956 (*Saturejion montanae, Festuco-Brometea*). The communities related to those associations have high species diversity – 125 species of vascular plants. The species composition, structure and ecological features define both communities as habitat type 6210 'Semi natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)' – HD 92/43 EC. Lozenska Mountain is a NATURA 2000 site. Special protection measures for the area under study should be provided in the Management plan for the site.

Towards linking phytosociology and floristics

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What are the data on vascular plant species distribution available across Europe? In Europe traditionally, two basic tried-and-tested methods registering species occurrences at various scales (phytosociological relevés at the fine scale and grid mapping data at the broad scale) are widely used. The success of both methods is, *inter alia,* strongly dependent on sampling intensity (i.e. bias in spatial cover of neglected species or habitats). Employing these methods, we are able to describe inter-specific associations (species groups) and species abundances. However, so far, practically no attempt has been done to find the linkage between these rich and independent data sources. In order to link the subjectively sampled relevés and systematically collected grid data within one small model area rich in relevé and grid data, two hypotheses were tested.

(1) Could the relevés serve as additional information for species richness assessment at the broad scale? It was calculated that the relationship between the species richness of a grid cell and the number of relevés recorded in that cell was not significant. It may mean that the relevés were probably recorded only in other grid cells than the species-richest ones (and attractive ones for botanists) and could be (with some limitations) applied to complete the grid mapping data.

(2) The distribution pattern of species is strongly scale dependent. What is the measure of this scale dependence? This scale effect was tested by investigating the transferability of species groups (statistically formed at two spatial scales) to another scale (i.e. fine-scaled relevés vs. broad-scaled floristic grid data). Correspondence of species groups derived from the finest scale (bottom-up approach) with those derived at the broad scale was higher than in the opposite (i.e. top-down) direction. Hence, a possible application of the results is to use species groups to predict the potential occurrence of missing species in broad-scaled floristic surveys from fine-scaled relevés.

Consequently, for phytodiversity assessment of smaller areas, using sophisticated combination of stratified vegetation sampling and systematic grid floristic mapping is recommended. Either simple species occurrence or species group presence could be used, as the data are partly mutually transferable and compatible but the bottom-up direction is preferable. However, different data format limitations and trade off between time (cost) effectiveness and the purpose of data sampled should be always carefully considered.

Comparative analysis of weed species composition of winter cereal fields under three crop management systems

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Floristic composition and conservation value of the weed vegetation of winter cereal fields on base-rich soils in western Hungary was compared under three management systems: (1) small, extensively managed fields; (2) small, intensively managed fields; (3) large, intensively managed fields. In total 600 1-m^2 plots were sampled (10 plots in 5 fields from 3 management systems in 4 geographic regions) and analysed by detrended correspondence analysis (DCA) and canonical correspondence analysis (CCA). Most variation in species composition was explained by the differences between the three management systems (particularly by the difference between the extensively managed fields on the one hand and the two types of intensively managed fields on the other hand) and by crop cover. There were several species positively associated with small extensively managed fields, but no species associated with any of the two types of intensively managed fields. Logistic regression of the occurrence of species groups important for nature conservation on the first CCA axis, representing the distinction between the extensively and intensively managed fields, showed that Red List and insect pollinated plant species occurred more frequently in small extensively managed fields, but there was no difference between fields in the frequency of bird seed-food species.

What determines the habitat invasibility: an example of *Aronia prunifolia* in Latvia

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In order to distinguish habitats potentially invaded by non-native plant species several questions should be answered, e.g. what is the current distribution of the target species, what are the preferred habitats, are there potential donor areas, and whether there are any factors limiting its spread. On a regional scale, most of widespread invasive plant species are highly tolerant against various environmental conditions and poorly limited by climatic and edaphic factors. This study provides a specific example concerning the distribution and habitat preferences of a locally invasive North-American shrub species *Aronia prunifolia* in Latvia. In order to find out what are the suitable conditions for *Aronia*, factors limiting its spread, and relevance of climatic characteristics, soil conditions and vegetation types were studied.

The species has invaded some coastal areas in the surroundings of settlements, where it occurs mainly in moderately moist *Nardus stricta, Deschampsia cespitosa* and/or *Sieglingia decumbens* dominated meadows. It occurs rarely in deteriorated birch forests (*Vaccinio uliginosi-Pinetea*) on the margins of former peat extraction sites, where it may form large stands, while being rare in the rest of the country except some scattered individuals in urban forests. Its current distribution patterns suggest that the spreading of species is favoured by certain factors such as mild suboceanic climate and low soil pH, while low winter temperatures and neutral to alkaline soils limit its distribution only to some coastal areas. In some areas it may become a vigorous grassland invader, causing changes in biologically valuable grassland types and successfully competing with the local secondary shrub species. Fast spreading is facilitated by vegetative propagation, seed dispersal by birds and fast regrowth after cutting.

Areas susceptible to *Aronia* invasions were distinguished on the basis of similarity to currently invaded habitat types. As the potentially invaded habitat types abandoned grasslands and as less important – human-disturbed forests and margins of deteriorated bogs were concerned. In the study area, the neighbouring semi-natural calcareous grasslands and broad-leaved forests with unfavourable conditions for establishment and growth of *Aronia* serve as buffer zone for its further spread. Similarly, large undisturbed forests and bogs, wetlands and agricultural lands may have a buffer function in the spread of invasive species.

Spatial modeling of plant species potential habitats

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Recent increasing of environmental data availability (remote sensing data, floristic and vegetation databases) and widely adopted computer and information technologies open new possibilities for biodiversity conservation and ecosystem control, both on regional and global level. It concerns spatial and dynamic ecosystem modeling at different scales, which have a prediction sense. Plant species distribution is determined by complex of ecological factors. Some of them have immediate effect on populations (mostly abiotic: temperature, moisture, soil fertility etc.), others affect indirectly (as for example, interspecific interactions). Complex of landscape factors includes a lot of components (climate, relief, soil and vegetation types etc.) and has a determining role for plant distribution.

Tatarstan Republic (68,000 km^2), situated in east part of European Russia, was modeled area. Worked out model is based on probabilistic evaluation of habitat suitability to species requirements. It consists of three blocks:

1. Model of potential habitats complying with species ecological requirements.
2. Model of potential species distribution in different landscapes.
3. Model of potential species distribution in different vegetation patches.

Systems of bioindicator values can be used to evaluate ecological conditions in habitats and ecological requirements of species. In this way, we used Ciganov system for broad-leaved-coniferous zone, similar to Ellenberg or Landolt systems. This indicator values contain data for eight environmental factors (temperature, continentality, soil moisture, nitrogen, reaction, light etc.) for building the first block of model. Probabilistic evaluation of environmental conditions for sample plots was made, then using resulted data Ciganov system was transformed into ‘local’ probabilistic indicator system, considering actual natural data. A suitability of environmental conditions to species requirement was found out by comparing probabilistic values of each plot and plant species. As a result, suitability degree was established and continuous spatial model was computed using kriging method on a 1 × 1 km grid.

The second block is based on landscape map of Tatarstan. Probability of species occurrence in certain landscape patch was established as species frequency in corresponding landscape type and evaluated for each patch on two hierarchical levels.

Probability of species occurrence in different vegetation patches was established in similar way, using vegetation map.

Finally, by adding the three spatial model results together and finding an arithmetic mean for each grid node we got continuous spatial distribution model representing species ecological requirements, landscape and phytocoenotic relations. This model was applied to 500 rare species of Tatarstan flora.

Phytosociological data as additional reference in the assessment of condition and conservation strategy for riparian habitats of European importance: the Natura 2000 SAC 'Rogalińska Dolina Warty' (Poland)

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In 2007, geobotanical investigations were carried out in the Special Area of Conservation (SAC) 'Rogalińska Dolina Warty' in Western Poland. The most important aim was to determine current condition of 'habitats of community interest' (Annex I to the Council Directive 92/43/EEC) and proposals for their successful protection. Altogether, 11 Natura 2000 habitat types were found, 8 of which were of natural origin and 3 of semi-natural origin.

Floristic records and some additional observations of habitat conditions (e.g. field estimation of disturbances in vertical and horizontal vegetation structure, evidence of human activities etc.) were the main way of geobotanical investigations. However, over 150 of the mentioned records were made, at the same time, in a form of phytosociological relevés according to the Braun-Blanquet method. During further data analysis and cartographic interpretation of the collected material it occurred that, in many cases, a precise and appropriate assessment of habitats' condition and their probable dynamics were possible only with an insight to more detailed data recorded in individual phytocoenoses, e.g. species richness, spatial structure or chosen plant presence and abundance. For these reasons using phytosociological data was of indispensable benefits.

All the observed 11 habitat types were classified within 3 groups comprising information on their genesis (natural vs. semi-natural origin) and plant formations: (1) natural forest communities, (2) natural non-forest and (3) semi-natural communities. Assessment of current conditions and most appropriate protection strategy was made according to different criteria used for each of the mentioned group separately. In case of natural habitats (both forest and non-forest) the main (negative) criteria included (1) secondary succession stages or processes of 'degeneration' usually exemplified by relatively high disturbance in spatial structure of phytocoenoses and (1,2) spatial dominance of some expansive alien species. On the other hand, number of vascular plants was considered as a positive evaluation criterion, especially for the assessment of semi-natural habitats (3).

For better understanding of the results and their future successful implementing in the conservation practice, only 3 evaluation levels (i.e. 'very good condition', 'good' and 'relatively poor') were finally proposed and used as the main cross-relation units on an applied geobotanical map. The map comprised both spatial information on habitat diversity itself, as well as the mentioned evaluation of their condition (referred to particular spatial units) which was associated (and discussed in the text) by a proposed form of protection, i.e. mainly: passive conservation, active reconstruction or active preservation.

Agrestal vegetation under changing farming systems in Lithuania

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Aims. Evaluation and prognoses of the main change tendencies of species and communities of agrestal vegetation.
Research object. Agrestal (detected in arable fields and first-year waste-lands) weed species and communities were investigated.
Methods. Sites for investigation were geographical trapezoids of approximately 100 km^2 with the lengths of their borders of 00°10' northern latitude and 00°06' eastern longitude. Each territory was divided into 100 squares 1 km^2 each. Sampling of arable land vegetation was performed in 50 continuously distributed research squares.
Data analysis. Species frequencies were estimated as mean values for each territory. Species abundances were calculated using coverage index. TURBOVEG phytocoenological data management database was used for data storage and processing.
Results. Eight territories of agrestal vegetation monitoring reflect diversity of Lithuanian natural conditions (relief, soil, climate, potential vegetation) and land-use peculiarities in different regions of the country. The most frequent (typical) weeds of arable land are perennial rhizomatous plants *Elytrigia repens* and four annual weeds – *Tripleurospermum perforatum, Chenopodium album, Persicaria lapathifolia* and *Fallopia convolvulus*. Medium constancy classes are shared mostly among annual archaeophytes (*Stellaria media, Viola arvensis, Galeopsis tetrahit, Capsella bursa-pastoris, Sinapis arvensis, Centaurea cyanus, Euphorbia helioscopia, Raphanus raphanistrum,* etc.) and intrusive perennial weeds (*Sonchus arvensis, Cirsium arvense, Equisetum arvense, Taraxacum officinale, Rumex crispus, Artemisia vulgaris, Stachys palustris, Mentha arvensis, Achillea millefolium, Convolvulus arvensis*). The most abundant weeds in Lithuanian agrocommunities are *Elytrigia repens, Stellaria media, Fallopia convolvulus, Tripleurospermum perforatum, Sonchus arvensis* and *Galium aparine*. Perennial tall plants *Sonchus arvensis* and *Elytrigia repens*, as well as *Tripleurospermum perforatum* and *Galium aparine* are the most important for agrestal community structure. It has been revealed that only 56 (22%) of all observed weed species can reach high abundance. Therefore, the dominance of weeds in Lithuanian agrestal communities is not high. Particularly high number of apophytes originating from grasslands, fringe or even forest communities can be treated as an indicator of extensive farming. Continuous traditional farming is also indicated by a high frequency and abundance of speirochoric archaic weeds (*Bromus secalinus, Agrostemma githago* and *Vicia villosa*). The presented results on repeated observations (2001–2002 and 2007) of weed frequency and abundance show the trends of changes in natural environment and are related with prevailing farming tendencies.

Syntaxonomic diversity in the evaluation of biodiversity hotspots in Mediterranean region

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Biodiversity hotspots represent places of extremely high plant diversity, which are being either actually or potentially threatened. These hotspots are very important for the evaluation of biodiversity value as whole, future trends of speciation and endemogenesis, especially within the context of global climate change and its assessment. One of the biodiversity hotspots that is considered to be unique on the global scale is the Mediterranean area. There is a special value contained in the still poorly investigated Balkan peninsula where several macro-hotspots have been identified depending on refugial features which have been preserved until the present in numerous canyons of Dinaric streams. For the evaluation of actual values of some of the biodiversity hotspot areas different approaches, mainly based on floristic characteristics, are applied. However, the investigations conducted within these areas have shown how significant is the role that vegetation science plays in the evaluation of natural values of the hotspots.

On horizontal and vertical profile of the littoral and middle Dinaric Alps, within the Neretva river basin which is considered to be the largest refugium of Tertiary flora on the Balkan peninsula, communities of highest floristic richness, endemism, relictness and syntaxonomic diversity were identified. These are communities belonging to the following endemic and relict alliances: *Centaureo-Campanulion, Edraianthion tenuifoliae, Micromerion croaticae, Amphoricarpion autariti, Moltkeo-Potentillion speciosae* (*Asplenietea trichomanis*); *Peltarion alliaceae, Corydalion leiospermae, Bunion alpini, Silenion marginatae, Saxifragion prenjae* (*Thlaspietea rotundifolii*); *Cymbopogo-Brachypodion ramosi, Peucedanion neumayeri* (*Thero-Brachypodietea*); *Pinion heldreichii, Pinion illyricae, Fraxino orni-Ericion carneae* (*Erico-Pinetea*); *Carpino orientalis-Petterion, Seslerio-Ostryon* (*Ostryo-Carpinetalia orientalis*); *Seslerion robustae, Oxytropidion prenjae, Oxytropidion urumovi, Festucion bosniacae, Seslerion tenuifoliae, Seslerio-Edraianthion pumili* (*Elyno-Seslerietea*).

In each of these alliances a great number of endemo-relict associations was identified, of which many are stenotopic (*Minuartio handeli-Caricetum pollicensis, Amphoricarpi-Pinetum heldreichii, Heliospermo retzdorfiani-Oreoherzogietum illyricae, Alyssetum moellenderfiani, Saxifragetum prenjae* and *Arenario gracilis-Campanuletum hercegovinae*). All of these associations are good indicators for the assessment of state, carrying capacity, threat level, endemism, rarity, functionality and floristic richness, thus, could be used as an outstanding tool for the establishment of conservation priorities and monitoring of global climate changes (associations of the alliances *Pinion heldreichii, Oxytropidion prenjae* and *Saxifragion prenjae*), for being highly responsive to changes in main ecologic parameters, especially in hygro-thermic regime.

Plant community ecology of *Pinus sylvestris* L., an extirpated species reintroduced to Ireland

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Despite its indeterminate native status, *Pinus sylvestris* is being widely planted in semi-natural habitats in Ireland. The associated vegetation communities had not previously been described and the conservation value of these stands was unknown. Botanical surveys were carried out at 20 plots of *P. sylvestris*-dominated woodland and scrub throughout the Republic of Ireland. Vegetation, structural and environmental data were recorded. Data were analysed using non-parametric and multivariate statistical techniques and a synoptic table was prepared. *P. sylvestris* was found to be a non-specialist in terms of its environmental tolerances. Beta diversity among the plots was high. The plots surveyed represented 14.23% of the native flora. There was a low level of constancy of species. Four reasonably well defined vegetation communities were identified. Soil pH, altitude and slope had important roles in defining these vegetation types and soil pH and altitude influenced their species richness. *P. sylvestris* is well established and naturalising in Irish semi-natural habitats. The associated vegetation communities were diverse and formed a significant resource for native biodiversity. Some of the communities described corresponded with habitats of international conservation importance. This research has demonstrated that the communities associated with *P. sylvestris* in Ireland are of conservation value.

What controls the species-composition of floodplain grasslands?

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Almost 4000 relevés were collected from wet, traditionally-managed grasslands on 18 floodplain sites throughout England. These data were classified using TWINSPAN into 14 plant communities which were interpreted using the UK National Vegetation Classification and phytosociological analogues elsewhere in Europe. The water regime of each sample point was individually modelled and these models validated against dipwell observations of water-table behaviour in the field. Results show that the mean water regime of each plant community was distinct, suggesting that this is a key determinant of community composition and distribution, and can be used to understand patterns of wet grasslands across floodplains. These results are presented graphically using the concept of Sum Exceedance Values, a method for quantifying water regime that is transferable between sites. Correlating the degree of waterlogging expressed as SEVs with the mean Ellenberg F-value (as modified for the UK) for each quadrat gives a clear linear relationship, suggesting that published F-values could be used predictively for understanding hydrological preferences of vegetation types not included in the survey. For a sub-set of community types, differences between phosphorus availability suggest that this is an important secondary factor. Three sites were studied in detail using repeat sampling of fixed-point relevés to determine the rate of vegetation change in relation to known hydrological shifts. Results show a rapid response to increased waterlogging and loss of species-richness, including the demise of rare plants. As elsewhere in Europe, floodplain grasslands are a very scarce, valuable and still much-threatened habitat in the UK and the results have been used to recommend changes in floodplain management within agri-environment schemes.

Distance decay in Central European oak forests

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Similarity of analogous biotic communities diminishes with distance in nature. This natural law has been often referred to as ‘distance decay’. Distance decay of community similarity may result from various geographical and ecological processes influencing species co-occurrence in space and time. Recent development of large vegetation data bases covering large regions enables us to study distance decay on different spatial scales and in various vegetation types. Thus we are able to approach the causes of spatial variation in community composition, especially to distinguish between variation driven by environmental and geographical factors. In our case study, we analyzed great amount of phytosociological relevés from different countries of Central Europe to track the patterns of distance decay in regional oak forest communities. We were particularly interested in two questions: (1) Do distance decay patterns differ in different oak forest types? If yes, what could be the causes? (2) Do distance decay patterns differ in different parts of Central Europe or is there one prevailing large-scale pattern? We have tried to answer the questions using modern methods of spatial analysis of multivariate data. Our results suggest that at the scale of Central Europe, environmental factors are more important determinants of species composition of oak forest communities than pure geographical factors. Nevertheless, as we discuss, natural patterns may have been seriously obscured by the artefacts imposed by the inconsistent quality of input data coming mainly from large vegetation data bases.

Simple method of subset selection from large vegetation databases

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Large vegetation databases are now available for various meta-analyses, which opens new possibilities for ecological research, but at the same time it opens new methodological questions. One of such important questions is how to select relevant subsets of data from large databases: different selection criteria yield differently structured subsets, whose analysis may yield different results and different ecological interpretations. Since for pragmatic reasons we usually seek simple and explicit selection criteria, but vegetation is a very complex entity, there is a trade-off between simplicity/complexity of selection criteria and insufficient/sufficient ecological representativeness of the resulting data subsets.

We have developed a simple method of subset selection that tries to optimize costs and benefits of simplicity/complexity of selection criteria. The method consists of five steps: (1) formulation of a simple criterion for relevé pre-selection (e.g. dominance of *Quercus pubescens* in the tree layer), (2) ordination (NMDS, DCA, PCA, etc.) of the whole data set, (3) extraction of the scores of pre-selected (i.e. *Quercus pubescens* dominated) relevés in n-dimensional ordination space, (4) optional elimination of spatial outliers within pre-selected relevés using outlier analysis of their ordination scores, (5) final selection of all relevés similar to pre-selected relevés using n-dimensional convex hull. In this manner, we combine simple and explicit selection criteria with a complex selection tool reflecting similarity in total species composition. We consider our method to be the first approximation and hope that it will be followed by other, more elaborated attempts to solve the problem.

Diversity of grassland vegetation in the West Carpathians

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The West Carpathian flysh zone and the adjacent Inner Carpathian sedimentary basins were chosen for vegetation diversity research concerning mesic meadows, pastures and montane grasslands. Both regions are similar with respect to geological bedrock, formed by flysh with alternating various types of sedimentary rocks. Further, the entire area is variable in chemical composition of flysh and climate. Grassland vegetation of the West Carpathians has never been investigated and classified consistently across particular countries (Czech Republic, Slovakia and Poland). Distribution of some vegetation units is therefore determined by the state borders. This study aims to describe variation of grassland vegetation and to determine distribution of particular vegetation types in the West Carpathians, covering the territory of all three countries. The dataset contained phytosociological relevés of classes *Molinio-Arrhenatheretea* and *Calluno-Ulicetea*. Methods comprised clustering and classification techniques and ordination analysis. Results indicate that the main factors affecting diversity of grassland vegetation in the study area are connected with mineral richness and altitude, followed by moisture and nutrient availability. Beside these, some vegetation types seem to be determined just by management practice. Different management practices may also be crucial for the development of specific vegetation types with distributions determined by state borders.

The response of plant functional types in *Nardus* grasslands to land-use change in the past 30 years – a study from two lower mountain ranges close to the Upper Rhine

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During the past 50 years the land use in the Black Forest and the Vosges changed remarkably but the land use patterns remained different. In the Black Forest less productive areas were afforested in large part. Productive areas were used more intensively. Therefore few *Nardus* grasslands (*Nardetalia*) are left that are used as pastures like in the past. In the Vosges selected areas are cultivated intensively whereas large parts remained pastures or are extensified. In order to compare changes of the floristic composition of these grasslands depending on land use modifications across altitudinal zones as well as across regions the plant functional type (PFT) approach is chosen.

Vegetation records from different survey periods from two regions serve as basic data. Additionally, the distribution of species that are characteristic for this vegetation unit is compared on the level of PFT. The PFT as well as the assignment of species are determined by means of classification of species traits. The data bases LEDA and BioPop are used as data source. The frequency of PFT depending on region and survey period is balanced. In order to quantify the effect of land use pattern on the distribution of PFT, this balance is subjected to an ordination together with parameters representing the land use pattern.

Progress in Charophyte phytosociological survey in the Guadiana River Basin (SW Spain)

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We discuss how in this case phytosociological data can be a useful tool to outline the importance of the knowledge of the biodiversity at medium-scale pattern. We have firstly recognized seven phytosociological associations of Charophyte subaquatic communities in the Guadiana River Basin (SW Spain). They have been concisely described and grouped into the corresponding categories according to the classic progression of Braun-Blanquet criteria. Physiognomical, structural and ecological, floristic and biogeographical characters have been indicated.

The syntaxonomical system:

Charetea fragilis Fukarek ex Krausch 1964
Charetalia hispidae Sauer ex Krausch 1964
Charion fragilis Krausch 1964
Charetum conniventis Velayos, Carrasco & Cirujano 1989
Charetum fragilis Corillion 1957
Charion vulgaris (Krause ex Krause & Lang 1977) Krause 1981
Charetum braunii Corillion 1957
Charetum vulgaris Corillion 1957
Nitelletalia flexilis Krause 1969
Nitellion flexilis Dambska 1966 em. Krause 1969
Nitelletum confervaceae Corillion 1957
Nitelletum flexilis Corillion 1957
Nitelletum opacae Corillion 1957

These associations are Protected Habitats of the Council Directive 92/43/EEC (Code 3140), but in the studied area of Spain they have not been included in the National Inventory of Habitats. Due to actual land-use change we estimate they can suffer high regression, with consequent loss of biodiversity.

Vegetation assessment with pollen flows study

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In the last years aeropalynological studies became one of the most accurate, easy and feasible tool to study vegetation composition, phenology and shifts related to climate changes. The most remarkable example is given by the surveying of the movement of *Ambrosia artemisiifolia* over Western Europe.

Entomopalynologial studies using honeybee's pollen collection patterns showed to be possible to access the presence of more than 150 plants in an area of 113 km^2, and in many cases to ascertain its importance on the site flora. The study of anemophilous pollen flows can indicate the presence of pollen sources of 50 km from the sampling area.

In the present work we compare the vegetation of two Portuguese regions using anemophilous and entomophilous pollen flows, emphasizing the advantage of application of these tools to assess the floral composition and changes over the years.

Calcareous fen vegetation of Latvia

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Calcareous fens are rarely found throughout Latvia and there are two main areas with high concentration of calcareous fens, namely the Coastal Lowland and the Abava River Valley and its tributaries. Topogenous, limnogenous and soligenous calcareous fens are found in Latvia. The area occupied by calcareous fens and rich fens associated with them is about 1500 ha. The size of one locality varies from several square meters to 200 ha. The largest known calcareous fen is Platene Mire (230 ha). Calcareous and rich-fen vegetation was studied and twelve plant communities were distinguished and assigned to the following associations: *Schoenetum ferruginei, Caricetum davallianae, Caricetum buxbaumii, Cladietum marisci, Eleocharitetum quinqueflorae, Chrysohypno-Trichophoretum alpini, Caricetum lasiocarpae, Caricetum hostianae, Caricetum paniceae* and *Caricetum elatae*. Two communities, namely *Sesleria caerulea* and *Myrica gale* dominated communities, were not assigned to any association. The mean species number varies from 6.3 for *Caricetum paniceae* to 22.6 for *Schoenetum ferruginei*. Moisture and hydrological regime are the main factors causing smaller species number in very wet sites. Abandoned fens still posses the characteristic species composition, while in drainage influenced and abandoned fens *Molinia caerulea* and different shrub and tree species have outcompeted the majority of fen species. Calcareous fens are the rarest mire type in Latvia because of natural factors and due to cessation of traditional management and previous drainage their conservation status is considered to be unfavourable.

On the existence and availability of vegetation data in Europe – results of a questionnaire

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Almost a century ago Josias Braun-Blanquet developed his approach for vegetation field study, which was explained and demonstrated in his famous handbook *Pflanzensoziologie. Grundzüge der Vegetationskunde* of 1928. At that time, nobody could foresee what the impact of this methodology would be for vegetation science as well as for its application in nature conservation. Thousands of so-called vegetation relevés have been made, collected in field books, and published afterwards in more or less approachable literature. Some twenty years ago, the software package TURBOVEG was developed by Stephan Hennekens for the input, storage and handling of vegetation data. Since then, many national and regional data bases have been compiled, providing the basis for national and international classification overviews and other scientific studies. Within the framework of the European Vegetation Survey, the initiative was taken to get an insight in the amount of vegetation data that have been collected in Europe throughout the last century and the amount of data that has been computerized. The results of the questionnaire will be presented, whereas some new aspects concerning TURBOVEG will be shown, e.g. the development of a compact edition for PocketPC and the use of Google Maps for geo-referencing of relevés.

Species distribution and aggregation/segregation patterns along a snowmelt gradient in snowbeds

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Alpine snowbeds are characterised by a long-lasting snow cover. This key climate change-sensitive abiotic factor controlling plant life in snowbeds will alter the growing conditions until the end of this century. To determine winners and losers of climate change among the vascular plant species inhabiting snowbeds, we analysed the small scale species distribution and spatial patterns along a snowmelt gradient of three weeks within snowbeds in the Swiss Alps.

Species richness was reduced to 50% along the gradient towards later snowmelt date. The distribution of species along the snowmelt gradient allowed the establishment of five species categories with different realised niches: the dominants; three categories of subordinates: the indifferents to snowmelt dates, the snowbed specialists, and the avoiders of late-snowmelt sites; and the transients. The spatial pattern was strongly dependent on snowmelt date. Consequently, aggregation within the categories and segregation particularly between the two opposing categories, the specialists and the avoiders, was found. Within particular snowmelt dates the association patterns found between categories were still similar to those found along the whole snowmelt gradient, i.e. aggregation within the categories and between the categories preferring the early melting sites, and segregation between categories particularly occurring at the opposite ends of the gradient. Therefore, the segregating effect of the snowmelt gradient was enhanced by factors operating at the level of single snowmelt dates, particularly biotic interactions.

In conclusion, the currently existing dominance of the dominants and specialists in the late melting snowbeds is probably caused by the intolerance of the avoiders and transients against the prevailing growing conditions. In contrast, the dominance of the avoiders in the early melting sites is probably due to their competitive power and the inhibition of the specialists and the dominants. With regard to climate change, this means that the avoiders will take advantage from an increasing number of suitable habitats due to an earlier start of the growing season and from their competitive superiority compared to the specialists or even some dominants. Thus, an invasion process will gradually replace the currently characteristic snowbed vegetation by alpine grassland species. The present study highlights the vulnerability of the established snowbed vegetation, a sensitive indicator of alpine vegetation in general, to climate change.

Dynamics of vegetation in natural fir-beech and spruce forests in the East Carpathian Mts.

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In 2004–2005, vegetation of natural fir-beech (1165–1252 m a.s.l.) and spruce (1265–1385 m a.s.l.) forests in the East Carpathians was repeatedly surveyed on 36 plots in the forest reserve in the Marmarosh massif. The plots were originally established in the 1930s (Zlatník et al. 1938). The objective was to assess vegetation dynamics after 70 years.

The study site is situated in the core area of the Carpathian Biosphere Reserve in the Zakarpattya province of the Ukraine. There were 20 plots in fir-beech forest (*Dentario glandulosae-Fagetum*) and 16 plots in spruce forest (*Calamagrostio villosae-Piceetum*). The plot sites were chosen by Zlatník in the 1930s and methods of our field survey strictly followed his methods. In the 1930s and now phytosociological relevés were recorded using the Braun-Blanquet seven-degree abundance-dominance scale. Each relevé encompassed an area of 100 m^2. Vegetation changes between the 1930s and 2004–2005 were studied with multivariate ordination analysis by CA and CCA methods.

After 70 years, herb species composition partly changed. In the 1930s 71 species were found. Now 17 original species were not found, but 10 species newly appeared. We tested the influence of environmental factors on changes in species composition. We assessed the changes in species composition by time span and altitude, and verified the influence of both factors on these changes.

Environmental characteristics were tested by CCA (direct gradient analysis, forward selection procedure). According to this procedure, factors most affecting the variability of species data include altitude (45.2%) and time span (16.3%), both significant at $p < 0.001$. In our example we have verified that contrast between plots caused by different altitudes is almost three times more important than time span.

In the spruce forest only minor changes in species composition occurred after 70 years, but changes were evident in the fir-beech forest. Fir-beech forest exhibited an increase in nitrophilous and heliophilous taxa (*Rubus idaeus, Senecio nemorensis* agg., *Galeopsis speciosa*, *Impatiens noli-tangere*). Their increase could be caused by nitrogen deposition, but they can indicate a stage of stand disintegration too. Species that decreased most significantly are typical of spring period (e.g. *Anemone nemorosa, Helleborus purpurascens, Isopyrum thalictroides*), so different season of vegetation survey could be one of the main reasons for this decrease.

Alpine and subalpine spring vegetation in the High Tatra Mts (Western Carpathians): Major types, environmental gradients and relationships between vegetation and environmental factors

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In the recent years, several studies on wetland vegetation and ecology were made in the Western Carpathians. However, virtually no study was focused on spring vegetation above the timberline in detail. As major determinants of wetland vegetation variation strongly differ above and below the timberline and likewise between springs and fens, I focused only on the springs in the alpine belt and analyzed them separately, using new original data from the field as well as all available literature data. In the poster, analyses of species composition and vegetation-environment relationships are presented with the aim to show:

(i) Major types of the (sub)alpine spring vegetation and their syntaxonomical interpretation;

(ii) Major gradients in vegetation composition;

(iii) Relationships between vegetation and environmental factors.

Numerical classification revealed that on some springs fen vegetation dominated by *Warnstorfia exannulata* or *Calliergon sarmentosum* has developed and that it is clearly floristically differentiated from spring vegetation and belongs to the *Scheuchzerio-Caricetea fuscae* class. The spring vegetation, *Montio-Cardaminetea* class, was divided into four distinct groups corresponding to the following associations: *Caltho-Dicranelletum squarrosae* Hadač 1956, *Cardamino opizii-Cratoneuretum falcati* Szafer et Sokołowski 1927, *Crepido paludosae-Philonotidetum seriatae* Hadač & Váňa 1971 and *Cardaminetum opizii* Szafer et al. 1923.

The major gradient in species composition was associated with pH, dependent on bedrock, and the second most important gradient with altitude. There was only weak correlation between pH and species richness of the vegetation

The diagnostics of ecological conditions of the grass vegetation habitats with use of the coenoflors complex analysis method in space of syntaxonomical data

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In Sudost-Desna watershed area (Bryansk Region, Russian Federation) 47 associations, 16 subassociations and 14 variants assigned to 20 alliances, 15 orders, 8 classes of grass vegetation, and 13 basal and derivative communities were described according to the Braun-Blanquet approach. *Phragmito-Magnocaricetea* and *Molinio-Arrhenatheretea* are syntaxonomically most variable classes. For the diagnostics of habitat conditions at the level of associations and alliances the complex coenoflors analysis in space of syntaxonomical data is used. A floristic variety of associations is lead with use of statistical methods. The ‘relative specific syntaxon diversity’ (Mirkin et al. 2004) diminishes on the gradient of increasing soil humidity, defined on the basis of indicator values (Ellenberg et al. 1992). The least specific communities appear in habitats with soils rich with mineral nitrogen.

According to results of the cluster analysis of vegetation beta-diversity it is established that syntaxa of the xerophytic and mesoxerophytic meadows (*Scabioso-Poion, Hyperico-Scleranthion, Koelerion glaucae, Festucion valesiacae* alliances) have high floristic specificity. The hygrophytic and mesohygrophytic bottomland vegetation (others alliances), on the contrary, forms single ecological and floristic space. With use of the cluster analysis syntaxonomic ecotones are selected: at the level of alliance – associations of *Cynosurion*, at the level of association – association *Inulo-Allietum* etc.

The geobotanical and ecological analyses are led with use of spectra method at the level of alliance. The concepts of ‘floral element’ (Walter 1977, Walter & Straka 1970, Kleopov 1990), ‘type of area’ (Meusel et al. 1965) and ‘polyzonal floristic complex’ (Bulokhov 2000) are used. The spectra of dry meadow coenoflors demonstrate the steppization from the *Alopecurion* to *Festucion valesiacae* alliance. Spectra of life forms (Raunkier 1936, Seryabryakov 1964) and ecobiomorphs (Lavrenko & Sveshnikova 1965) reflect the distribution of communities in a wide range of ecological conditions, well determine habitats of associations, as confirmed through indicator values.

The coenoflors are differentiated in accordance with the habitats conditions and can be used for phytoindication. The coenoflors complex analysis demonstrates the syntaxon independence, floristic and ecological originality.

Development of indicator values on the basis of expert-statistical methods

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At the present time bioindication methods and indicator values are widely used in environmental monitoring. Despite critical statements of many researchers about the simplification of ecological responses of plants to a complex environment and discrepancies between indicator values and actual field measurements, species indicator values are very effective in environmental assessment of habitats and irreplaceable at studying spatial models of distribution of species and communities.

For this study, we used 5035 phytosociological plots from the FLORA database covering the territory of the Tatarstan Republic. The information from the FLORA database was transformed in the following sequence: matrix of species (columns) by plots (rows); system modification species abundance coding; creation of the species sample, where species are met in more than 7 plots, and the selection of plots containing more than 7 species. As a result 4923 plots have been selected.

At the second stage we carried out an ordination using CA (Correspondence analysis) method based on the algorithm by Legendre & Legendre in statistical environment R. For better interpretation of CA axes information about ecological-coenotic groups (ECG) and Ellenberg indicator values were used.

Arrangement of species along the CA1 axis has revealed regular distribution. In the left part of the axis there are species of boreal, broad-leaved and mixed forests and peat bogs. Species of steppe meadows and steppes are situated on the opposite part of the CA1 axis. Such distribution of species permits to interpret it as an axis of complex factor combining optimal conditions of habitats and climatic zonal features.

Along the second axis (CA2) species are distributed from aquatic, riparian and wet meadow species on the one side of the gradient to species of shrub steppes in stony habitats on the other side and forest species in the middle. Thus, CA1 axis can be interpreted as an axis representing the moisture factor. Since CA2 axis reflects influence of one certain factor, it is possible to develop indicator values for moisture on this basis.

In this study an attempt of application of ordination axes for creation of indicator values is undertaken. Further there is an object of algorithm development using various standard methods of data classification which will combine all available information on ecological properties of species: data from species ordination, indicator values of Ramensky (1956), Landolt (1977), Tsyganov (1983) and Ellenberg et al. (1991), actual field measurements and expert evaluations. As a result, statistical data processing permits to create indicator values which reflect requirements of species to environmental factors more precisely in conditions of certain region.

Quantitative investigation of turlough vegetation – preliminary findings

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Turloughs are temporary lakes over karst limestone that fill and empty mainly in response to groundwater fluctuations. They are included as Priority Habitats on Annex I of the EU Habitats Directive (92/43/EEC), and are also protected as Groundwater Dependent Terrestrial Ecosystems under the EU Water Framework Directive (WFD) (2000/60/EC). Ireland is, therefore, under obligation to conserve and maintain these valuable habitats. Turloughs are subjected to regular inundation with calcium-rich groundwater, exerting a highly selective pressure on their biota, which has resulted in the unique flora and fauna of these ecotones. Regular zonation of vegetation is evident in turloughs, which is related to depth, frequency and timing of inundation.

As the initial phase of a three-year project, field surveys were carried out in a number of turloughs over two field seasons, recording plant species cover/abundance (using the Domin scale), along with information on mean vegetation height, amount of grazing and/or poaching and type of herbivores present. The relevé data were then analysed using ordination and hierarchical clustering.

Preliminary results indicate the presence of discrete vegetation units occurring in areas with a similar flooding regime, grazing intensity and soil type. A range of species and vegetation types were found in different turloughs, dependant on soil type, flooding regime and management.

Expert system approach for investigation and modeling of long-term forest dynamics

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Making the expert systems based on the GIS databases opens a possibility of solving a broad spectrum of problems in geosystem dynamics modeling and palaeolandscape reconstruction. Experience of expert system forming for reconstruction of forest-steppe region vegetation covering long-term dynamics, based on the long history of region settlement and global changes of climate is described.

The complex of forest-steppe ecological systems in landscapes of boreal ecotone is caused by a climatic boundary – transition of hydrothermal factor value through 1. Moisture deficiency causes potential instability of a forest cover. Long-term forest dynamics in the Holocene, sensitive to global climate changes, is also directly connected with a condition of anthropogenic influence. Wars and migrations determined variability of demographic structure of human population and as a result the irregular development of the areas at modern forest-steppe regions lasted for millennia. Therefore, definition of climax conditions on the particular local sites vegetation becomes a difficult problem. The computerized spatial information and modern GIS technologies allow to solve this problem.

Expert system is a complex of databases defining the state of research object, formal solving rules of the decision choice set and software for their check. Ability to predict on the basis of a set of formal solving rules is the basic property of such systems. Traditional expert systems assume the choice of one of known alternatives, which complicates forecasting of natural systems properties. In geographical space of ecotone objects property definition for accurate determination of numerical borders is obviously very difficult to establish. Rule formulation in clear language for expert is also important. Formalization method for verbal descriptions of qualitative characteristics and expert's confidence level in statement validity is necessary. At a case study lexical variables of fuzzy logic (Zaden 1965) were used. This approach allowed constructing forecast estimations even when rules were insufficiently authentic, and the forecast was inconsistent.

By attribute data collecting from GIS layers in a regular grid (step of 400 m) the spatial information database of rather stable (e.g. relief factors) and temporarily changeable (dated settlements of ancient farmers) environmental parameters was formed. Rules were developed on literary and contemporary record analysis, modern and retrospective maps and plot studying.

The expert system determines applicability of the rules in each knot of a grid and sums the working rules estimations. Received forecast results in terms of conventional values of reliability of forest presence/absence produced forest vegetation distribution maps for several time slots.

Review of the classes of the vegetation of Ukraine

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The last edition of '*The syntaxonomy of the vegetation of Ukraine*' was published 12 years ago (1996). During this period much progress has taken place in the Ukrainian phytosociology, due to the increase in the number of researchers, accumulation of numerous relevés, creation of phytocoenological database and the special edition for publishing phytosociological papers. The publication of multivolume edition '*Vegetation of Ukraine*' has begun, and the following volumes have been published: '*Alpine vegetation*' (2000, 2002), '*Higher aquatic vegetation*' (2006) and '*Halophytic vegetation*' (2007). During this period the knowledge on vegetation diversity of the country has increased. In total the diversity of the Ukrainian vegetation comprises 64 classes: chasmophytic vegetation – 6 classes, alpine vegetation – 6, aquatic vegetation – 7, vegetation of fresh-water marshes, fens and bogs – 5, temperate heathlands and grasslands – 3, psammophytic vegetation – 3, steppes, xerothermic and petrophytic vegetation – 5, halophytic vegetation – 9, woodlands and scrub – 11, synanthropic vegetation – 9 classes. In works on the basis of geobotanical relevés new classes of vegetation which have not been mentioned before for the territory of the country are listed, particularly *Adiantetea* Br.-Bl. 1948, *Rhizocarpetea geographici* Wirth 1972, *Verrucarietea nigricantis* Wirth 1980, *Charetea fragilis* Fukarek ex Krausch 1964, *Utricularietea intermedio-minoris* Pietsch 1965, *Isoëto-Littorelletea* Br.-Bl. et Vlieger in Vlieger 1937, *Rhamno-Prunetea* Rivas Goday et Carbonell 1961, *Quercetea robori-petraeae* Br.-Bl. et R. Tx. 1943, *Erico-Pinetea* Horvat 1959 and *Pulsatillo-Pinetea sylvestris* Oberd. 1992.

Comparison of an estimation efficiency of the environment conditions by different ecological scales in the forests of Southern Urals

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Today many ecological scales are available. Most popular scales in Russia are those by E. Landolt (1977), H. Ellenberg (1974) and D.N. Tsyganov (1983). The author compares how these scales reveal ecological regularity of forest vegetation of the South-Ural region (SUR). Three ecological gradients, temperature, humidity and nutrients, are used as test models for estimation of scale applicability.

17 associations of SUR natural forests (6 associations on each gradient), which have been based on 776 relevés, are included in the test models. For comparability the three scales were transformed to uniform range of Landolt's scale. As the basic criterion of estimation quality of community habitats was used: conformity of change of quantitative estimations on scales of association sequence along ecological gradients; conformity of the received estimations of those ecological modes which are specified for these estimations.

Out of the coenoflora of 17 associations of the SUR forests (667 species), the species list of Landolt's scale contains 377 species (56.5%), of Ellenberg's scale 362 species (54.3%), and of Tsyganov's scale 494 species (74.1%).

Estimations of all scales under examined factors increase along ecological gradients. The scales of Ellenberg and Tsyganov showed slightly inaccurate estimation for factors of humidity and nutrients and not always corresponded to ecological conditions which are specified for these estimations.

For the factor of temperature the most accurate estimations were received on the scales of Landolt and Tsyganov. On Ellenberg's scale for the factors of humidity and temperature some shifts in the sequence along ecological gradients occurred.

It should be also noted that representativeness of Tsyganov's scale by quantity of species for the SUR forests is higher than is the case of the other scales.

On the interval Tsyganov's scale a mean value not always coincides with species ecological optimum which can be displaced to any of the edge value of the scale. Therefore this scale is less accurate than scales of Landolt and Ellenberg which give species optima on each gradient.

Thus, our investigations allowed to compare applicability of the three scales for estimation of forest habitat conditions in the study area. The Landolt's scale seems to be more effective in comparison with scales of Ellenberg and Tsyganov, with respect to the accuracy of ecological modes and ability to differentiate them.

This investigation is supported by the Russian Fund of Fundamental Science (grant 07-04-00030-a).

The occurrence of arctic-alpine species within high-mountain plant communities in relation to enviromental factors, functional types and phytogeography

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High mountains of the Carpathians embedded within the other European mountain ranges are characterised by various geological bedrock; miscellaneous climatic and soil features contribute to an exceptional variability of habitats, including refuges that provide optimal conditions for high-altitude plants. Under specific conditions a diverse mosaic of vegetation types developed with an abundance of relic and endemic taxa. The landscape heterogeneity and island phenomenon play important role in structuring of the plant communities.

The evaluation of individual vegetation types should be done on the basis of complex knowledge and should follow not only the floristic composition of phytocoenoses and ecological characteristics, but also the general evolutionary assembly rules connected with phytogeography of the species.

This contribution serves a view on processing of phytosociological relevés together with phytogeographical, functional and ecological data, paying particular attention to phytogeographical elements in the flora of the Western Carpathians, life forms of individual taxa and Ellenberg indicator values. We used selected high-mountain plant communities of the Western Carpathians with abundant arctic-alpine species as an excellent model system. This contribution also handles with the distribution of arctic-alpine taxa within the Western Carpathians and their abundance in individual vegetation types.

We worked with more than 43,000 samples taken from the Slovak National Vegetation Database. We used physiognomic parameters (structure), qualitative and quantitative parameters (presence/absence) of significant components (life forms, chorological elements), abundance of plant species and relations among them (spatial pattern) to test the differences between individual vegetation types with significant abundance of arctic-alpine species. Fourteen alliances (from the classes *Asplenietea trichomanis, Caricetea curvulae, Carici rupestris-Kobresietea bellardii, Elyno-Seslerietea, Loiseleurio-Vaccinietea, Montio-Cardaminetea, Mulgedio-Aconitetea, Salicetea herbaceae* and *Thlaspietea rotundifolii*), as classified in individual volumes of *Plant communities of Slovakia*, were compared with respect to abundance of chorological elements, species richness, environmental factors and species composition.

The abundance of arctic-alpine species was significantly correlated not only with the European high-mountain element, but also with the occurrence of the Carpathian or Western Carpathian endemic taxa. The island phenomenon of the highest mountains gave rise not only to formation of refuge for relic taxa, but according to plasticity of individual taxa, the same habitats also provided suitable conditions for speciation and hence became the centre of endemism.

The evaluation of floristic diversity of forest communities situated in the vicinity of mining subsidence reservoirs based on phytosociological data

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The objects of the present study are forest communities located in the neighbourhood of anthropogenic water reservoirs. These water reservoirs were formed in land depressions in areas of former underground exploitation of coal in The Upper Silesian Industrial Region in Poland. The objective of the investigation was to determine the patterns of distribution and species diversity of phytocoenoses in the vicinity of human-induced post coal mine subsidence reservoirs. The data, in percentage intervals of vascular plant cover (the scale: 0%, 10%, 20%...100%), were sampled along transects laid perpendicularly to the margin of water basins towards adjacent woodlands. The basic sample plot was an area of 25 m^2. Within forest communities nearby subsidence three reservoirs in total 45 phytosociological records were collected. The syntaxonomical names and affiliation of species were adopted after Matuszkiewicz (2001). Additionally, soil samples were taken in order to estimate environmental conditions. The obtained data were analyzed using commonly applied numerical methods: classification (a method of minimal variance aiming at distinguishing vegetation units) and ordination (DCA and CCA to show variation of phytocoenotic systems against the background of habitat conditions). The multivariate analyses and non-parametrical tests revealed significant dependence of floristic composition on physical and chemical soil traits. The important factors turned out to be C/N ratio and humidity as well as phosphorus content. With a distance from banks of subsidence reservoirs the contribution of particular plant functional types of species changes, e.g. share of hygrophilous plants decreases, whereas frequency and abundance of forest edge and woodland species increases. The present forest communities surrounding anthropogenic water reservoirs form spatial arrangement of vegetation along environmental gradient as follows: *Alnion glutinosae* alliance → *Alno-Ulmion* alliance → *Carpinion* alliance → *Quercion robori-petraeae* alliance.

Weed vegetation in northwestern Balkans: diversity and differentiation

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The data on weed vegetation of the western Balkan peninsula (surveyed between 1939–2006) was applied to study changes in species compositon. A large dataset of arable weed vegetation (2426 relevés after stratified resampling) was compiled and analysed with direct and indirect ordination, regression and beta diversity analysis. Five environmental variables (Altitude, Season, Year, Crop, Phytogeographical region) were used for determining broad-scale changes in weed species composition. The most important parameter is phytogeographical region and the second is crop type. Altitudinal and seasonal gradients were found as less important, although significant, what contradicts the results from Central and northern Europe. Therophytes were more common in spring and in cereals, and declined by the end of the 20th century. Hemicryptophytes increased in that period. Beta diversity is higher in cereals and summer, while decline along altitudinal gradient as in Central Europe was not observed. In southern part of the study area thermophilous species are shifted into higher altitudes. The results are discussed in relation to similar studies in northern and Central Europe.

Perennial ruderal vegetation of the Czech Republic: a new vegetation survey

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A high number of vegetation units of perennial ruderal vegetation have been distinguished in the traditional phytosociological system of the Czech Republic (Moravec et al. 1995, Red list of plant communities of the Czech Republic and their endangerment). Due to inconsistent delimitation of these units, which often differed among various authors, the revision of the recent classification system was done. A large data set of relevés was extracted from the Czech National Phytosociological Database and geographically stratified. The procedure of formalized reproduction of an expert-based vegetation classification was applied. By means of the Cocktail method, sociological species groups were defined. Consequently, formal definitions were created using these sociological species groups and also using species dominance. Syntaxonomical classification of the ruderal vegetation commonly classified in the classes *Artemisietea vulgaris* and *Agropyretea repentis* was revised. Finally, only one class *Artemisietea vulgaris* including four alliances (*Onopordion acanthii, Dauco-Melilotion, Convolvulo-Agropyrion* and *Arction lappae*) was accepted for the monograph Vegetation of the Czech Republic. In comparison with the last Czech phytosociological survey, 17 associations (instead of 25) were distinguished. Associations with poor floristic differentiation and a disputable occurrence in the country were omitted. Revision of nomenclature of syntaxa was done.

Patterns of floristic differentiation of riparian forest vegetation along a rural to urban gradient

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The aim of the present work is to study the riparian vegetation along the section of Pinios River which runs through the urban and peri-urban (rural) area of the city of Larissa (central Greece). In total, 58 relevés were sampled. The relevé data set was analyzed by means of classification (TWINSPAN) and ordination (DCA). Passive explanatory variables, such as Ellenberg indicator values, data recorded in the field and plant species biological traits were used in DCA in order to help the interpretation. The significance of the correlations of the explanatory variables with the first two DCA axes was evaluated using Kendall's Tau correlation coefficient. The values of explanatory variables were compared between the distinguished groups of relevés by means of the Mann-Whitney U test.

The main gradient of the riparian vegetation differentiation followed the transition from the urban to the rural environment. The environmental variables presenting the highest significant correlations with this gradient were Ellenberg indicator values for light and acidity, riparian vegetation width, ground inclination, presence of garbage and amount of litter. Among species biological traits, urbanity, percentage of oligohemerobic and a-euhemerobic species, and percentage of aliens were highly significantly correlated with the vegetation gradient. In conclusion, our results suggest that decrease of disturbance and increase of riparian vegetation width will contribute to the conservation and/or restoration of the riparian vegetation of Pinios River in the study area.

The classification of grassland communities to the higher syntaxonomical units in Slovakia

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During the last three years, formal definitions of grassland associations of the classes *Molinio-Arrhenatheretea, Festuco-Brometea*, and partly the *Nardetea strictae*, were performed. In many cases, the classification of some associations to the alliances is ambiguous and different in the national syntaxonomical reviews of European countries. Out of the database of phytosociological relevés from the Slovak Republic, only relevés classified to the grassland associations based on formal definitions were chosen. The clusters containing relevés of individual communities were used for numerical classification and ordination in order to find the relationships between them. For further interpretation of the individual clusters, the average Ellenberg indicator values for the relevés of each cluster were used for the ordination analysis. Based on the results of the analyses, the classification of several communities to the alliances was re-evaluated.

The effects of the northeast monsoon on the altitudinal distribution of vegetations in Taiwan

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In Taiwan, it has been considered that altitudinal distribution of vegetation differs around the island due to thermal variation associated with latitude, the Massenerhebung effect and the northeast monsoon wind prevailing in winter. Vegetation distribution of three watersheds located respectively in the north, central and south Taiwan was analyzed to elucidate the influences of those environmental factors on the distribution patterns of plant species. Plant species that were found in the three watersheds occurred at significantly lower altitudes in the north than in the other two watersheds. Floristic composition of plant communities in the northern watershed was similar to those of the other two watersheds at higher altitudes rather than those in the same altitude zone. Species richness decreases monotonically along the altitudinal gradient both in the central and southern watersheds, whereas species richness peaks in the 1500–2000 m altitudinal band in the northern watershed. All analyses for altitudinal distribution, floristic composition and species richness indicated that the differences between the central and southern watersheds were slight. Winters in northern Taiwan are wetter and colder because of the cold and moist air brought by the northeast monsoon wind prevailing in winter. However, the influences of the northeast monsoon wind can barely reach the central and southern watersheds due to the blockage of the Central Mountain Range. Consequently, the northeast monsoon wind is considered as the most influential factor for lower altitudinal distribution of species and vegetation in the northern watershed. The relatively high species richness recorded in the 1500–2000 m band of the northern watersheds is attributed to the joining of those species from higher altitudes. If the latitude effect and Massenerhebung effect are truly present in Taiwan, more sample sites and sample sites located further south are needed to detect their relatively weak effects.

Festuco-Brometea communities in southeastern Bulgaria

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Semi-natural grasslands of different types in southeastern Bulgaria were studied according to the Braun-Blanquet approach. A total number of 349 relevés were collected during 2004–2006 and analyzed using TWINSPAN and Cocktail method. The variety of associations within the alliances was recognized after reviewing all available literature. The aim of the study is to determine the syntaxonomic diversity within the *Festuco-Brometea* class in the region. The vegetation of 148 relevés belongs to dry grasslands of two alliances, five associations, three subassociations and one unclassified community. The *Festucion valesiacae* Klika 1931 is represented by ass. *Botriochloetum* (*Andropogonetum*) *ischaemi* (Krist. 1937) I. Pop 1977 *typicum* Apostolova & Meshinev 2006 and *asperuletosum cynanchicae* subass. nov.; ass. *Festuco valesiacae-Stipetum capillatae* Sillinger 1930; ass. *Medicagini-Festucetum valesiacae Wagner* 1941; ass. *Trifolio arvensis-Festucetum valesiacae* ass. nov. and *Chrysopogon gryllus*–community. The *Saturejion montanae* Horvat 1962 alliance is represented by ass. *Euphorbio myrsinitae-Botriochloetum* (*Myrsino-Ischaemetum*) R. Jovanović 1955 *medicagini rhodopaetum* subass. nov. The associations are characterized ecologically and floristically. One new association and two new subassociations are proposed. With the exception of *Botriochloetum ischaemi*, all associations are reported for the first time for Bulgaria. The close relation between *Festuco-Brometea* and *Koelerio-Corynephoretea* in the studied region are also discussed.

Invasions by *Rosa rugosa* and *Hippophaë rhamnoides* and their habitats on the Baltic coast of Russia

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The consequences of adventitious *Rosa rugosa* Thunb. and *Hippophaë rhamnoides* L. invasion in coastal plant communities of the Russian Baltic Sea coasts are considered. The phytocoenoses dominated by *Rosa rugosa* reduce species diversity. The Ellenberg light values in these communities decrease with increasing cover of rose. The findings were compared with similar data obtained by M. Isermann on the German North Sea coast. Negative effects of *Rosa rugosa* invasion are compensated by protecting sand coast from erosion. Compared to rose, sea-buckthorn has less influence on the floristic composition of coastal phytocoenoses and their environment.

Causalistic distribution of *Styrax officinalis* within its Italian enclave

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Styrax officinalis (*Styracaceae*) is an outstanding species in the taxonomical and phytogeographical assessment of the Italian peninsula. It exhibits a very narrow range around 42° latitude, with populations concentrated on the hills bordering at east the Tyrrhenian subcoastal lowland known as Roman Campagna. Disjunct stands occur South of the city of Naples, on the slopes of a coastal ridge (peninsula of Sorrento) at 41° N. The Italian populations apparently represent the westernmost Europaean outposts of a major Aegaeo-Anatolian-Palestinian range-bulk, but their native character is not universally accepted. *Styrax* is successional in local communities of transitional sub-Mediterranean deciduous to Mediterranean evergreen sclerophyllous forest. Primary sites are likely to be permanent communities exhibiting savanoid physiognomy and relic traits, in which its most frequent associates are *Adropogoneae, Carpinus orientalis, Cercis siliquastrum, Pistacia terebinthus,* along with *Quercus pubescens* s.l. and *Q. ilex*. While the density of its populations is increasing today, *Styrax* hardly spreads outside its historical narrow range despite of the apparent suitability of the ruling (macro-)climatic conditions. In order to approach this issue, a causalistic analysis of its Italian range is attempted here using a geostatistical approach. Whether or not its stands are native, the parameterisation of this phytogeographically intriguing species might be useful to enlight the question of its restricted local range and of its observed migrational immobility, along with the contribution to more realistic outputs in outlined future environmental scenarios based on predicted changes in the distribution of crucial species.

Phytosociological database of non-forest vegetation of Croatia

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Phytosociological research of vegetation in accordance with the Braun-Blanquet methodology has been carried out in Croatia for about 80 years. The foundations of vegetation science were established by Ivo Horvat and Stjepan Horvatić, followed by many botanists, resulting in numerous phytosociological publications. A phytosociological database of non-forest vegetation of Croatia has been in construction for several years. The TURBOVEG program is used for the input and storage of data. So far, 5610 relevés and more than 135,000 records of plant species-locality have been collected. Various attributes are associated with each relevé, the most basic being: literature source, date of sampling, locality, coordinates, relevé area, exposition, inclination, vegetation cover, name of community, type of management. Best covered by the data are grassland, water, marshland and halophilous vegetation. For these types of vegetation almost all available relevés have been collected, while the database of ruderal, weed and other types of non-forest vegetation is still in preparation.

The grassland vegetation of Croatia shows great biological diversity. To date, about 110 associations of grassland vegetation are known, and a total of 3350 relevés have been entered into the database. The best-represented communities are those of the *Molinio-Arrhenatheretea* class. The most widespread association is *Arrhenatheretum elatioris*, in broad terms.

Water and marshland vegetation is represented by 1040 relevés. Most of the data belongs to the *Phragmito-Magnocaricetea* class, and the most frequent marshland association is *Phragmitetum australis*.

The database of the halophilous coastal vegetation of Croatia embraces 510 relevés. The most widespread is the vegetation of maritime rocks that belongs to the association *Plantagini-Limonietum cancellati*.

Other types of non-forest vegetation are represented by 710 relevés in the database.

Since the vegetation syntaxonomic system in Croatia is neither unified nor processed by numerical methods, the current database will serve for further phytosociological investigations, various ecological analyses, as a basis for protection actions, and for many other aspects of vegetation research.

The class *Phragmito-Magnocaricetea* in Croatia: classification, ecological conditions and threats

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In Croatia, the class *Phragmito-Magnocaricetea* embraces the marshland vegetation of stagnant water, stream banks and terrain depressions with periodic floodwater. Phytosociological research of marshland vegetation has been carried out in accordance with the Braun-Blanquet methodology. So far, 820 relevés have been collected and stored in the database.

Marshland vegetation of the class *Phragmito-Magnocaricetea* in Croatia covers the order *Phragmitetalia*, three alliances – *Phragmition, Magnocaricion* and *Sparganio-Glycerion fluitantis* – and a total of 40 communities. The alliance *Phragmition* contains the following 17 associations: *Acoretum calami, Butometum umbellati, Cladietum marisci, Cyperetum longi, Equisetetum fluviatilis, Glycerietum maximae, Oenantho-Rorippetum, Phragmitetum australis, Phragmiti-Typhetum minimae, Sagittario-Sparganietum emersi, Scirpetum lacustris, Scirpetum litoralis, Scirpetum maritimi, Scirpetum tabernaemontani, Sparganietum erecti, Typhetum angustifoliae*, and *Typhetum latifoliae*. The alliance *Magnocaricion* contains 17 communities: *Caricetum acutiformis, Caricetum buekii, Caricetum elatae, Caricetum gracilis, Caricetum otrubae, Caricetum paniculatae, Caricetum rostratae, Caricetum vesicariae, Caricetum vulpinae, Eleocharitetum palustris, Eleocharitetum uniglumis, Galio palustris-Caricetum ripariae, Hydrocotyle-Caricetum elatae, Phalaridetum arundinaceae, Carex randalpina* community, *Iris pseudacorus* community, and *Juncus subnodulosus* community. The alliance *Sparganio-Glycerion fluitantis* contains 6 communities: *Apietum nodiflori, Glycerietum fluitantis, Glycerietum plicatae, Leersietum oryzoidis, Nasturtietum officinalis*, and *Veronica beccabunga* community.

The best-represented marshland community in the database is *Phragmitetum australis*, followed by *Galio palustris-Caricetum ripariae* and *Caricetum gracilis*. Diversity of marshland vegetation and of the appertaining plant species is considerably higher in inland Croatia than along the Adriatic coast.

Through the process of numerical classification it was found that most clusters correspond to specific associations of marshland vegetation, but do not confirm the division in higher syntaxonomic categories, i.e. alliances and orders. As regards the ecological conditions in habitats, numerical analysis indicated that variation in marshland vegetation is mostly affected by nutrient content, soil reaction, soil moisture, water depth, and type of management.

Since marshland vegetation belongs to the most endangered habitat types, the main threats could be considered to be: natural succession expressed by overgrowth by scrub and woody species, absence of mowing, fragmentation of habitats by the construction of roads and other objects, drainage of marshes, and loss of moisture from the habitat caused by watercourse regulation.

Vegetation, biodiversity and nature conservation in Scotland – making the links

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The historical basis for nature conservation in Scotland was the protection of special sites, an approach strengthened with the implementation of the Habitats Directive and Natura 2000. Site selection has been based to a large extent on vegetation survey and classification. The UK Biodiversity Action Plan introduced a wider approach in 1995 with action plans for priority habitats and species. Overwhelmed by hundreds of action plans, we are trying to apply an ‘ecosystem approach’ to rationalise habitat and species conservation in Scotland. What role can vegetation science and ecology play in this process?

Possible influence of global climate change on wetland plant species diversity

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The current models of global climate change for Central Europe predict the increase in mean annual temperatures, more frequent occurrence of hot summers and extreme climate events (e.g. storm rainfalls and floods) and in some regions also strong decrease of sum of precipitations. Such changes can have large consequences for the frequency of individual plant species and communities in the landscape and for their large-scale distribution patterns. On the regional level, large shifts in plant species diversity can be hypothesised. Wetland plants, especially annual species of exposed pond bottoms and aquatic macrophytes, are very sensitive to the changes in their environment. Many of these species are characterised by large inter-annual variation in their frequency and biomass production, depending on the temperature and precipitation fluctuations. It applies especially for the occurrences in limiting conditions on the border of species's distribution range: only in the climatically exceptional years or areas these species can be detected. In the Czech Republic, the examples of such species are (1) species with (sub)atlantic distribution, e.g. *Myriophyllum alterniflorum* and *Littorella uniflora*, (2) species most frequent in boreal zone, e.g. *Nuphar pumila* and *Potamogeton praelongus*, (3) native thermophilous species, frequent in warm regions (S Europe, subtropic zone), e.g. *Lindernia procumbens* and *Wolffia arrhiza* and (4) thermophilous neophytes, e.g. *Azolla filiculoides* and *Lindernia dubia*. The species of the first and second group occur in Central Europe in humid and relatively cold uplands, two latter groups are represented only in warm lowlands. In the last decade, some rare thermophilous species were more frequently documented in the Czech Republic. The cumulation of exceptionally hot and dry summers favors thermophilous species and disadvantages species intolerant to warm waters, quick substrate dessication or low atmosphere moisture. Also many common wetland species, e.g. *Typha latifolia, Lemna gibba* and *Ceratophyllum demersum*, profit from high temperatures in hot summers. This is reflected in their faster growth and increase of biomass production. The species not possessing the ability of more intensive growth with increasing temperature can be outcompeted from the stands. An evidence of the described plant diversity changes in the Central European wetlands already exists. However, in many cases climate-dependent changes are strongly modified by other processes, particularly by eutrophication and management. Therefore, in the predictive climatic models of plant species and community distribution and diversity special attention to other factors should be paid. Thus, the databases with large amount of phytosociological relevés containing also data about environment and management are useful for the analyses of the spatio-temporal changes of the flora and vegetation and their causes.

Possibilities in using indicator values for explaining vegetation classification on different scales

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Using Ellenberg values in the interpretation of classifications is problematic, because it can only be done by averaging the values. However, in large scale surveys, where older literature data are often used, it can be the only available method for describing the quality of the environment. By this presentation we intend to examine the suitability of these values in the interpretation of the clusters on three different levels/scales – local (about 25 km^2), microregional (about 100 km^2) and regional (about 700 km^2). The clusters were obtained by classification of the *Carpinion* alliance relevés.

Results show that using ecological indicator values (especially temperature and humidity related ones) on local level does not bring extra information, as local species pool is too uniform even in case of different types. However, if we investigate larger areas, the gradients described by ecological indicator values are more suitable than using objective values (e.g. various climate parameters).

Vegetation as an indicator of river degradation based on survey in Great Britain and Northern Ireland

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The river vegetation was surveyed in Britain and Northern Ireland. More than one thousand phytosociological relevés were recorded. Analysis supported by TWINSPAN revealed 73 major vegetation types, classified mostly as associations. The environmental conditions were described by 68 variables, which included geographical and morphological features as well as river water quality parameters, watershed geology and land-use information. The environmental matrix was subjected to principal component analysis (PCA) to compress data without losing much information and simplifying the representation. The identified vegetation communities and environmental data were interrelated with some descriptive analysis based on the mean value, analysis of variance (ANOVA) and also by the multivariate Canonical Correspondence Analysis (CCA). Abundance of plant communities was evaluated against ecological variables, enabling the communities to be ordered against particular environmental factors. Analysis showed that eutrophication is the major gradient determining development of the river vegetation. The macrophyte vegetation was significantly differentiated by water quality, as well as by hydromorphology, geography and land use. To some extent, geological data also reflected the differentiation pattern. All of these ecological factors were linked with processes of eutrophication. It was also found that different vegetation groups indicate apparent reaction to the river conditions. The strong influence of trophy level was confirmed in case of typical aquatic communities as well as for bank vegetation and also bryophyte and algae assemblages. Analysis enabled classification of river phytosociological communities in the oligotrophy-eutrophy gradient dividing them into five categories.

Numerical analyses and syntaxonomical revision of the oak woodland communities of Anatolia

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The paper brings a syntaxonomic revision of Anatolian oaks forest vegetation based on numerical analyses of large amount of relevés, both published and unpublished. Many relevés of oak dominated vegetation were involved. The relevés were georeferenced and analyzed using modern methods of multivariate statistics, including direct and indirect ordinations, TWINSPAN and agglomerative cluster analyses. The revealed gradients and relevé clusters were ecologically and geographically interpreted.

Grasslands of the *Arrhenatherion elatioris* and *Cynosurion cristati* alliances in Slovakia

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Grasslands of the *Arrhenatherion elatioris* Luquet 1926 and *Cynosurion cristati* Tüxen 1947 alliances belong to the agriculturally most important semi-natural vegetation of Slovakia. Till now more than 2000 phytosociological relevés of these alliances have been stored in the Slovak phytocenological database (CDF). They were ordered by the authors to 13 associations of *Arrhenatherion elatioris* and to 6 associations of *Cynosurion cristati* alliance. The plant community of some relevés in the database was not identified primarily as a consequence of unclear borders and relationships between syntaxa. In 2005–2007, syntaxonomic revision of the above mentioned grassland alliances was done within the scope of projects Classification and ecological differentiation of the mesophilous and xerophilous grassland communities in the Slovak part of the Western Carpathians and Formalized classification system for identification of grassland vegetation. During syntesis of grassland vegetation many problems appeared, for example different classification of some plant communities in Slovakia and other European countries, unclear borders between syntaxa, different understanding of the association content by the authors of relevés etc. After checking reasonability of the hitherto described associations in Slovakia and setting up more specific borders between the problematical syntaxa eight folfowing associations were accepted within the analysed alliances: *Arrhenatherion elatioris* alliance – *Pastinaco sativae-Arrhenatheretum elatioris* Passarge 1964, *Ranunculo bulbosi-Arrhenatheretum elatioris* Ellmauer in Mucina et al. 1993, *Poo-Trisetetum flavescentis* Knapp ex Oberdorfer 1957, *Anthoxantho odorati-Agrostietum tenuis* Sillinger 1933 and *Lilio bulbiferi-Arrhenatheretum elatioris* Ružičková 2002, and in *Cynosurion cristati* – *Lolietum perennis* Gams 1927, *Lolio perennis-Cynosuretum cristati* and *Alopecureto pratensis-Festucetum pseudovinae* Juhász-Nagy 1957. For the accepted grassland communities formal definitions were proposed for application in the electronic identification system of grassland vegetation.

Differentiation of calcicolous beech forests (*Cephalanthero-Fagenion* suballiance) in Slovakia

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Calcicolous beech forests belong to the most species-rich forest communities of Slovakia. Their proper classification and delimitation on the suballiance level is important not only for basic research but also for nature conservation, because they are included in the Natura 2000 unit Medio-European limestone beech forests.

A national data set of beech-forest relevés has been completed recently. Slovak TURBOVEG database (more than 40 000 relevés) comprises 3396 relevés with *Fagus sylvatica* occurrence, however, only in 1792 relevés beech cover achieves over 25% in the tree layer. According to the original authors' classification on the association level, it is possible to assign 961 relevés with beech occurrence to the *Eu-Fagenion*, 595 to the *Cephalanthero-Fagenion*, 65 to the *Acerenion* and 40 to the *Galio-Abietenion* suballiance. The rest of relevés was classsified only on the *Fagion* alliance level or to other alliances, mainly *Tilio-Acerion*, *Carpinion* and *Luzulo-Fagion*.

Diagnostic species for four suballiances of *Fagion* alliance were defined according to the fidelity measure. *Cephalanthero-Fagenion* is the best floristically differentiated suballiance (especially by *Carex alba, Sorbus aria* agg., *Campanula rapunculoides, Vincetoxicum hirundinaria, Laserpitium latifolium, Calamagrostis varia* and *Cephalanthera rubra*). On the other hand, a single species, *Dentatria bulbifera*, is found to be diagnostic for *Eu-Fagenion*. Results obtained from the original authors' classification were compared with several formalized approaches used recently for beech forest classification in Europe: TWINSPAN classification, Coctail method and delimitation by predefined diagnostic species selected regarding the Ellenberg indicator values. Sharpness and average fidelity of *Cephalanthero-Fagenion* unit within the *Fagion* alliance were used for the classification method evaluation. Further details, comparison of the traditional and formalized classifications and their feasibility for the suballiance level classification are discussed.

Changes of aquatic macrophyte vegetation: study from a river basin in Slovakia

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Changes of diversity, abundance and distribution of aquatic macrophytes between 2000 and 2007 were observed in a 4.5 km long section of the Turiec river between Moškovec and Socovce villages, downstream of Turček water reservoir. The river has a typical basin character, the surrounding landscape is formed mainly by agricultural areas or semi-natural meadows and pastures. Average annual discharge is 6–8 m^3/s and average annual water temperature is about 11 °C.

We selected river sections with more or less similar hydrological and ecological status, human impact and species distribution. In each river section, all macrophytes were sampled and the Plant Mass Estimate (PME) was assessed using a five-level scale (from rare to very abundant). Based on the PME data, following numerical derivatives were calculated: the Relative Plant Mass (RPM; %), the Mean Mass indices (MMT – mean mass total and MMO – mean mass occurrence; range from 1 to 5) and distribution ratio (d; ratio between MMT and MMO; range from 0 to 1). The ecological status of the study area of the Turiec river (in the sense of Water Framework Directive 2000/60/EC) was expressed as the Module macrophytes (MMP) ranging from 0 (bad status) to 1 (high status) only for hydrophytes.

In comparison to 2000, total number of macrophytes in 2007 increased from 25 to 35, although only amounts of amphiphytes and helophytes were changed. Number of hydrophytes increased from 11 to 12; invasive *Elodea canadensis* is a single new species. RPM of hydrophytes represents the major part from all recorded species (95% and 80% in 2000 and 2007, respectively), and it was changed for most hydrophytes. The most significant changes were detected for *Myriophyllum spicatum*, filamentous algae (decrease) and *Potamogeton crispus* (increase). Besides *Potamogeton crispus* and bryophytes, MMT more or less decreased for all other hydrophytes. In 2007, ∑ MMT decreased from 16.46 to 14.5. On the other hand, sum of both amphiphytes and helophytes MMT increased twice (7.4 and 14.1 in 2000 and 2007, respectively). Within hydrophytes, *Batrachium* species (including *B. aquatile* and *B. trichophyllum*), *Myriophyllum spicatum* and *Potamogeton crispus* were ubiquitous (d > 0.5) in 2000, whereas in 2007 only *Batrachium* species and *Potamogeton crispus*. Other species had more or less clumped distribution (d > 0.5). In all times, *Batrachium* species belonged to the most frequent species of the study area and their abundance was relatively high (MMT > 2.5). When comparing both studied years, distribution ratio of *Batrachium* species increased and achieved almost maximum value (d = 0.96). The poor ecological status (MMP = 0.378 and MMP = 0.333 in 2000 and 2007, respectively) of surveyed river section was assessed during both years, however, a slight decline of quality based on aquatic plants was observed after seven years.

The impact of mining activities on the vegetation associations in the surroudings of Baia Mare town (Maramures County)

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This paper is a case study of physical and chemical stability of a tailing pond under 20-year preservation. During this period vegetation installation was extremelly unsatisfying. In Maramures County, the hot spot area of non-ferrous mining industry, over 20 tailings ponds are located, many of them still active. A special situation can be noticed near the city of Baia Mare, where in the same area there are three tailing ponds, one of them being under preservation. Aspects related to soil characteristics (structure, particle size, porosity, texture, mineral composition, etc.) associated with vegetation dynamics are presented. Chemical reactions that occur due to chemical composition of pond's dam and their pollutant impact on environment are also presented. Results of pond's biological rehabilitation are discussed.

Shrub discriminant traits of the Mediterranean maquis

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Mediterranean maquis is largely distributed in the Mediterranean Basin; it is dominated by evergreen sclerophyllous and drought-tolerant semi-deciduous species. Mediterranean maquis structure results from a mixture of different shrub species making dense aggregation. Shrub composition reflects different species adaptive strategies to cope with stress factors, in particular with high air temperature and low water availability. Nevertheless, the structure of shrub species affects the microclimate beneath and around them, and it determines a heterogeneous light environment within the shrub crown affecting leaf morphology of the co-occurring species. Thus, the species aggregation and their position in a shrub depend on their light level adaptability and size. The main objective of this study was to analyse shrub structure of the Mediterranean maquis, developing along the Latium coast near Rome. Species aggregation pattern was also considered. The following parameters were analysed: total shrub and crown height, shrub crown volume, and LAI. Species measurements included: height, total leaf area per plant, specific leaf area (SLA), leaf area mass (LMA), leaf tissue density (LTD), and leaf longevity. Microclimate either within or around shrubs was measured. The results on the whole underlined the impact of shrub size on microclimate, determining a patchiness of microclimatic variations. Shrub volume defined three different shrub sizes: small (1.9±1.5 m^3), medium (13.1±4.8 m^3) and large (34.9±8.8 m^3). Most of the shrubs (86%) were formed by many species (up to a maximum of ten) and the other shrubs by one species. Among the most frequent species co-occurring in shrubs formation, *Cistus incanus* L. had the highest frequency, occurring mainly at the outermost part of the small shrubs. On the contrary, *Erica arborea* had the lowest frequency occurring mainly in the large shrubs. Moreover, considering leaf morphological traits, the results underlined a low shade tolerance of *C. incanus* and a high drought tolerance of *Phillyrea latifolia* L. *and Quercus ilex*, characterised by the highest LMA, LTD and leaf longevity. Thus, considering the structural and morphological trait combination, associated also to a short leaf longevity, *C. incanus* should not be competitive in response to air temperature increase in the Mediterranean Basin. Variations in shrub structure might be the first response to global change affecting Mediterranean maquis species composition. Because of this understanding, Mediterranean maquis shrub structure and species co-occurrence might help to forecast the effects of new climatic conditions on the Mediterranean-type ecosystems.

Biodiversity in the calcareous grasslands northwest of Sofia

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These results are preliminary as a part of PhD thesis. The study area includes low mountains and hills of average altitude of 950 m. The karst landscape is characterized by diverse structures. The vegetation is referred to *Festuco-Brometea*. Based on 126 relevés, the floristic diversity comprises 421 vascular plants. A significant share of recorded flora (35.4%) is referred to sub-Mediterranran or Mediterranean floristic elements. Euro-Asiatic and Euro-Siberian elements are represented by 23.5%. The rest of species are distributed in a large variety of floristic elements. Two local and 29 Balkan endemic species strengthen the general impression that the region is a refuge of considerable floristic diversity. The origin of such diversity should be tracked out in the history. The studied xerophytic grasslands are of secondary origin and have developed for thousands of years. The study region is a part of Natura 2000. The results can be used for a management plan preparation.

Nardus stricta grasslands in the Balkan Range (Bulgaria)

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This study represents the diversity of *Nardus stricta* grasslands in the Balkan Range in Bulgaria and contributes to the national vegetation classification in accordance with the Braun-Blanquet approach. The study is based on 336 phytocoenological relevés containing matgrass. Numerical classification is made using the JUICE software. Two associations are identified: *Nardetum strictae* Greb. 1950 and *Plantagini atratae-Nardetum strictae* (Simon 1957) nom. nov. within the classes *Nardo-Callunetea* Preising 1949 and *Juncetea trifidi* Hadač in Klika et Hadač 1944, respectively.

Bioassay experiment for assessment of site productivity in oak forests

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Local productivity of forest stands could be estimated by soil analysis or by analysis of herb layer biomass. However, both approaches have some weak points. Soil chemical analysis gives information about the quantity of nutrients in soil, but cannot reveal their real availability for plants. In contrast, the content of nutrients in herb biomass can be highly dependent on species composition (due to the differences in nutrient utilization by different species). In addition, biomass production depends on light and moisture availability.

A promising method for estimating soil nutrient availability is a bioassay experiment, which has been successfully used in several studies dealing with grassland vegetation. We decided to test this approach in forest vegetation, using a set of samples from oak forest stands stratified along the gradient of productivity. We set up a greenhouse experiment based on planting of radish (*Raphanus sativus* subsp. *sativus*) in soil samples taken from these plots. The advantages of this bioassay experiment are unlimited moisture conditions, equal light availability, constant climatic conditions and lack of interspecific competition. After harvesting, oven-dried biomass of radishes was weighted and analysed for nutrients content (N, P, K and Ca).

So far we have only some preliminary results based on data from only 50 plots. We analysed the relationship between data obtained in bioassay experiment, data based on forest biomass, soil data and other ecological factors measured in plots. Results of the control experiment indicate that the growth of radish is limited by the availability of phosphorus. Multivariate regression model reveals that the most important explanatory variable for the biomass of radish is soil reaction, probably because in our sampling covered mostly forests on acidic soils where the availability of phosphorus increases with pH. Both radish biomass and herb layer biomass are significantly correlated with concentration of total phosphorus in soil. However, there is no significant relationship between biomass of the radish and biomass of herb layer, because other factors, such as light, moisture and species composition play also important role.

Imprints of history in vegetation of abandoned landscape

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Recently accelerated landscape changes offer an opportunity to reveal basic mechanisms forming vegetation on the long-term scale and in the landscape context. The changing landscapes represent some kind of unintentional long-term experiments. Despite the fact, that the initial conditions and factors of these 'experiments' cannot be manipulated, they can be at least partly traced using historical sources and modern GIS analysis. Here, we summarize results of our studies of early successional forests. The current vegetation was interpreted with help of historical sources (mainly historical maps and aerial photographs) and environmental factors were derived from digital elevation model. The studies were conducted in the Doupovské hory Mountains, a region that underwent large-scale abandonment in the 1950s and provides unique opportunity to address the following questions:

- Does the vegetation of early successional forests follow similar gradients as in the ancient forests?
- Is the environmental variability induced by former human land use still causing variability in current vegetation?
- Is the vegetation development influenced by historical landscape structure?

We found that the vegetation of early successional forests reflects similar environmental gradients as the vegetation of ancient forests but it partly reflects also the former land use. There is vegetation typical of abandoned villages, pastures, meadows, and arable fields. Also chemical soil properties vary according to past land use. Nevertheless, the differences between land use types significantly vary among different areas. Hence, former land use affects the vegetation variability but its particular effect depends on specific conditions in the areas such as different management practices, species pools or combinations of abiotic factors. The distribution pattern of some species reflects the historical landscape structure. They are restricted to sites continuously covered by woody vegetation or migrate only slowly to surrounding new forests, whereas others are widespread. Hence, the migration rates differ broadly among species and these differences can substantially influence the vegetation development.

We conclude that investigating past land use is valuable tool to interpret vegetation patterns as it reflects disturbance regimes, suitable habitat patterns and nutrient budget in the past. For these reasons, the historical context should not be neglected in vegetation research. Moreover, it allows predicting the diversity of future vegetation arising in currently changing landscapes.

How to express topographically complex landscape in vegetation data analysis?

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Searching for main ecological gradients is a traditional focus of phytosociological studies. Some of them try to find explanation of vegetation patterns through easily determined variables variables such as aspect, slope, altitude, land forms and indices generated from geographic information systems. Together with Ellenberg indicator values, these are the most common and often the only environmental variables tested. Many authors also use various temperature indices and energetic balance calculation (radiation, heat, hill shade, heat index, skyview, potential direct solar irradiation) as indirect characteristics of topoclimate which can play a crucial role in vegetation distribution.

However, interpretation of these indirect environmental variables need not perfectly reflect the major variation in vegetation, because plants and vegetation are affected by complex microclimate parameters. The aim of this study was to compare some temperature, irradiation and heat indices with phenological data measured in the field, using the example of two main valleys of Moravian Karst (Czech Republic). Varied topographically complex landscape characterized by narrow V-shaped valleys deeply incised into a limestone plateau is a remarkable feature of this area.

The source dataset of 50 phytosociological relevés was sampled in August 2006 in both potentially extremely warm and extremely cold habitats. Each relevé had a size of 10 × 20 m and contained records of all vascular plants and their cover values. During early springs of 2004–2006 phenological observations were done in the same sites. Shifts in phenological development were categorized into five stages, from phenologically most advanced to most delayed habitats. The stage of phenological development of each sample plot was calculated as an average over all phenologically recorded species stages. Various indices were calculated for each sample plot and passively projected on the detrended correspondence analysis ordination diagram.

The main gradient in ordination diagram (1st axis) is significantly better associated with phenological vegetation development than with indirect indices calculated from relief models. The same pattern was found for all the years when phenological observations were done.

In conclusion, indirect environmental variables calculated from GIS models have a very limited interpretation capability in such conditions in comparison with field phenological observations.

Global change effects on seedling recruitment in grasslands

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European grassland ecosystems belong to the most species-rich and at the same time the most threatened habitats. Seedling recruitment is of high importance for the successful establishment of new plant populations, the maintenance of present populations and thus for species diversity in these ecosystems. Climate change, in combination with the impact of land-use change, will lead to new issues within the key processes of seedling recruitment.

To test for the effects of climate and land-use change on three characteristic grassland species (*Pimpinella saxifraga, Leontodon autumnalis* and *Sanguisorba officinalis*) I established two experiments.

First, I established a pot experiment with manipulation of watering regime and litter coverage to investigate how predicted shifts in precipitation affect a plants' performance at the start of the life cycle. I analyzed whether the effect of litter changes with i) the relative position of seeds (seeds on top of litter vs. below), ii) water availability (from humid to intermittently dry), and iii) whether the response to water availability and seed position varies among species.

Second, I investigated the effects of different land-use practices and additional experimental disturbance treatments on seedling recruitment in grassland stands in a two-year seed addition experiment. Sampling plots (21 m^2) with 32 randomly arranged subplots (0.1 m^2) were set up in 20 grassland fields. Species were sown separately with a density of 100 seeds/0.1 m^2 in two disturbance treatments (no disturbance, 100% topsoil removal) and under four different land-use treatments (mowing, silage mowing, meadow-pasture, grazing).

In the pot experiment, seedling emergence showed little response to litter position under humid conditions across species. In contrast, under intermittently dry conditions seedling emergence depended heavily on litter position. This suggests that species ability to cope with stressful abiotic conditions becomes more context-dependent under predicted climatic changes and in turn that effects of land-use become even more important.

In the field experiment, additional experimental disturbance with destruction of the sward (experimental gap) had stronger positive effects on establishment rates compared to disturbance effects of actual land-use. These facilitative effects of gaps indicate microsite limitation in the recruitment across all land-use practices.

These findings indicate an increase of microsite limitation in the recruitment of grassland species due to three reasons: climate change related drought, land-use change related effects of litter, and land-use change related decrease of gaps in the sward.

Analysis of dispersal limitation in the Austrian Alps using phytosociological data

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There is increasing awareness that many plant species are not in equilibrium with their current environment. Dispersal limitations, operating across various temporal and spatial scales, have been invoked as an important source of such disequilibrium. Accordingly, inter-specific differences in the degree of 'range filling' have been shown to be correlated with functional traits of the respective species, in particular with those related to dispersal capacities. However, a comprehensive investigation of the extent to which alpine species fill their potential ranges, has not been accomplished yet. In the study presented here we want to examine (1) the extent to which plant species of alpine grasslands fill their potential range as predicted by habitat distribution models which are based on the assumption that species are in equilibrium with current environmental conditions, and (2) if differences in range filling can be explained by species functional traits. Most studies focusing on supra-regional dispersal limitations are based on floristic data using grid sizes of many square kilometres. In mountainous areas like the Alps, however, the environmental conditions within one grid cell are extremely heterogeneous. Thus, distribution models derived from these data are not very reliable and tend to overestimate the environmental amplitude of species. We try to overcome this limitation by using species presence data available from a phytosociological database which contains at present *ca*. 4,200 relevés of alpine grasslands. Only for a small amount of relevés, accurate geographic coordinates are available. Most relevés are spatially represented by GIS polygons which have been derived from the source literature manually. Polygon sizes vary from a few hectares to several square kilometres. By intersecting these polygons with altitude, slope and aspect (data which are available for almost all relevés) using a digital elevation model, the spatial accuracy of plot locations can be increased. Site variables for the distribution modelling are derived either directly from source literature or by map-overlay of the polygons with GIS-layers. For large polygons, average values (in the case of metric variables) or the values which cover the largest part of the polygon are taken. In the latter case, a test of plausibility is made (especially for geological data). The accuracy of this estimation process will be tested by mimicking the procedure using sample plots with well-known coordinates.

Quantification of range filling will be done by comparing the modelled distribution with data of the floristic inventory of Austria. Therefore, modelling of the potential range and quantification of the actual range filling will be based on two independent data sets, using their respective strengths (high spatial resolution versus complete coverage of the study area).

Tall-herb fringe communities on forest edges (*Trifolio-Geranietea sanguinei* Th. Müller 1962) in the northern Ukraine

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The results of the first investigation of the tall-herb fringe communities of the *Trifolio-Geranietea sanguinei* Th. Müller 1962 class in the northern Ukraine (Polissya) are presented. Tall-herb fringe communities on forest edges have not been studied till now in the Ukraine. An investigation of this type of communities is important for completing data on European vegetation diversity in the eastern part of the continent and due to their specific role in landscape ecological structure and maintanance of biodiversity level.

Syntaxonomical differentiaton, phytocoenotic, systematical, biomorphological structure and ecological peculiarities of the *Trifolio-Geranietea sanguinei* communities are studied. Their syntaxonomical diversity in the region is determined, which consists of 11 assotiacions of 2 alliances of 1 order. Besides, 2 associations are divided into 2 subassociations and 1 alliance is divided into 2 suballiances. Eight associations are recorded as new for the Ukraine.

Biological spectra of the associations show that polycarpic herbs prevail, but lignose biomorphs are also common. As to the life forms hemicryptophytes prevail, although many species are phanerophytes and chamaephytes. The specific character of the forest edge communities is the prevalence of rhizomatous species. The analysis of ecological strategies is made.

Edaphic and hydrological conditions of the fringe biotopes of the region are analyzed by the method of synphytoindication (using ecological indicator values). Communities of the *Trifolio-Geranietea sanguinei* class are mesophytic subacidophilous mesotrophic-semieutrophic heminitrophilous hemicarbonato-phobic-acarbonatophilic coenoses, which form, towards less fertile and more acidic conditions, the following series: *Trifolio-Astragaletum ciceri* Reichhoff in Hilbig et al. 1982 > *Campanulo bononiensis-Vicietum tenuifoliae* Krausch in Th. Müller 1962 > *Origano-Vincetoxicetum hirundinariae* Kolbek et Petříček 1979 ex M. Wojterska 2003 > *Geranio-Trifolietum alpestris* Th. Müller 1962 > (*Vicietum sylvaticae* Oberd. et Th. Müller in Th. Müller 1962 + *Agrimonio-Vicietum cassubicae* Passarge 1967 + *Trifolio medii-Agrimonietum* Th. Müller 1962) > *Trifolio-Melampyretum nemorosi* (Passarge 1967) Dierschke 1973 > (*Sedo maximi-Peucedanetum oreoselini* Brzeg 1983 ex Macicka-Pawlik et Wilczyńska 1996 + *Veronico officinalis-Hieracietum murorum* Klauck 1992) > *Lathyro montani-Melampyretum pratensis* Passarge 1967. The distribution of communities in the region is mapped and four rare assotiations defined.

The investigation was made thanks to financial support of the Ministry of Education and Science of the Ukraine as the grant of the President of Ukraine No. F13/67-2007.

Pattern of local plant species richness along the gradient of landscape topographic heterogeneity: result of spatial mass effect or shift in microsite environmental conditions?

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Topographic heterogeneity has important consequences for spatial configuration of habitats in a landscape – increasing topographic heterogeneity brings different habitats close to each other. An important question is how will be microsite species richness influenced by aggregation of various habitats in its vicinity. Both empirical and theoretical studies documents that microsite species richness will increase with increasing heterogeneity of the surrounding landscape, and this relationship is usually attributed to the spatial mass effect (species can grow in unfavourable habitat due to dispersal link with the populations in favourable habitats nearby).

Here, we analyzed the relationship between microsite species richness and topographic heterogeneity of the surrounding landscape, using a stratified data set of 2551 forest relevés from the Czech National Phytosociological Database. The results show that while some vegetation types are more species-rich if surrounded by a heterogeneous landscape (e.g. both thermophilous and acidophilous oak forests), some are less species-rich (beech and ravine forests) and yet others do not show any pattern (e.g. oak-hornbeam forests). Interpretation of this pattern as a result of the spatial mass effect is supported by the analysis of habitat generalists and specialists: simulation models predict that importance of spatial mass effect is higher in communities with higher proportion of generalists, and oak forests have, compared to other forest types, relatively high proportion of habitat generalists.

However, parallel analysis using Ellenberg indicator values (EIVs) offers an alternative explanation of the revealed pattern. It shows that, generally, soil reaction in various vegetation types is higher in heterogeneous landscapes, while stand productivity (estimated through EIVs for nutrients) has an ambiguous pattern – in high-productive vegetation types it increases with heterogeneity, while in low-productive types it decreases in heterogeneous landscapes. We argue that using known empirical relationships (monotonic increasing richness-pH and hump-shaped richness-productivity relationship), these shifts in ecological characteristics of microsites may themselves explain the changes in species richness within particular vegetation types.

Topographic heterogeneity is a special case of environmental heterogeneity, having causal link to other types of landscape heterogeneity, e.g. through topoclimate, natural disturbances, soil conditions or intensity of human impact. Our study indicates that observed relationships between microsite species richness and topographical heterogeneity of the surrounding landscape can be interpreted both as a result of spatial mass effect and the shift in microsite ecological conditions. We offer these explanations as complementary rather than alternative.

Wet meadows of the alliance *Molinion* and their environmental gradients in Slovenia

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The main objective of this study was to examine the relationships between wet meadow plant communities of the *Molinon* alliance and their environmental conditions in Slovenia. The ecology of these communities was analysed in detail. The study provides the data on the vegetation and environmental parameters, the significance of parameters for the plant species composition, most important environmental gradients and differences between plant communities. In all plots the vegetation was recorded and soil parameters were analysed (pH, plant-available P and K, Nt, organic C, C/N ratio, exchangeable Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, H^{+}, electrical conductivity and base saturation). Other conditions were also considered (e.g., mean annual temperature and precipitation, humidity index, mean Ellenberg moisture and nutrient value) to test possible correlations as well. Vegetation was classified by means of multivariate cluster analysis, while vegetation-site relationships were examined with direct gradient analysis (CCA). Six associations from the *Molinion* alliance (*Selino-Molinietum, Plantagini altissimae-Molinietum, Carici davallianae-Molinietum, Gentiano-Molinietum litoralis, Junco conglomerati-Betonicetum* and *Sanguisorbo-Festucetum commutatae*) were identified and analysed. Soil reaction was identified as most significant environmental parameter explaining the variation of the studied vegetation. There are several statistically significant differences in site conditions between the communities (pH, moisture, nutrient status and Ca^{2+}). The studied associations represent clearly defined ecological units.

Supervised classification of phytosociological data using artificial neural networks and random forests

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Vegetation classifications have been traditionally created with the use of unsupervised classification methods such as cluster analysis or TWINSPAN. These methods produce entirely new classifications of the input phytosociological data sets. However, if there is an established scheme such as national vegetation classification, clusters derived by unsupervised methods from particular data sets rarely match the established vegetation units perfectly. Therefore, recently there has been an increasing attention paid to the application of supervised classification methods which are applicable for matching relevés to the units of established classifications. Some promising tools for supervised classification have been developed in the field of algorithmic modelling. In the context of vegetation classification, recent tests using a classification of Czech grasslands demonstrated the utility of one of the techniques, artificial neural networks (ANN). However, other algorithmic techniques such as random forests (RF) can be equally useful or even better.

We addressed two questions: (1) What is the difference in accuracy of supervised classifications produced by artificial neural networks and random forests? (2) Do these methods perform better with species presence/absence or with percentage cover data? The data set used for this study included 5822 relevés of forests vegetation from the Czech Republic, with expert assignments to 10 alliances and 42 associations given by the relevé authors. We considered four classification cases as combinations of either alliances or associations as classification units, and either species presence/absence of percentage cover. Each of these four cases was classified by multi-layer perceptron, which is a kind of artificial neural network, and by random forests, using the MATLAB 7.4 package. We achieved average percentage of correct classification cases in the range of 83–87% in classification to the alliance level 65–76% in classification to the association level. Lower accuracy for associations results from the higher number of classification units, therefore from the higher initial probability of classification error.

Our results indicate that there is no considerable difference in performance of artificial neural networks and random forests if they are applied to supervised classification of phytosociological data. They also produce very similar results if applied to presence/absence or cover data.

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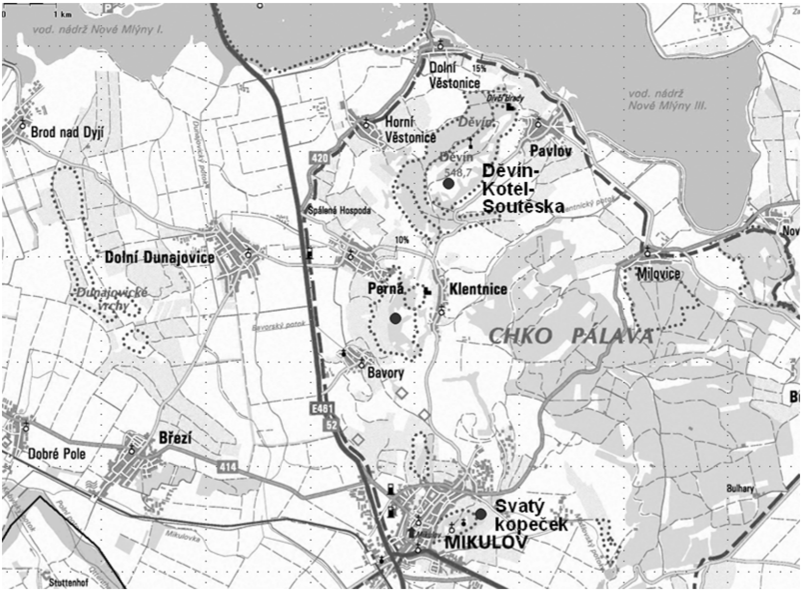
Pavlov Hills: Botanical Excursion Guide

Jiří Danihelka, Vít Grulich & Milan Chytrý

Introduction

The Pavlov Hills (in Czech Pavlovské vrchy, Pálava) is a range of limestone hills in southern Moravia situated between the Dyje River (in German Thaya) and the Czech-Austrian border near the town of Mikulov. Its northernmost point is located about 30 km south of the southern margin of the city of Brno. The area is 11 km long and 2 to 3 km wide. The altitudinal difference between the Dyje River in Pavlov (165 m) and the top of Děvín Hill (554 m) is 389 m. The northernmost hilltop with the ruin of the 14th century castle Děvičky (= Dívčí hrady, Maidenstein) stands out above the village of Pavlov. Southwards, the highest Děvín Hill (554 m) follows, which is separated in the south by the narrow gorge called Soutěska from Kotelná Hill (462 m). Růžový vrch Hill, with another castle ruin on the top, and Stolová hora Hill (459 m), with a prominent plateau, form the central part of the range. Turold Hill (385 m) and Svatý kopeček Hill (363 m), the latter with a church on its top, surround the town of Mikulov from the north and



Pavlov Hills

the east, respectively. The southernmost Šibeničník Hill (238 m) is situated south of the town near the border with Austria. Schweinbarther Berg, Höhlenstein, and Falkenstein Hills in the adjacent part of Lower Austria belong to the same range.

Geology

The landscape of the Pavlov Hills is strongly modulated, with outcrops and cliffs of pure, hard and white limestone of Upper Jurassic origin, called Ernstbrunn limestone. Sedimentation of Ernstbrunn limestone was preceded by the sedimentation of grey calcareous claystone and clay limestone, called Klentnice layers. The Pavlov Hills are situated at the margin of the flysch zone of the Eastern Alps and Western Carpathians. The flysch beds consist of strongly folded Lower Tertiary claystone, sandstone and conglomerate. During the periods of orogenetic activity in the Tertiary, large blocks of Jurassic and Lower Cretaceous rocks were torn from their Jurassic ground (now situated up to 2 km below the surface), and re-deposited over the younger flysch beds.

In the Lower Badenian period (Upper Tertiary), the Pavlov Hills were surrounded by a warm sea. Pieces of Jurassic rock present in the littoral gravel from that period indicate that limestone may have been already denuded at that time. At 15 Ma BP (before present) a strong subsidence formed the Vienna Basin. During the following 9 Ma, up to 3 km thick layers of maritime and lacustrine sediments were deposited on its bottom.

During the Quaternary, loess and debris, comprising also re-deposited Tertiary clay and fossil soils, were deposited on the footslopes of the Pavlov Hills. A complete sequence of loess sedimentation from the last two glacials and two interglacials, with buried chernozem horizons, can be observed in excavation pits near the village of Dolní Věstonice.

Soils

The prevailing soil types are rendzinas, calcareous pelosols, chernozems, and luvisols. Rendzinas were formed over hard Ernstbrunn limestone; they are shallow and dry, of neutral to moderately alkaline reaction. They are covered mainly with dry grasslands and open thermophilous oak forests. Calcareous pelosols are developed on Mesozoic and Tertiary calcareous clays and mostly covered with forests. Chernozems are found on loess deposits on the foothills of the Pavlov hills. Luvisols occur on moderately inclined hillsides covered with slope deposits or decalcified loess. These soils are deep and have a more balanced water supply; they support mainly oak-hornbeam forests.

Climate

The climate of the Pavlov Hills is subcontinental, summer-warm and dry. The mean annual temperature at Mikulov is 9.5 °C, the mean temperature of the growing season (April-September) is 15.9 °C. The warmest and coldest months are July and December with mean temperatures of 19.4 °C and -1.6 °C, respectively. Due to its location in the lee of the Bohemian-Moravian Highlands (Českomoravská vrchovina), the area around the Pavlov Hills is one of the driest in the Czech Republic. The mean annual precipitation is 571 mm, of which 367 mm falls in the growing season. Monthly rain sums vary considerably, and long periods of drought are common. Such climate supports the development of forest-steppe vegetation.

Nature conservation

The Pavlov Hills are included in the Protected Landscape Area (PLA) Pálava, which was established in 1976. Ten years later the area became a UNESCO Biosphere Reserve. The particular limestone hills and other valuable sites within the PLA are protected as National Nature Reserves (NNR), Nature Reserves (NR) and Nature Monuments (NM). There are two NNRs (Děvín-Kotel-Soutěska and Tabulová, Růžový vrch a Kočičí kámen), three NRs (Turold, Svatý kopeček and Šibeničník) und three NMs (Kočičí skála, Růžový kopec and Anenský vrch).

Landscape history

The Pavlov Hills and their surroundings are world-famous for a series of Upper Palaeolithic archaeological sites on their foothills, most notably between the villages of Dolní Věstonice and Pavlov. These sites provided a rich source of prehistoric artefacts (especially art) from the settlements of mammoth hunters from the Gravettian period (28–22 ka BP). These artefacts include carved representations of animals, humans and enigmatic engravings, a figure of a young man carved in mammoth ivory, which may represent the first example of portraiture (i.e., representation of an actual person), the earliest examples of ceramics (burned clay) figurines, including the famous Venus of Dolní Věstonice. One of the burials revealed a human female skeleton, ritualistically placed beneath a pair of mammoth scapulae, which is believed to be the first proof of a female shaman.

In 1991 palynologists E. Rybníčková and K. Rybníček analysed a peat sediment from the nearby Bulhary site, dated to around 26 ka BP. Besides indicators of steppe (*Artemisia*, *Chenopodiaceae*, *Ephedra* and *Plantago* cf. *media*) and tundra (*Betula nana*) they found a surprisingly abundant tree pollen, including drought- and cold-adapted species such as *Pinus cembra*, *P. sylvestris*, *Larix* and *Betula pendula*, but also moisture-demanding species such as Picea, Alnus and rarely also some broad-leaved deciduous trees. This was the first evidence of the full-glacial forests in eastern-central Europe, which was later confirmed by new data from Hungary and Slovak, Polish and Czech Carpathians. Based on the analogy with contemporary landscapes of continental southern Siberia, we can imagine the landscape of the Gravettian mammoth hunters as a forest-steppe with steppic grasslands on the loess plains and southern slopes, *Picea-Alnus* woodland in the river floodplains, *Pinus cembra-P. sylvestris-Larix-Betula* woodland on north-facing slopes and patches of Betula nana tundra in colder and wetter places. This interpretation is supported by the fossil mollusc faunas found in the Quaternary sediments on the foothills of the Pavlov Hills.

Due to lack of peat deposits in the dry area of southern Moravia, Holocene history of the Pavlov Hills can be reconstructed mainly based on the malacozoological evidence. It indicates that loess sedimentation was followed by spread of some warm-demanding continental species in the Late Glacial. In the Early Holocene, the area was covered by forest-steppe. At the beginning of the Atlanticum (8 ka BP) there was a sudden increase in precipitation which supported spread of mesic forests. However, Neolithic farmers colonized the area at approximately 7.5 ka BP and started a large-scale deforestation of the surrounding lowland areas, including the Pavlov Hills. The area has been permanently settled by humans ever since, with a remarkable peak in the Bronze Age, when settlements were built also on the hilltops. Although patches of mesic deciduous forest were always present on the hills, particularly on the north-facing slope of Děvín Hill, several species of molluscs and plants typical of such forests are missing there, because they failed to immigrate through the surrounding deforested landscape. Steppes in the Pavlov Hills are primary in the sense that they represent a direct continuation of the Pleistocene continental steppes. At the same time, they are secondary in many places, because they spread to the areas deforested by humans since the Neolithic.

Vegetation

The Pavlov Hills are situated in the Pannonian phytogeographical region, which reaches its north-western limit in Lower Austria and southern Moravia. This region represents the westernmost extremity of the continuous zone of the Euro-Siberian forest-steppe, which extends through the Danube valley and Pannonian Basin up to the southern fringes of the Western Carpathians, eastern fringes of the Eastern Alps, and south-eastern edge of the Bohemian Massif. The following description of vegetation mainly concerns Děvín Hill (National Nature Reserve Děvín-Kotel-Soutěska), the highest and largest of the Pavlov Hills, which harbours most of the natural and semi-natural vegetation types found in the area.

Forests

Natural vegetation of the lower hillsides of the Pavlov Hills is Pannonian oak-hornbeam forest of the association *Primulo veris-Carpinetum* (alliance *Carpinion betuli*). The main tree species are *Quercus petraea* and *Carpinus betulus,* accompanied by *Acer campestre, Tilia cordata* and *T. platyphyllos*. The shrub layer is well developed and rich in species, including *Cornus mas, Euonymus verrucosa*, *Ligustrum vulgare* and *Staphylea pinnata*. The herb layer includes *Campanula persicifolia, C. rapunculoides, Festuca heterophylla, Melittis melissophyllum*, *Primula veris* and *Viola mirabilis*.

Upwards, on sites with soils still deep and moist enough to support more or less closed canopy, oak-hornbeam forests are replaced by thermophilous oak forests of the association *Corno-Quercetum* (alliance *Quercion pubescenti-petraeae*).

Dominant trees are *Quercus petraea* and *Q. pubescens*. The shrub layer is usually luxuriant, consisting of thermophilous shrubs such as *Cornus mas*, *Ligustrum vulgare* and *Viburnum lantana*. The herb layer contains thermophilous species *Lithospermum purpurocaeruleum*, *Tanacetum corymbosum* and *Teucrium chamaedrys,* along with nutrient-demanding species of mesic forests, such as *Alliaria petiolata* and *Geum urbanum*.

The steep upper slopes with limestone outcrops support open stands of thermophilous oak forests classified as *Pruno mahaleb-Quercetum pubescentis* (alliance *Quercion pubescenti-petraeae*). Their tree and shrub layers can be hardly separated, as *Quercus pubescens* trees are usually low and bushy, and shrubs, e.g. *Cornus mas*, *Viburnum lantana* and *Ligustrum vulgare*, are numerous and vigorously growing. In the ground layer, many species of thermophilous forest fringes are present, such as *Dictamnus albus*, *Geranium sanguineum* and *Vincetoxicum hirundinaria,* as well as dry grassland species such as *Aster amellus*, *Carex humilis, Festuca rupicola*, *Inula ensifolia* and *Stachys recta*. At a finer scale, shrub association *Violo hirtae-Cornetum maris* (*Berberidion*) and herbaceous fringe communities of the alliance *Geranion sanguinei* can be distinguished here, along with different types of dry grasslands.

On the north-facing slopes of Děvín Hill, two types of broad-leaved ravine forest (alliance *Tilio-Acerion*) occur. The first one, *Aceri-Carpinetum betuli*, is more widespread and includes stands with *Tilia platyphyllos*, *Carpinus betulus* and *Acer pseudoplatanus*. It is confined to sites with well developed, moderately humid soils. The shrub layer is scarce due to the closed canopy and high densities of mouflon. The herb layer contains *Alliaria petiolata*, *Asarum europaeum, Campanula trachelium*, *Lathyrus vernus* and *Pulmonaria officinalis*; in early summer, they are overgrown by tall stands of *Aconitum lycoctonum*. Upwards, at the foot and ledges of limestone cliffs, this type of ravine forest is replaced by patches of *Seslerio albicantis-Tilietum cordatae*. This relict community, here with *Tilia platyphyllos* as the dominant tree, harbours several species of *Sesleria* grasslands, such as *Anthericum ramosum*, *Bupleurum falcatum*, *Erysimum odoratum, Hylotelephium maximum, Sesleria caerulea* and *Vincetoxicum hirundinaria*.

Most forests of the Pavlov Hills used to be coppiced in the past, but this traditional management has been abandoned since the mid 20th century. Overgrown coppices have developed closed canopy which led to retreat of light-demanding species and spread of mesophilous forest herbs. The game preserve for bezoar goat (*Capra aegagrus*) and mouflon existed on Děvín Hill until 1996.

Grasslands

Dry grasslands of the Pavlov Hills have always attracted botanists, and formal phytosociological descriptions of their most important types were already done by Zlatník (1928) and most notably by Klika (1931). In phytosociological terms, they belong to the class of Euro-Siberian steppes, *Festuco-Brometea*. The stands of *Festuco valesiacae-Stipetum capillatae* (alliance *Festucion valesiacae*) represent a type of continental steppe. They are associated with very dry places with moderately developed soil. Besides the name-giving species, they contain *Bothriochloa ischaemum*, *Centaurea stoebe*, *Festuca rupicola* and *Stipa pulcherrima*. The association *Poo badensis-Festucetum pallentis* (alliance *Bromo pannonici-Festucion pallentis*) is related to submediterranean grasslands of southern Europe and limestone or dolomite grasslands of the fringes of the Alps and Carpathians, although it contains several species of continental steppe as well. It occupies more extreme habitats with shallow soils of limestone outcrops. Several succulent *Crassulaceae*, such as *Jovibarba globifera*, *Sedum acre* and *S. album*, are confined to these places, together with *Allium flavum*, *Campanula sibirica*, *Festuca pallens*, *Iris pumila*, *Poa badensis* and *Teucrium montanum*. Short-living spring therophytes, such as *Arabis auriculata*, *Cerastium pumilum* agg., *Erophila spathulata* and *Holosteum umbellatum*, are typical of both types of dry grassland. The north- and west-facing rocky slopes support *Sesleria caerulea* grasslands of the association *Minuartio setaceae-Seslerietum caeruleae* (alliance *Diantho lumnitzeri-Seslerion*). These are related to *Sesleria* grasslands which occur on limestones of the montane and subalpine belt of the Alps and the Carpathians. It is supposed that in the Pleistocene full-glacial periods these grasslands occupied lowland mesic sites on base-rich soils, but they retreated due to spread of other vegetation types in the Holocene. Currently they are restricted to high-altitudinal limestone areas in the Alps and the Carpathians and to a few lowland sites such as the Pavlov Hills. They harbour several relict or dealpine species, e.g. *Arenaria grandiflora*, *Biscutella laevigata* subsp. *varia*, *Dianthus lumnitzeri*, *Saxifraga paniculata* and *Tephroseris integrifolia*.

Dry grassland types described above are natural in many places, but at some sites they developed due to deforestation and grazing. There are also other grassland types of secondary origin in the Pavlov Hills which are of high interest for biodiversity conservation. For example, deep soils on loess and other soft sediments on the foothills support semi-dry grasslands with *Bromus erectus* and *Brachypodium pinnatum* (*Polygalo majoris-Brachypodietum pinnati*, alliance *Cirsio-Brachypodion pinnati*). Some of these grasslands developed on abandoned fields, and during few decades they became very rich in species and attained a high conservation value.

Other examples of remarkable plant communities of the Pavlov Hills include xeric shrub communities (alliances *Berberidion* and *Prunion spinosae*), weed communities of calcareous soils (alliance *Caucalidion lappulae*) and communities of fallow land (*Dauco-Picridetum*, alliance *Dauco-Melilotion*).

Flora

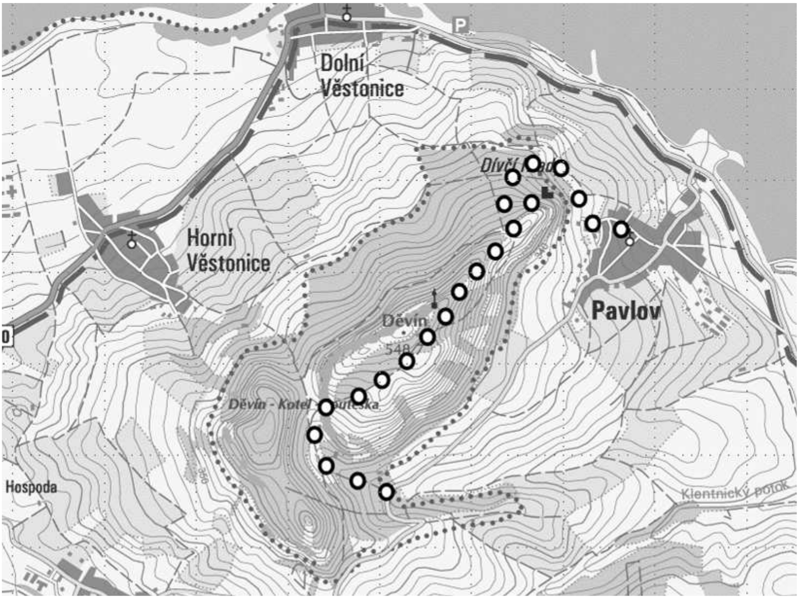
The Pavlov Hills have, due to their geographic position at the northeastern edge of Pannonia, a very remarkable flora. Steppe and rock habitats harbour two major plant groups with contrasting distribution ranges: (1) “eastern” species, i.e. those with Pannonian, Pontic-Pannonian, or Continental distribution ranges, and (2) “southern” species, i.e. mainly those with Submediterranean distribution ranges. Several species of the first group reach their western distribution limits in southern Moravia, while those of the second group grow here near their northern distribution limits. Continental species are represented, among others, by *Adonis vernalis*, *Astragalus austriacus*, *Carex stenophylla*, *Helictotrichon desertorum*, *Peucedanum alsaticum*, *Phlomis tuberosa*, *Stipa pennata* s. str., *Thalictrum foetidum* and *Viola ambigua*; they may be considered relicts of late Pleistocene and early Holocene continental steppe. *Cytisus procumbens*, *Iris pumila*, *Jurinea mollis*, *Linum hirsutum* and *Medicago prostrata* are Pontic-Pannonian or Pannonian species. The group of species with Submediterranean distribution ranges includes *Ficaria calthifolia*, *Fumana procumbens*, *Globularia bisnagarica*, *Linum tenuifolium*, *Lithospermum purpurocaeruleum*, *Minuartia fastigiata*, *M. setacea*, *Orlaya grandiflora*, *Parietaria officinalis*, *Quercus pubescens*, *Salvia aethiopis*, *Stipa pulcherrima*, *Teucrium montanum*, *Trinia glauca* and *Viola kitaibeliana*, the latter known in the Czech Republic only from the castle ruin Děvičky on Děvín Hill. *Stipa eriocaulis*, in the Czech Republic growing only on Svatý kopeček Hill above the town of Mikulov, also belongs to this group. Central European species are represented by *Viola tricolor* subsp. *saxatilis* and by species of broad-leaved deciduous forests, such as *Aconitum lycoctonum*, *Corydalis pumila* and *Hepatica nobilis*. *Dianthus lumnitzeri*, protected under the EU Habitats Directive, is endemic to western Pannonia. It occurs in southern Moravia (only in the Pavlov Hills), Lower Austria, south-western Slovakia and northern Hungary. The rocks of Děvín Hill harbour *Arenaria grandiflora* at the northernmost point of its distribution range.

National Nature Reserve Děvín-Kotel-Soutěska

The National Nature Reserve Děvín-Kotel-Soutěska is situated in the northernmost part of the Pavlov Hills between the villages of Pavlov, Dolní Věstonice, Horní Věstonice, Perná and Klentnice. It includes Děvín Hill (Maidenberg in German; 554 m) in the north-east and Kotelná Hill (also Obora Hill; 462), separated by the narrow and deep gorge Soutěska. On the northernmost hilltop of Děvín there is a ruin of the medieval castle Děvičky (in German Maidenstein). The hills are built mainly of hard and white Ernstbrunn limestone, forming spectacular cliffs above the Soutěska gorge, above the north-western slopes of Děvín Hill and on the western slope of Kotelná Hill.

The nature reserve, established in 1946, is 381 ha large. Its vegetation has been basically described above in the characteristics of vegetation of the Pavlov Hills as a whole. Flora of the reserve consist of 643 species, recorded in 1992–2004(–2007) and listed in Appendix 1.

Human impact on the ecosystems of Děvín Hill has been very long. In the Upper Palaeolithic Gravettian Period, there were human settlements on lower slopes of the hill. A fortified settlement was established in the northeast of the hilltop in the Upper Bronze Age. The castle Děvičky, built in late-Romanic and early-Gothic style, was first mentioned in written documents in the early 13th century. In the 14th century, another castle, known as Neuhaus or Domus nova, was established in the northern part of Kotel Hill. Small limestone quarries existed at several places.



National Nature Reserve Děvín-Kotel-Soutěska; dots indicate the excursion route

Nature Reserve Svatý kopeček

Svatý kopeček (363 m; Heiliger Berg in German) is flanking the town of Mikulov from the east. The hill, elongated roughly from the northeast to the southwest, is formed of white and hard Jurassic limestone. Its northwestern part was destroyed by the quarrying of limestone, lasting from 1816 to the early 1970s.

On the northwestern slopes of the hill, fragments of chasmophytic vegetation with *Aurinia saxatilis* subsp. *arduini* and *Thalictrum foetidum* are developed. The steep west-facing slope above the town of Mikulov is covered by *Sesleria caerulea* grasslands of the association *Minuartio setaceae-Seslerietum caeruleae*, harbouring a small population of *Pulsatilla grandis*. South- and southeast-facing slopes of Svatý kopeček support a patchy mosaic of dry grasslands of the associations *Poo badensis-Festucetum pallentis* and *Koelerio macranthae-Stipetum joannis*, the latter containing large stands of *Stipa pulcherrima* and *S. eriocaulis*. In mid-April, stands of flowering *Iris pumila* may be observed along the tourist trail, followed by another iris, *I. humilis* subsp. *arenaria* two weeks later. *Prunus mahaleb* and *Crataegus monogyna* are dominant species of dense shrubberies on the southeast-facing slope.

The forest stands on the hill are mainly secondary, with *Fraxinus excelsior*, *Quercus robur* and *Acer platanoides* as dominant species. Also *Pinus nigra* was planted here at the turn of the 19th century or somewhat later, as was *Syringa* *vulgaris*, introduced here by the Scenic Improvement Society ("Verschönerungsverein") and now encroaching large patches on the west-facing slope. Further invasive trees are *Robinia pseudacacia* and *Ailanthus altissima*, both spreading mainly on the east-facing slope. The thermophilous oak forests of the association *Corno-Quercetum* survived only as a small stand in the northeastern part of the reserve.

The flora of the reserve includes about 407 species and hybrids of vascular plants, recorded here in 1992–2004 (Appendix 2). Svatý kopeček is one of the most species-rich sites for the genera *Orobanche* (s. lat.) and *Viola* in the Czech Republic, supporting seven species of the former, and eleven species and five hybrids of the latter. The most remarkable species of these genera are *Orobanche arenaria*, *O. artemisiae-campestris* and *Viola ambigua*. Due to the geographic location above the western edge of the town of Mikulov and strong human influence, the proportion of alien species is very large.

The fifteen Stations of the Cross along the path to the hilltop were established in 1626–1723. The white Baroque pilgrimage Church of St. Sebastian and the neighbouring campanile on the flat top were built in the 17th century. By construction of these buildings catholic church tried to support the Counter-Reformation and to break up the old pagan belief that the hill summit was the meeting point of witches, as documented by the original German name of the hill – Tanzberg (Hill of Dances). From the top of Svatý kopeček there is a nice view of the medieval town of Mikulov, dominated by a chateau, built in the 17th century on the fundaments of the original gothic castle by Cardinal Franz von Dietrichstein, Bishop of Olomouc and Governor of Moravia. Since 1946, Svatý kopeček has been protected as nature reserve.

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Appendix 1. Vascular plants of the National Nature Reserve Děvín-Kotel-Soutěska. Alien species are marked by (al.)

Acer campestre
Acer platanoides
Acer pseudoplatanus
Acinos arvensis
Aconitum lycoctonum subsp. *lycoctonum*
Adonis aestivalis
Adonis vernalis
Adoxa moschatellina
Aegopodium podagraria
Aesculus hippocastanum (al.)
Aethusa cynapium s. lat.
Agrimonia eupatoria
Agrostis gigantea
Achillea collina
Achillea pannonica
Ailanthus altissima (al.)
Ajuga genevensis
Ajuga chamaepitys
Ajuga reptans
Alliaria petiolata
Allium angulosum
Allium flavum
Allium oleraceum
Allium scorodoprasum
Allium senescens subsp. *montanum*
Alopecurus pratensis
Alyssum alyssoides
Alyssum montanum
Amaranthus powellii
Amaranthus retroflexus
Anagallis foemina
Androsace elongata
Anemone nemorosa

Anemone ranunculoides
Anemone sylvestris
Anthericum ramosum
Anthriscus cerefolium subsp. *trichosperma*
Anthriscus sylvestris
Anthyllis vulneraria
Arabis auriculata
Arabis glabra
Arabis hirsuta
Arabis sagittata
Arabis turrita
Arctium lappa
Arctium tomentosum
Arenaria grandiflora
Arenaria serpyllifolia
Armoracia rusticana (al.)
Arrhenatherum elatius
Artemisia absinthium
Artemisia campestris
Artemisia vulgaris
Arum cylindraceum
Asarum europaeum
Asparagus officinalis
Asperula cynanchica
Asplenium ruta-muraria
Asplenium trichomanes
Aster amellus
Aster lanceolatus
Aster linosyris
Astragalus austriacus
Astragalus cicer
Astragalus glycyphyllos
Astragalus onobrychis
Atriplex oblongifolia
Atriplex patula
Atriplex sagittata
Aurinia saxatilis subsp. *arduini*
Avenula pratensis
Avenula pubescens
Ballota nigra subsp. *nigra*
Barbarea stricta
Barbarea vulgaris subsp. *vulgaris*
Bellis perennis
Berberis vulgaris
Berteroa incana
Betonica officinalis
Betula pendula
Bidens frondosa
Biscutella laevigata subsp. *varia*
Bothriochloa ischaemum
Botrychium lunaria
Brachypodium pinnatum
Brachypodium sylvaticum
Briza media
Bromus benekenii
Bromus erectus
Bromus hordeaceus subsp. *hordeaceus*
Bromus inermis
Bromus japonicus
Bromus sterilis
Bromus tectorum
Bryonia alba
Bupleurum falcatum
Calamagrostis epigejos
Camelina microcarpa
Campanula bononiensis
Campanula glomerata
Campanula persicifolia
Campanula rapunculoides
Campanula sibirica
Campanula trachelium
Cannabis ruderalis
Capsella bursa-pastoris
Cardamine impatiens
Carduus acanthoides
Carduus crispus
Carduus nutans
Carex caryophyllea
Carex contigua
Carex digitata
Carex humilis
Carex michelii
Carex montana
Carex muricata
Carex pilosa
Carex praecox
Carex supina
Carex sylvatica
Carlina acaulis subsp. *acaulis*
Carlina biebersteinii

Carpinus betulus
Carum carvi
Caucalis platycarpos
Centaurea jacea subsp. *angustifolia*
Centaurea scabiosa
Centaurea stoebe
Centaurea triumfettii subsp. *axillaris*
Cephalanthera damasonium
Cephalanthera rubra
Cerastium arvense
Cerastium glutinosum
Cerastium holosteoides subsp. *triviale*
Cerastium pumilum
Cerastium semidecandrum
Cerinthe minor
Chaerophyllum bulbosum
Chaerophyllum temulum
Chamaecytisus ratisbonensis
Chamaecytisus virescens
Chelidonium majus
Chenopodium album
Chenopodium hybridum
Chenopodium opulifolium
Chenopodium polyspermum
Chenopodium pumilio
Chondrilla juncea
Cichorium intybus
Cirsium arvense
Cirsium vulgare
Clematis recta
Clematis vitalba
Clinopodium vulgare
Colchicum autumnale
Conium maculatum
Consolida regalis
Convallaria majalis
Convolvulus arvensis
Conyza canadensis
Cornus mas
Cornus sanguinea
Corydalis cava
Corydalis intermedia
Corydalis pumila
Corylus avellana
Cotoneaster integerrimus
Crataegus laevigata
Crataegus monogyna
Crepis biennis
Crepis foetida subsp. *rhoeadifolia*
Crepis praemorsa
Cuscuta epithymum
Cuscuta europaea
Cyclamen purpurascens
Cynoglossum officinale
Cytisus nigricans
Cytisus procumbens
Dactylis glomerata
Dactylis polygama
Datura stramonium
Daucus carota subsp. *carota*
Dentaria bulbifera
Dentaria enneaphyllos
Descurainia sophia
Dianthus lumnitzeri
Dianthus pontederae
Dictamnus albus
Digitalis grandiflora
Dipsacus laciniatus
Dorycnium germanicum
Dryopteris filix-mas
Echinops sphaerocephalus
Echium vulgare
Elymus caninus
Elytrigia intermedia
Elytrigia repens
Epilobium montanum
Epilobium roseum
Epipactis helleborine
Epipactis microphylla
Erigeron podolicus
Erigeron serotinus
Erodium cicutarium
Erophila spathulata
Eryngium campestre
Erysimum durum
Erysimum cheiranthoides
Erysimum odoratum
Euonymus europaea
Euonymus verrucosa
Eupatorium cannabinum

Euphorbia amygdaloides
Euphorbia cyparissias
Euphorbia epithymoides
Euphorbia esula
Euphorbia exigua
Euphorbia falcata
Euphorbia helioscopia
Euphorbia waldsteinii
Euphrasia stricta
Euphrasia tatarica
Falcaria vulgaris
Fallopia dumetorum
Festuca arundinacea
Festuca gigantea
Festuca heterophylla
Festuca pallens
Festuca pratensis
Festuca rubra
Festuca rupicola
Festuca valesiaca
Ficaria calthifolia
Ficaria verna subsp. *bulbifera*
Filipendula vulgaris
Fragaria moschata
Fragaria vesca
Fragaria viridis
Fraxinus excelsior
Fumana procumbens
Fumaria schleicheri
Fumaria vaillantii
Gagea lutea
Gagea minima
Gagea pusilla
Gagea villosa
Galanthus nivalis
Galeobdolon montanum
Galeopsis angustifolia
Galeopsis pubescens
Galinsoga parviflora
Galium album subsp. *album*
Galium album subsp. *pycnotrichum*
Galium aparine
Galium austriacum
Galium boreale subsp. *boreale*
Galium glaucum
Galium mollugo agg.
Galium odoratum
Galium spurium
Galium sylvaticum
Galium verum
Genista tinctoria
Gentiana cruciata
Geranium columbinum
Geranium divaricatum
Geranium pratense
Geranium pusillum
Geranium pyrenaicum
Geranium robertianum
Geranium sanguineum
Geum urbanum
Glechoma hederacea
Glechoma hirsuta
Globularia bisnagarica
Hedera helix
Helianthemum grandiflorum subsp. *obscurum*
Helianthus tuberosus
Hemerocallis sp. (al.)
Hepatica nobilis
Heracleum sphondylium
Hesperis sylvestris
Hesperis tristis
Hieracium bauhini
Hieracium bifidum
Hieracium brachiatum (*H. bauhini – H. pilosella*)
Hieracium cymosum
Hieracium densiflorum (*H. bauhini – H. cymosum*)
Hieracium lachenalii
Hieracium murorum
Hieracium pilosella
Hieracium pilosellinum (*H. densiflorum/zizianum < H. pilosella*)
Hieracium racemosum
Hieracium rothianum (*H. echioides > H. pilosella*)
Hieracium sabaudum
Hieracium umbellatum
Holosteum umbellatum
Hordelymus europaeus

Hordeum murinum
Humulus lupulus
Hylotelephium maximum
Hyoscyamus niger
Hypericum hirsutum
Hypericum montanum
Hypericum perforatum
Impatiens parviflora
Inula britannica
Inula conyza
Inula ensifolia
Inula hirta
Inula oculus-christi
Inula salicina subsp. *salicina*
Inula ×stricta (= *I. ensifolia* × *I. salicina*)
Iris graminea
Iris humilis subsp. *arenaria*
Iris pumila
Iris variegata
Isatis tinctoria subsp. *tinctoria*
Isopyrum thalictroides
Jovibarba globifera subsp. *hirta*
Juglans regia (al.)
Jurinea mollis
Kickxia spuria
Knautia arvensis
Knautia ×posoniensis (= *K. arvensis* × *K. kitaibelii*)
Koeleria macrantha
Lactuca quercina
Lactuca serriola
Lactuca viminea
Lamium album
Lamium amplexicaule
Lamium maculatum
Lamium purpureum
Lappula squarrosa
Lapsana communis
Larix decidua (al.)
Lathraea squamaria
Lathyrus latifolius
Lathyrus niger
Lathyrus pratensis
Lathyrus tuberosus
Lathyrus vernus
Lavatera thuringiaca
Leontodon hispidus
Leonurus cardiaca var. cardiaca
Leonurus marrubiastrum
Lepidium campestre
Leucanthemum vulgare subsp. *vulgare*
Libanotis pyrenaica
Ligustrum vulgare
Lilium martagon
Limodorum abortivum
Linaria genistifolia
Linaria vulgaris
Linum catharticum
Linum hirsutum
Linum tenuifolium
Lithospermum arvense
Lithospermum officinale
Lithospermum purpurocaeruleum
Lolium perenne
Lonicera xylosteum
Loranthus europaeus
Lotus borbasii
Lotus corniculatus
Lycopus europaeus
Lysimachia nummularia
Malus domestica (al.)
Malus sylvestris
Malva alcea
Medicago falcata
Medicago lupulina
Medicago minima
Medicago prostrata
Medicago sativa (al.)
Medicago ×varia (= *M. falcata* × *M. sativa*)
Melampyrum arvense
Melampyrum cristatum
Melampyrum nemorosum
Melampyrum pratense
Melica ciliata
Melica nutans
Melica picta
Melica transsilvanica
Melica uniflora
Melilotus alba

Melilotus officinalis
Melittis melissophyllum
Mentha longifolia
Mercurialis perennis
Milium effusum
Minuartia fastigiata
Minuartia setacea
Moehringia trinervia
Muscari comosum
Muscari neglectum
Muscari tenuiflorum
Mycelis muralis
Myosotis arvensis
Myosotis ramosissima
Myosotis stricta
Myosoton aquaticum
Neottia nidus-avis
Nepeta cataria
Nepeta nuda
Nigella arvensis
Odontites vernus subsp. *serotinus*
Oenanthe aquatica
Omphalodes scorpioides
Onobrychis arenaria
Ononis spinosa
Onopordum acanthium
Orchis militaris
Orchis purpurea
Origanum vulgare
Orlaya grandiflora
Ornithogalum kochii
Orobanche alba subsp. *alba*
Orobanche alba subsp. *major*
Orobanche caryophyllacea
Orobanche elatior
Orobanche lutea
Orobanche picridis
Orobanche purpurea
Orthantha lutea
Oxytropis pilosa
Papaver confine
Papaver maculosum subsp. *austromoravicum*
Papaver rhoeas
Parietaria officinalis
Pastinaca sativa subsp. *sativa*
Persicaria hydropiper
Peucedanum alsaticum
Peucedanum cervaria
Phalaris arundinacea
Phleum phleoides
Phleum pratense
Phlomis tuberosa
Picea abies (al.)
Picris hieracioides
Pimpinella major
Pimpinella saxifraga subsp. *nigra*
Pinus nigra (al.)
Pinus sylvestris (al.)
Plantago lanceolata
Plantago major
Plantago media
Plantago uliginosa
Poa angustifolia
Poa annua
Poa badensis
Poa bulbosa
Poa compressa
Poa nemoralis
Poa pratensis
Poa trivialis
Polygala major
Polygonatum multiflorum
Polygonatum odoratum
Polygonum aviculare s. lat.
Populus alba
Populus tremula
Populus ×canadensis (al.)
Potentilla arenaria
Potentilla argentea
Potentilla heptaphylla
Potentilla inclinata
Potentilla recta
Potentilla reptans
Primula veris
Prunella vulgaris
Prunus avium
Prunus cerasifera
Prunus domestica
Prunus fruticosa
Prunus mahaleb
Prunus spinosa

Prunus ×*eminens* (*P. fruticosa* × *P. cerasus*)
Pseudotsuga menziesii (al.)
Pulmonaria officinalis
Pulsatilla grandis
Pyrus pyraster
Quercus cerris (al.)
Quercus petraea
Quercus pubescens
Quercus robur
Ranunculus illyricus
Ranunculus polyanthemos
Ranunculus repens
Rapistrum perenne
Reseda lutea
Reseda luteola
Rhamnus cathartica
Robinia pseudacacia (al.)
Rosa agrestis
Rosa canina
Rosa dumalis subsp. *subcanina*
Rosa gallica
Rosa spinosissima
Rubus armeniacus (al.)
Rubus caesius
Rumex acetosa
Rumex crispus
Rumex obtusifolius
Salvia nemorosa
Salvia pratensis
Salvia verticillata
Sambucus nigra
Sanguisorba minor
Saxifraga paniculata
Saxifraga tridactylites
Scabiosa canescens
Scabiosa ochroleuca
Scorzonera austriaca
Scorzonera cana
Scorzonera hispanica
Scrophularia nodosa
Securigera varia
Sedum acre
Sedum album
Sedum spurium
Senecio jacobaea
Senecio viscosus
Serratula tinctoria
Seseli annuum
Seseli hippomarathrum
Seseli osseum
Sesleria albicans
Setaria pumila
Setaria viridis
Sherardia arvensis
Silene latifolia
Silene noctiflora
Silene nutans
Silene otites
Silene vulgaris subsp. *antelopum*
Silene vulgaris subsp. *vulgaris*
Sinapis arvensis
Sisymbrium altissimum
Sisymbrium loeselii
Sisymbrium orientale
Sisymbrium strictissimum
Solanum nigrum
Solidago virgaurea subsp. *virgaurea*
Sonchus asper
Sonchus oleraceus
Sorbus aria
Sorbus aucuparia (al.)
Sorbus danubialis
Sorbus domestica
Sorbus torminalis
Stachys annua
Stachys germanica
Stachys palustris
Stachys recta
Staphylea pinnata
Stellaria media
Stellaria pallida
Stipa capillata
Stipa pennata s. str.
Stipa pulcherrima
Symphytum officinale
Syringa vulgaris (al.)
Tanacetum corymbosum subsp. *corymbosum*
Tanacetum vulgare
Taraxacum erythrospermum

Taraxacum parnassicum
Taraxacum sect. *Ruderalia*
Taraxacum serotinum
Taxus baccata
Tephroseris integrifolia
Teucrium chamaedrys
Teucrium montanum
Thalictrum flavum
Thalictrum minus
Thesium dollineri
Thesium linophyllon
Thlaspi arvense
Thlaspi perfoliatum
Thuja occidentalis (al.)
Thuja plicata (al.)
Thymelaea passerina
Thymus glabrescens
Thymus pannonicus
Thymus praecox
Tilia cordata
Tilia platyphyllos
Torilis arvensis
Torilis japonica
Tragopogon dubius
Tragopogon orientalis
Trifolium alpestre
Trifolium arvense
Trifolium campestre
Trifolium dubium
Trifolium montanum
Trifolium pratense
Trifolium repens
Tripleurospermum inodorum
Ulmus glabra
Ulmus laevis
Ulmus minor
Urtica dioica
Valeriana stolonifera subsp. *angustifolia*
Valerianella locusta
Verbascum blattaria
Verbascum chaixii subsp. *austriacum*
Verbascum lychnitis
Veronica arvensis
Veronica chamaedrys s. str.
Veronica persica
Veronica polita
Veronica praecox
Veronica prostrata
Veronica sublobata
Veronica teucrium
Veronica triloba
Veronica vindobonensis
Viburnum lantana
Vicia angustifolia
Vicia cracca
Vicia dumetorum
Vicia hirsuta
Vicia pisiformis
Vicia tenuifolia
Vicia tetrasperma
Vinca minor
Vincetoxicum hirundinaria
Viola ambigua
Viola arvensis
Viola hirta
Viola kitaibeliana
Viola mirabilis
Viola odorata
Viola reichenbachiana
Viola rupestris
Viola suavis
Viola tricolor subsp. *saxatilis*
Viola ×scabra (= *V. hirta* × *V. odorata*)
Viola ×vindobonensis (= *V. odorata* × *V.suavis*)
Viscum album subsp. *album*
Vitis sp. (al.)

Appendix 2. Vascular plants of the Nature Reserve Svatý kopeček. Alien species, mainly planted trees and shrubs, and rather recent garden escapees, are marked by (al.).

Acer campestre
Acer negundo
Acer platanoides
Acer pseudoplatanus
Acinos arvensis
Aesculus hippocastanum (al.)
Agrimonia eupatoria
Achillea collina
Achillea pannonica
Ailanthus altissima (al.)
Ajuga genevensis
Ajuga chamaepitys
Alliaria petiolata
Allium flavum
Allium oleraceum
Allium rotundum
Allium scorodoprasum
Allium senescens subsp. *montanum*
Alyssum alyssoides
Alyssum montanum
Anemone ranunculoides
Anthericum ramosum
Anthriscus caucalis
Anthriscus cerefolium subsp. *trichosperma*
Anthriscus sylvestris
Anthyllis vulneraria
Arabis auriculata
Arabis glabra
Arabis hirsuta
Arabis sagittata
Arctium lappa
Arenaria serpyllifolia
Arrhenatherum elatius
Artemisia absinthium
Artemisia campestris
Artemisia vulgaris
Asparagus officinalis
Asperula cynanchica
Asplenium ruta-muraria
Asplenium trichomanes
Aster amellus
Aster linosyris
Astragalus austriacus
Astragalus onobrychis
Atriplex oblongifolia
Atriplex patula
Aurinia saxatilis subsp. *arduini*
Avenula pratensis subsp. *hirtifolia*
Avenula pubescens
Ballota nigra subsp. *nigra*
Berberis vulgaris
Berteroa incana
Betonica officinalis
Bothriochloa ischaemum
Brachypodium pinnatum
Brachypodium sylvaticum
Bromus benekenii
Bromus erectus
Bromus inermis
Bromus japonicus
Bromus sterilis
Bromus tectorum
Bryonia alba
Bupleurum falcatum
Calamagrostis epigejos
Camelina microcarpa
Campanula bononiensis
Campanula persicifolia
Campanula rapunculoides
Campanula sibirica
Campanula trachelium
Capsella bursa-pastoris
Carduus acanthoides
Carduus crispus
Carduus nutans
Carex contigua
Carex humilis
Carex michelii
Carex montana
Carex muricata s. str.
Carex supina
Carlina biebersteinii
Carpinus betulus

Caucalis platycarpos
Centaurea scabiosa
Centaurea stoebe
Centaurea triumfettii subsp. *axillaris*
Cephalanthera damasonium
Cerastium glutinosum
Cerastium pumilum
Cerastium semidecandrum
Cerastium tomentosum (al.)
Chaerophyllum temulum
Chelidonium majus
Chenopodium album
Chenopodium strictum
Chondrilla juncea
Cichorium intybus
Cirsium vulgare
Clematis recta
Clematis vitalba
Clinopodium vulgare
Consolida regalis
Convallaria majalis
Convolvulus arvensis
Conyza canadensis
Cornus mas
Cornus sanguinea subsp. *sanguinea*
Cotoneaster integerrimus
Crataegus laevigata
Crataegus monogyna
Crataegus ×fallacina (= *C. monogyna × C. praemonticola*)
Crataegus ×media (= *C. monogyna × C. laevigata*)
Cuscuta epithymum
Cymbalaria muralis (al.)
Cynoglossum officinale
Cytisus procumbens
Dactylis glomerata
Dactylis polygama
Daucus carota subsp. *carota*
Descurainia sophia
Dianthus pontederae
Dictamnus albus
Digitalis grandiflora
Diplotaxis tenuifolia
Dorycnium germanicum
Echium vulgare
Elymus caninus
Elytrigia intermedia
Elytrigia repens
Epipactis helleborine
Erigeron acris agg.
Erigeron annuus
Erodium cicutarium
Erophila spathulata
Eryngium campestre
Erysimum diffusum
Euonymus europaea
Euonymus verrucosa
Euphorbia cyparissias
Falcaria vulgaris
Fallopia dumetorum
Festuca pallens
Festuca pseudovina
Festuca rupicola
Festuca valesiaca
Fragaria moschata
Fragaria vesca
Fragaria viridis
Fraxinus excelsior
Fumana procumbens
Fumaria vaillantii
Gagea pratensis
Gagea transversalis
Gagea pusilla
Galanthus nivalis
Galium album subsp. *album*
Galium album subsp. *pycnotrichum*
Galium aparine
Galium glaucum
Galium odoratum
Galium verum
Geranium pusillum
Geranium robertianum
Geranium sanguineum
Geum urbanum
Glechoma hederacea
Globularia bisnagarica
Hedera helix
Helianthemum grandiflorum subsp. *obscurum*
Heracleum sphondylium

Hieracium murorum
Hieracium pilosella
Hieracium rothianum
Hieracium sabaudum
Hieracium umbellatum
Holosteum umbellatum
Hordeum murinum
Hylotelephium maximum
Hypericum hirsutum
Hypericum montanum
Hypericum perforatum
Impatiens parviflora
Inula conyza
Inula ensifolia
Inula hirta
Inula oculus-christi
Iris humilis subsp. *arenaria*
Iris pumila
Isopyrum thalictroides
Jovibarba globifera subsp. *hirta*
Juglans regia (al.)
Jurinea mollis
Koeleria macrantha
Laburnum anagyroides
Lactuca quercina
Lactuca serriola
Lactuca viminea
Lamium album
Lamium amplexicaule
Lamium maculatum
Lamium purpureum
Lapsana communis
Larix decidua (al.)
Lavatera thuringiaca
Leontodon hispidus
Lepidium campestre
Ligustrum vulgare
Linaria genistifolia
Linaria vulgaris
Linum tenuifolium
Lithospermum purpurocaeruleum
Lolium perenne
Lonicera caprifolium
Loranthus europaeus
Lotus borbasii
Lotus corniculatus
Lycium barbarum
Mahonia aquifolium (al.)
Medicago falcata
Medicago lupulina
Medicago minima
Medicago sativa (al.)
Medicago ×varia (= *M. falcata* × *M. sativa*)
Melampyrum arvense
Melica altissima (al.?)
Melica ciliata
Melica uniflora
Melilotus officinalis
Mercurialis perennis
Minuartia fastigiata
Minuartia setacea
Moehringia trinervia
Muscari neglectum
Muscari tenuiflorum
Myosotis ramosissima
Narcissus pseudonarcissus (al.)
Nonea pulla
Onobrychis viciifolia
Origanum vulgare
Ornithogalum kochii
Orobanche alba subsp. *alba*
Orobanche alsatica
Orobnache arenaria
Orobanche artemisiae-campestris
Orobanche caryophyllacea
Orobanche elatior
Orobanche lutea
Orthantha lutea
Oxytropis pilosa
Papaver maculosum subsp. *austromoravicum*
Parthenocissus inserta
Pastinaca sativa subsp. *sativa*
Petrorhagia prolifera
Peucedanum alsaticum
Phleum phleoides
Picris hieracioides
Pimpinella saxifraga subsp. *nigra*
Pinus nigra (al.)
Pinus sylvestris (al.)
Plantago lanceolata

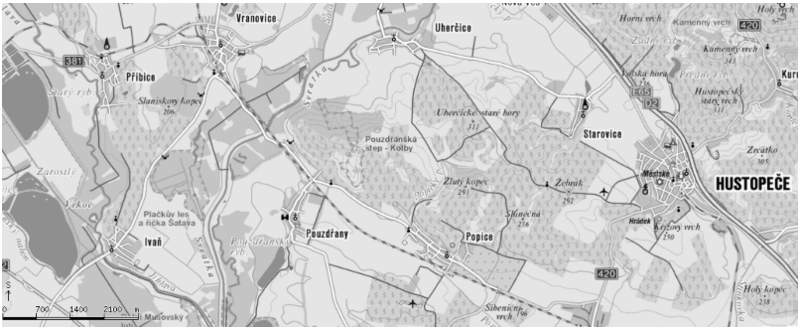
Plantago major
Plantago media
Platycladus orientalis (al.)
Poa angustifolia
Poa annua
Poa badensis
Poa bulbosa
Poa compressa
Poa nemoralis
Polygonatum multiflorum
Polygonatum odoratum
Polygonum aviculare s. lat.
Populus alba
Potentilla arenaria
Potentilla argentea
Potentilla heptaphylla
Potentilla inclinata
Potentilla recta
Primula veris
Prunus avium
Prunus cerasifera (al.)
Prunus fruticosa
Prunus mahaleb subsp. *simonkaii*
Prunus spinosa
Prunus ×eminens (= *P. fruticosa* × *P. cerasus*)
Pseudolysimachion spicatum
Pulmonaria officinalis
Pulsatilla grandis
Pyrus pyraster
Quercus cerris (al.)
Quercus petraea
Quercus pubescens
Quercus robur
Ranunculus auricomus agg.
Ranunculus illyricus
Ranunculus polyanthemos
Reseda lutea
Rhamnus cathartica
Ribes rubrum
Ribes uva-crispa
Robinia pseudacacia (al.)
Rosa canina subsp. *canina*
Rosa canina subsp. *corymbifera*
Rosa pimpinellifolia
Rubus caesius
Rumex patientia
Salix caprea
Salvia officinalis (al.)
Salvia pratensis
Salvia verticillata
Sambucus nigra
Sanguisorba minor
Saponaria officinalis
Saxifraga tridactylites
Scabiosa ochroleuca
Scilla sibirica
Scorzonera austriaca
Scorzonera cana
Scrophularia nodosa
Securigera varia
Sedum acre
Sedum album
Sedum spurium
Senecio jacobaea
Seseli annuum
Seseli hippomarathrum
Seseli osseum
Sesleria albicans
Setaria viridis
Silene latifolia subsp. *alba*
Silene nutans
Silene otites
Silene vulgaris subsp. *antelopum*
Silene vulgaris subsp. *vulgaris*
Sisymbrium orientale
Solidago canadensis (al.)
Solidago virgaurea subsp. *virgaurea*
Sorbus torminalis
Stachys recta
Staphylea pinnata
Stellaria media
Stipa capillata
Stipa eriocaulis
Stipa pennata s. str.
Stipa pulcherrima
Syringa vulgaris
Tanacetum corymbosum subsp. *corymbosum*
Taraxacum sect. *Erythrosperma*
Taraxacum sect. *Ruderalia*

Taxus baccata
Teucrium chamaedrys
Teucrium montanum
Thalictrum foetidum
Thalictrum minus
Thesium linophyllon
Thlaspi perfoliatum
Thymus glabrescens
Thymus praecox
Tilia platyphyllos
Torilis arvensis
Torilis japonica
Tragopogon dubius
Tragopogon orientalis
Trifolium alpestre
Trifolium arvense
Trifolium pratense
Trifolium repens
Trifolium rubens
Tulipa ×gesnerana (al.)
Ulmus glabra
Ulmus minor
Urtica dioica
Valeriana stolonifera subsp. *angustifolia*
Valerianella locusta
Verbascum chaixii subsp. *austriacum*
Verbascum lychnitis
Verbascum phoeniceum
Verbascum ×pseudolychnitis (= *V. chaixii* subsp. *austriacum* × *V. lychnitis*)
Veronica arvensis
Veronica polita
Veronica praecox
Veronica prostrata
Veronica sublobata
Veronica teucrium
Veronica vindobonensis
Viburnum lantana
Vicia tenuifolia
Vinca minor
Vincetoxicum hirundinaria
Viola ambigua
Viola arvensis
Viola collina
Viola hirta
Viola mirabilis
Viola odorata
Viola reichenbachiana
Viola riviniana
Viola rupestris
Viola suavis
Viola tricolor subsp. *saxatilis*
Viola ×haynaldii (= *V. ambigua* × *V. suavis*)
Viola ×hungarica (= *V. ambigua* × *V. odorata*)
Viola ×kerneri (= *V. hirta* × *V. suavis*)
Viola ×scabra (= *V. hirta* × *V. odorata*)
Viola ×vindobonensis (= *V. odorata* × *V. suavis*)
Vitis sp. (al.)

Pouzdřany Steppe and Kolby Forest: Botanical Excursion Guide

Jan Roleček

The Pouzdřany Steppe and Kolby Forest are parts of the National Nature Reserve Pouzdřanská step-Kolby. The reserve is situated in southern Moravia above the village of Pouzdřany, about 25 km south of Brno and 6 km west of the town of Hustopeče.



Area around the Pouzdřany Steppe and Kolby Forest

The complex of Pouzdřany Steppe and Kolby Forest represents one of the best preserved remnants of subcontinental forest-steppe communities in the Czech Republic. Despite its limited area (47 ha), the nature reserve harbours much of the species richness of the now widely depleted Pannonian flora and fauna.

The surrounding hilly landscape belongs to the southernmost outskirts of the Central Moravian Carpathians. From the hilltop of Pouzdřany Steppe, there is a great view of the Pavlov Hills across the lower Dyje valley, partly flooded by the Nové Mlýny reservoirs. Fringes of the Bohemian-Moravian Highlands enclose the view to the west, while lowlands of the Pannonian basin stretch to the southeast. The bedrock is mostly formed of Palaeogene calcareous claystones and sandstones of the Carpathian flysch, partly covered by Pleistocene loess. Climate of the region is relatively warm (mean annual temperature 9.1 °C) and dry (mean annual precipitation 490 mm).

The reserve comprises steep sunny slopes with dry grassland vegetation (*Festucion valesiacae*; *Cirsio-Brachypodion pinnati*), scattered shrubs and solitary trees, and a plateau and shady slopes with a mesic forest (*Carpinion betuli*). The species-rich dry grasslands of sunny slopes (*Koelerio macranthae-Stipetum joannis*) are dominated by feather grasses (mostly *Stipa pennata* and *S. pulcherrima*), narrow-leaved fescues (*Festuca valesiaca, F. rupicola*), *Koeleria* *macrantha* or *Carex humilis*. Many drought-tolerant herbs and dwarf-shrubs are admixed, e.g. *Teucrium chamaedrys*, *Thymus pannonicus*, *Potentilla arenaria*, *Galium glaucum*, *Cytisus procumbens* and *Campanula sibirica*. In disturbed (grazed, trampled, mown or formerly ploughed) places on deeper soils, rare species of continental steppe (*Crambe tataria*, *Jurinea mollis* and *Astragalus exscapus*) are particularly abundant. In more mesic sites, broad-leaved grasslands (*Polygalo majoris-Brachypodietum pinnati*) with less drought-tolerant species (*Peucedanum cervaria*, *Centaurea scabiosa*, *Geranium sanguineum*, *Adonis vernalis*, *Viola hirta* and *Orchis militaris*) occur. Scattered shrubs and solitary trees include *Crataegus monogyna*, *Prunus spinosa*, *P. fruticosa*, *Quercus pubescens* and a rare continental element *Prunus tenella* (syn. *Amygdalus nana*). From the floristic point of view, the occurrence of a small population of a Pannonian endemic *Artemisia pancicii* is the most valuable. This putative glacial relict has a maximum of 20 localities across Pannonia, in Moravia, eastern Austria and in the Deliblatska peščara in northern Serbia.

Kolby Forest on the plateau provides a nice example of Central European mesic oak-hornbeam forest (*Primulo veris-Carpinetum betuli*), though recently somewhat damaged by illegal logging. The closed canopy is dominated by *Quercus petraea*, *Acer campestre* and *Carpinus betulus*, with *Ligustrum vulgare*, *Euonymus verrucosa* or *Crataegus laevigata* in the shrub layer. The species-rich herb layer is characteristic by colourful spring aspect with *Corydalis cava*, *C. solida*, *Anemone nemorosa*, *A. ranunculoides*, *Isopyrum thalictroides* or *Viola mirabilis*. Later on, *Melica uniflora*, *Poa nemoralis*, *Convallaria majalis*, *Galium odoratum*, *Dactylis polygama* and other nemoral species become dominant. On sunny forest edges, forest-steppe species are more abundant, including *Quercus pubescens*, *Brachypodium pinnatum*, *Lithospermum purpurocaeruleum*, *Dictamnus albus*, *Euphorbia epithymoides*, *Peucedanum cervaria*, *Geranium sanguineum*, *Polygonatum odoratum*, *Carex michelii* and *Iris variegata*.

References

Podpěra J. (1928): Steppe und Waldsteppe des Hutberges oberhalb Pouzdřany (Pausram). – Preslia 7: 153–167.

Appendix. Selected species of vascular plants in Pouzdřany Steppe and Kolby Forest

Acer campestre
Acer pseudoplatanus
Acinos arvensis
Adonis flammea
Adonis vernalis
Agrimonia eupatoria
Agrostis capillaris
Achillea collina
Achillea pannonica
Ajuga chamaepitys
Ajuga genevensis
Alliaria petiolata
Allium oleraceum
Allium rotundum
Allium scorodoprasum
Allium sphaerocephalon

Allium oleraceum
Allium rotundum
Allium ursinum
Alyssum alyssoides
Anemone nemorosa
Anemone ranunculoides
Anemone sylvestris
Anthericum ramosum
Anthoxanthum odoratum
Anthriscus sylvestris
Anthyllis vulneraria
Aquilegia vulgaris
Arabidopsis thaliana
Arenaria serpyllifolia agg.
Aristolochia clematitis
Arrhenatherum elatius
Artemisia absinthium
Artemisia pancicii
Artemisia pontica
Artemisia scoparia
Asarum europaeum
Asparagus officinalis
Asperula cynanchica
Aster amellus
Aster linosyris
Astragalus austriacus
Astragalus glycyphyllos
Astragalus exscapus
Astragalus onobrychis
Avenula pratensis
Avenula pubescens
Betonica officinalis
Betula pendula
Bothriochloa ischaemum
Brachypodium pinnatum
Brachypodium sylvaticum
Briza media
Bromus benekenii
Bromus erectus
Bromus inermis
Bromus japonicus
Bupleurum falcatum
Bupleurum rotundifolium
Calamagrostis arundinacea
Calamagrostis epigejos
Camelina microcarpa
Campanula bononiensis
Campanula glomerata
Campanula persicifolia
Campanula sibirica
Campanula rapunculoides
Campanula trachelium
Cardamine impatiens
Cardaria draba
Carex caryophyllea
Carex digitata
Carex humilis
Carex michelii
Carex montana
Carex muricata agg.
Carex praecox
Carex supina
Carlina vulgaris s. lat.
Carpinus betulus
Caucalis platycarpos
Centaurea jacea
Centaurea scabiosa
Centaurea stoebe
Centaurea triumfettii
Cerastium arvense
Cerinthe minor
Clematis recta
Clematis vitalba
Clinopodium vulgare
Conringia orientalis
Convallaria majalis
Cornus mas
Cornus sanguinea
Corydalis cava
Corydalis pumila
Corylus avellana
Crambe tataria
Crataegus monogyna
Crataegus laevigata
Crepis praemorsa
Crepis foetida subsp. *rhoeadifolia*
Cruciata glabra
Cynoglossum officinale
Cytisus nigricans
Cytisus procumbens
Dactylis glomerata
Dactylis polygama

Daucus carota
Dianthus pontederae
Dictamnus albus
Diplotaxis muralis
Dorycnium pentaphyllum agg.
Echium vulgare
Elymus caninus
Elytrigia intermedia
Elytrigia repens
Erigeron acris
Erodium cicutarium
Erophila verna
Eryngium campestre
Erysimum diffusum
Erysimum odoratum
Erysimum repandum
Euonymus europaea
Euonymus verrucosa
Euphorbia cyparissias
Euphorbia epithymoides
Euphorbia exigua
Euphorbia falcata
Euphorbia waldsteinii
Falcaria vulgaris
Festuca heterophylla
Festuca pseudovina
Festuca rupicola
Festuca valesiaca
Ficaria verna subsp. *bulbifera*
Filipendula vulgaris
Fragaria vesca
Fragaria moschata
Fragaria viridis
Fraxinus excelsior
Fumaria schleicheri
Fumaria vailantii
Galanthus nivalis
Galium aparine
Galium album
Galium glaucum
Galium odoratum
Galium sylvaticum
Galium tricornutum
Galium verum
Genista tinctoria
Geranium robertianum
Geranium sanguineum
Geum urbanum
Glaucium corniculatum
Glechoma hirsuta
Glycyrhizza glabra
Helianthemum grandiflorum
Helichrysum arenarium
Heracleum sphondylium
Hesperis sylvestris
Hieracium auriculoides
Hieracium bauhini
Hieracium densiflorum
Hieracium kalksburgense
Hieracium lachenalii
Hieracium laevigatum
Hieracium murorum
Hieracium pilosella
Hieracium rothianum
Hieracium sabaudum
Hieracium umbellatum
Holosteum umbellatum
Humulus lupulus
Hylotelephium maximum
Hypericum hirsutum
Hypericum perforatum
Chaerophyllum bulbosum
Chaerophyllum temulum
Chamaecytisus ratisbonensis
Chamaecytisus austriacus
Chondrilla juncea
Inula ensifolia
Inula ensifolia × *I. salicina*
Inula germanica
Inula hirta
Inula oculus-christi
Inula salicina
Iris graminea
Iris pumila
Iris variegata
Isopyrum thalictroides
Jurinea mollis
Knautia arvensis
Koeleria gracilis
Lactuca quercina
Lactuca serriola
Lamium album

Lappula squarrosa
Lathyrus niger
Lathyrus pannonicus subsp. *collinus*
Lathyrus tuberosus
Lathyrus vernus
Lavathera thuringiaca
Ligustrum vulgare
Lilium martagon
Linaria vulgaris
Linaria genistifolia
Linum flavum
Linum hirsutum
Linum tenuifolium
Lithospermum arvense
Lithospermum officinale
Lithospermum purpurocaeruleum
Lonicera caprifolium
Lotus corniculatus s. lat.
Lycium barbarum
Lycopsis arvensis
Malus sylvestris
Medicago falcata
Melampyrum arvense
Melampyrum pratense
Melampyrum cristatum
Melampyrum nemorosum
Melica nutans
Melica ciliata
Melica transsilvanica
Melica uniflora
Melittis melissophyllum
Milium effusum
Moehringia trinervia
Muscari comosum
Muscari neglectum
Muscari tenuiflorum
Neottia nidus-avis
Nigella arvensis
Nonnea pulla
Odontites vernus subsp.*serotinus*
Omphalodes scorpioides
Ononis spinosa
Orchis militaris
Origanum vulgare
Ornithogalum kochii
Orobanche alsatica
Orobanche arenaria
Orobanche caryophyllacea
Orobanche purpurea
Orthantha lutea
Oxytropis pilosa
Papaver maculosum subsp. *austromoravicum*
Peucedanum alsaticum
Peucedanum cervaria
Phleum phleoides
Phlomis tuberosa
Phyteuma spicatum
Picris hieracioides
Pimpinella saxifraga
Plantago lanceolata
Plantago media
Poa angustifolia
Poa bulbosa
Poa nemoralis
Polycnemum arvense
Polygala major
Polygonatum multiflorum
Polygonatum odoratum
Populus tremula
Potentilla alba
Potentilla arenaria
Potentilla patula
Potentilla recta
Primula vulgaris subsp. *canescens*
Prunus fruticosa
Prunus spinosa
Pseudolysimachion spicatum
Pulmonaria mollis
Pulmonaria officinalis agg.
Pulsatilla grandis
Pyrus pyraster
Pulsatilla pratensis subsp. *bohemica*
Quercus cerris
Quercus petraea
Quercus pubescens
Quercus robur
Ranunculus auricomus agg.
Ranunculus polyanthemos
Rapistrum perenne

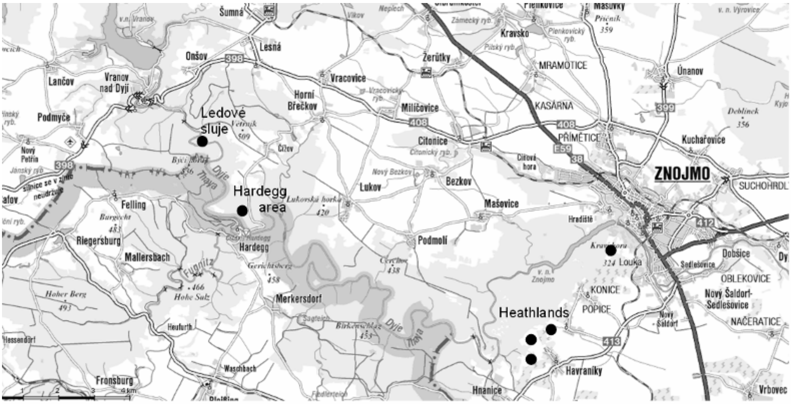
Reseda lutea
Reseda luteola
Rosa canina
Rosa dumalis
Rosa gallica
Rosa spinosissima
Salix caprea
Salsola kali subsp. *rosacea*
Salvia nemorosa
Salvia pratensis
Salvia verticillata
Sambucus nigra
Sanguisorba minor
Saponaria officinalis
Scabiosa ochroleuca
Sclerochloa dura
Scorzonera austriaca
Scorzonera cana
Scorzonera hispanica
Scorzonera purpurea
Securigera varia
Sedum acre
Senecio jacobaea
Serratula tinctoria
Seseli hippomarathrum
Seseli osseum
Sherardia arvensis
Silene nutans
Silene otites
Silene vulgaris
Sisymbrium loeselii
Solidago virgaurea
Sorbus domestica
Sorbus torminalis
Stachys annua
Stachys recta
Staphyllea pinnata
Stellaria holostea
Stipa capillata
Stipa pennata
Stipa pulcherrima
Symphytum tuberosum
Tanacetum corymbosum
Teucrium chamaedrys
Thalictrum minus
Thesium dollineri
Thesium linophyllon
Thlaspi perfoliatum
Thymus glabrescens
Thymus pannonicus
Tilia cordata
Tragopogon dubius
Tragopogon orientalis
Trifolium alpestre
Trifolium medium
Trifolium montanum
Trifolium rubens
Trinia glauca
Ulmus glabra
Ulmus laevis
Ulmus minor
Valeriana stolonifera subsp. *angustifolia*
Verbascum chaixii subsp. *austriacum*
Veronica praecox
Veronica prostrata
Veronica teucrium
Veronica vindobonensis
Viburnum lantana
Viburnum opulus
Vicia dumetorum
Vicia cracca
Vicia pisiformis
Vicia sylvatica
Vicia tenuifolia
Vinca minor
Vincetoxicum hirundinaria
Viola ambigua
Viola hirta
Viola mirabilis
Viola reichenbachiana
Viola riviniana
Viola suavis
Viola tricolor subsp. *saxatilis*

Podyjí National Park: Botanical Excursion Guide

Milan Chytrý & Vít Grulich

Introduction

Podyjí National Park is situated in southwestern Moravia between the towns of Znojmo and Vranov nad Dyjí along the Czech-Austrian border. Austrian Thaytal National Park is adjacent on the other side of the national border.



Podyjí National Park with indication of the sites to be visited

The territory of the National Park is at the southeastern edge of the Bohemian-Moravian Highlands (Českomoravská vrchovina). A remarkable landscape element is the 60–200 m deep, V-shaped valley of the Dyje (in German Thaya) River. The slopes of the valley are steep, with abundant rock outcrops, and dissected by numerous ravines. The valley is surrounded by a gently undulating landscape, which is rather typical of the Bohemian Massif in the central and south-western part of the Czech Republic. The highest point of the National Park is Býčí hora Hill (536 m) in its western part, the lowest point (208 m) is the level of the Dyje River at the eastern edge of the National Park.

The area is built of Proterozoic crystalline rocks of the Bohemian Massif. Granitoids (granites and granodiorites) predominate in the eastern part of the National Park, south-west of the town of Znojmo, where they are locally overlaid by soft Miocene (Upper Tertiary) deposits. Gneiss is the main bedrock type in the western part of the National Park, between the towns of Vranov nad Dyjí and Hardegg. Acidic mica shist is the most common bedrock in the central part of the National Park, but in this area outcrops of more base-rich bedrock (amphibolite, marble) are also encountered. Quaternary eolian deposits (loess) are found mainly in the eastern part of the area.

Predominant soil type is cambisol. Orthic luvisols occur on crystalline plateaus and gentle slopes with a thick layer of weathering products of ancient rocks or young deposits. Outcrops of ancient hard bedrock are covered by shallow rankers and lithosols, and marble outcrops with rendzinas. Gleysols are found in shallow wet depression on the plateaus, and loamy-sandy fluvisols on the alluvial terraces of the valley bottom. In the eastern part of the area, chernozems are developed on the fine-grained Tertiary or Quaternary deposits, whereas albic luvisols prevail on Neogene sand and gravel.

The climate in the east of the National Park is dry and warm. The mean annual temperature in Znojmo-Kuchařovice is 8.8 °C and the mean annual precipitation of 564 mm, which is similar to the warm and dry lowland area of southern Moravia. Moving to the northwest, the climate becomes increasingly cooler and wetter. Complex topography of the river valley generates remarkable mesoclimatic patterns. Whereas the gently undulating landscape, at least in the central and north-western part of the area, has oceanic climatic features with smaller differences between minimum and maximum temperatures, the climate of the river valley is more continental. Upper parts of the south-facing slopes may warm up considerably during the daytime but they cool off to temperatures lower than elsewhere in the valley during clear nights. There are two types of temperature inversion in the valley. Inversion due to topographical shading mainly affects the lower parts and foots of the north-facing slopes. It is most intense during the daytime and limits temperature maxima. This type of inversion supports occurrence of montane plants in these habitats. The second type of inversion is caused by the cold-air drainage, which occurs from time to time during clear and calm nights, and creates a temperature difference of up to 3 °C between the warmer upper slopes and cooler valley bottom. Particularly in spring, this inversion may cause a frost injury to sensitive plants. It is possible that some species of oceanic distribution and even Fagus sylvatica may be outcompeted from the valley due to frost injuries.

History of botanical research and nature conservation

The flora of the area was studied in detail by Adolf Oborny, a secondary school teacher, in 1870-1920. Since then hardly any species new to the region have been found except for a few ones from taxonomically intricate groups. The comprehensive *Flora des Znaimer Kreises* (Flora of the Znojmo District; Oborny 1879) enables a comparison with the current situation.

After 1948 the whole territory was closed to the public being a state border area (iron courtain). The Podyjí Landscape Protected Area was established in 1978. In the 1980s, research was resumed, and its results were later used as arguments for establishing a national park. This happened in 1991 when the Podyjí National Park was established on an area of 63 km^2, covering nearly the whole territory of the former Landscape Protected Area. Particularly valuable sites, formerly nature reserves, e.g. Hamerské vrásy, Havranické vřesoviště, Hradišťské terasy, Kraví hora, Popické kopečky and Údolí Dyje, are now protected under the regulations of the first zone (core area) of the National Park. The activities on the Czech side of the border were coordinated with those in Austria. On 1 January 2000, the National Park became bilateral through the establishment of the Thaytal National Park in the adjacent area in Austria.

Intensive botanical research, coordinated by Professor Jiří Vicherek at Masaryk University, Brno, took place in the whole area of the Podyjí National Park and in adjacent areas of Austria in the early 1990s. This research included inventories of macromycetes, lichens, bryophytes, vascular plants and plant communities, and resulted in three monographs and a series of journal papers.

Vegetation

The Podyjí National Park is situated in the transitional area between continental (Pannonian) and Central European (Hercynian) phytogeographical regions. The Pannonicum corresponds to the continental forest-steppe biome, and the Hercynicum to the deciduous forest biome. The boundary between these regions generally follows the geological dividing line between the Bohemian Massif (north-western and central part of the National Park, with higher altitudes, lower temperatures, higher precipitation, ancient siliceous bedrock, and a landscape mosaic of forest tracts and treeless areas) and the outer depressions of the Western Carpathians and the Eastern Alps (southeastern part of the National Park, with lower altitudes, warmer and drier climate, Tertiary and Quaternary deposits, and a landscape largely deforested since prehistoric times).

The predominant vegetation type of the National Park is the broad-leaved deciduous forest. In the western (Hercynian) part, near the towns of Vranov nad Dyjí and Hardegg, submontane beech forests (associations *Melico uniflorae-Fagetum sylvaticae*, *Carici pilosae-Fagetum sylvaticae* and *Tilio cordatae-Fagetum sylvaticae*; alliance *Fagion sylvaticae*) are the main types of potential natural vegetation. They are found in the gently undulating landscape at altitudes above 450 m. Hercynian oak-hornbeam forests (*Melampyro nemorosi-Carpinetum betuli; Carpinion betuli*) are predominant in the central part of the National Park and in the river valleys. Moving to the east towards the region of Pannonian flora, oak-hornbeam forests are replaced by acidophilous oak forests (*Genisto germanicae-Quercion*) and, on the south-eastern slope of the Bohemian Massif, by thermophilous oak forests (*Sorbo torminalis-Quercetum*; *Quercion petraeae*). In the outer depressions of the Carpathians, which are adjacent to the Bohemian Massif in the east, a mosaic of thermophilous oak forests (*Quercetum pubescenti-roboris*; *Aceri tatarici-Quercion*) and Pannonian oak-hornbeam forests (*Primulo veris-Carpinetum; Carpinion betuli*) is supposed to be the potential natural vegetation; however, this area has been largely deforested since the Neolithic.

A remarkable vegetation pattern is encountered in the river valleys. The alluvium is covered by riverine alder forests (*Stellario-Alnetum glutinosae; Alnion incanae*). Lower slopes support ravine forests (*Aceri-Carpinetum; Tilio-Acerion*) at steeper sites and oak-hornbeam forests (*Melampyro nemorosi-Carpinetum; Carpinion betuli*) at less inclined sites. South-facing upper slopes are covered by thermophilous oak forests (*Sorbo torminalis-Quercetum* and *Genisto pilosae-Quercetum petraeae*; both *Quercion petraeae*) whereas the north-facing slopes support acidophilous oak forests (*Luzulo albidae-Quercetum*; *Genisto germanicae-Quercion*). On the tops of ridges and cliffs, small patches of pine forests (*Cardaminopsio petraeae-Pinetum sylvestris*; *Dicrano-Pinion*) are found.

The river valley includes patches of primary treeless habitats on cliffs, rock faces and talus slopes. On south-facing slopes, these are covered by scrub (*Prunion spinosae*, *Berberidion*) or dry grasslands (*Festucion valesiacae*; *Alysso-Festucion pallentis*). North-facing treeless patches are dominated by rocky grasslands of *Calamagrostis arundinacea* on siliceous bedrock, and by *Sesleria caerulea* grassland (*Diantho lumnitzeri-Seslerion*) on marble. Talus slopes are covered with cryptogamic vegetation and, near the forest edges, with species-poor communities of mosses and ferns. There are rich bryophyte communities especially on open north-facing talus slopes, where several species of boreal distribution are found.

Secondary treeless vegetation is mainly found in the border area of the National Park and in the adjacent landscape. In the western and central part, *Arrhenatherion elatioris* and *Calthion palustris* meadows are predominant types of secondary meadows. *Arrhenatherion elatioris* meadows are also found on the Dyje deforested terraces in the river floodplain. The river is fringed by the *Phalaridion arundinaceae* riverine reeds with *Phalaris arundinacea* and *Carex buekii*. The largely deforested south-eastern slope of the Bohemian Massif in the eastern part of the National Park is well-known for its extensive dry heathland with thermophilous and continental species (*Euphorbio cyparissiae-Callunetum vulgaris; Euphorbio cyparissiae-Callunion vulgaris*) and acidophilous dry grasslands (*Potentillo heptaphyllae-Festucetum rupicolae; Koelerio-Phleion phleoidis*). The area of the outer depression of the Western Carpathians is mainly dominated by arable land and vineyards, and the most remarkable type of semi-natural vegetation is the *Convolvulo-Agropyrion* grassland in road verges on loess.

Flora

During the inventory of the flora of the Czech Podyjí and Austrian Thaytal National Parks and adjacent areas in the 1990s approximately 1290 species of vascular plants were recorded. Of these, 27% Central European, 26% are Eurasian temperate species, 12% submediterranean and 9% neophytes.

Deforested area of the southern Moravian lowlands, which is adjacent to the eastern border of the National Park, contains thermophilous Pannonian and continental species of steppe, ruderal habitats on loess and inland saline grasslands. The group of species that are only found in this area includes *Alcea biennis*, *Astragalus onobrychis*, *Atriplex oblongifolia*, *Carex hordeistichos, Cytisus procumbens, Iris pumila, Kochia prostrata* (only in Austria), *Peucedanum alsaticum*, *Ranunculus illyricus*, *Salvia austriaca* (only in Austria), *Scabiosa canescens, Sclerochloa dura, Scorzonera cana* and *Seseli hippomarathrum*. Some thermophilous species occur in this warm and dry eastern area, but are also found in the river valley in the central and western part of the National Park, e.g.

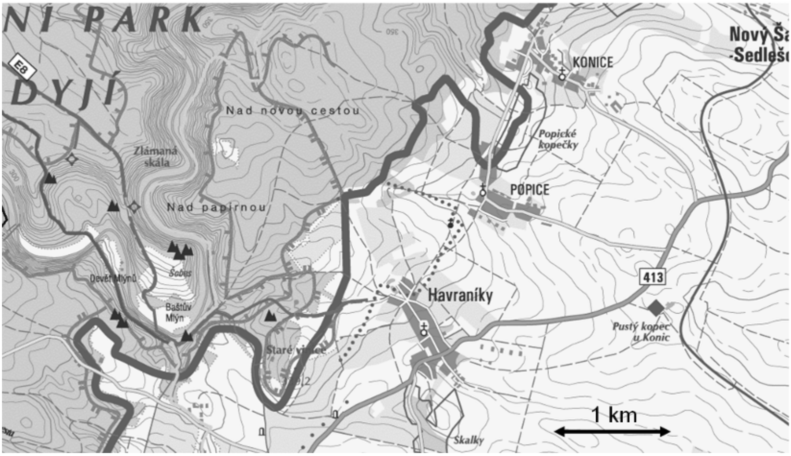
Armeria vulgaris, *Carex supina*, *Rosa jundzillii*, *R. spinosissima*, *Salvia pratensis* and *Scabiosa ochroleuca*. Another group of thermophilous species is confined to the areas with base-rich soils, found in the eastern lowland area and on the marble bedrock around the town of Hardegg in the central-western part of the National Park, e.g. *Aster amellus*, *Inula ensifolia* and *Polygala major*. A group of species phytogeographically related to the limestone fringes of the Alps is found on the marbles near Hardegg, e.g. *Buphthalmum salicifolium* (the only current locality in the Czech Republic), *Bupleurum longifolium* (now only in Austria), *Euphorbia angulata*, *Laserpitium latifolium* (only in Austria), *Polygala amara* and *Sesleria caerulea*. This marble area also harbours some orchids, such as *Cypripedium calceolus*, *Orchis militaris* and *O. purpurea*. Some thermophilous species are confined to the rock outcrops and forest edges in the Dyje river valley, including *Aconitum anthora*, *Aurinia saxatilis* and *Bupleurum affine*. Species of acidic rock outcrops are found in the river valley and in the area of the south-eastern edge of the Bohemian Massif; this group includes *Gagea bohemica*, *Genista pilosa*, *Scleranthus perennis*, *Sedum reflexum* and *Veronica dillenii*.

Montane species such as *Aconitum variegatum*, *Aruncus dioicus*, *Lunaria rediviva*, *Polystichum aculeatum*, *Rosa pendulina* and *Taxus baccata* are found in the shaded parts of the river valley. Another group of montane species, including *Atropa bella-donna*, *Equisetum sylvaticum*, *Hordelymus europaeus*, *Petasites albus*, *Prenanthes purpurea* and *Vicia sylvatica*, occurs on the plateaus dominated by beech forest in the western part of the National Park. Deforested plateaus in the central and western part of the National Park contain some wet meadows and patches of wet alder forest with submontane species such as *Bistorta major*, *Carex appropinquata*, *C. elongata*, *C. umbrosa*, *Salix rosmarinifolia*, *Scorzonera humilis*, *Tephroseris crispa* and *Trollius altissimus*.

Sites worth visiting

Dry heathlands near the villages of Popice and Havraníky (Appendix 1)

Gentle slopes of the south-eastern edge of the Bohemian Massif in the eastern part of the National Park are formed of granitoids, which are noticeable as slightly elevated outcrops. In places granitoids are covered by Tertiary deposits or loess. Natural vegetation of that area would be a mosaic of thermophilous oak forests with *Quercus petraea*, locally also *Q. pubescens*, and oak-hornbeam forests with *Carpinus betulus* and *Q. petraea*. However, the area has been deforested probably since the Neolithic period and shallow soils on the granitic bedrock were used as oligotrophic pastures for livestock. In the 18th and 19th centuries there was extensive sheep farming, but most pastures were abandoned already at the end of 19th century. Secondary succession of woody vegetation is rather slow on shallow granitic soils in the dry local climate, therefore an extensive area of former pastures has been preserved as an open land until the present. Preservation of grasslands and heathlands was facilitated by occasional grazing, accidental fires, and using some parts of the area as military training ground. Nature conservation management of grasslands and heathlands is applied since the early 1990s.



Area of heathlands in the eastern part of the Podyjí National Park (SW of the city of Znojmo).

Thermophilous acidophilous grasslands of the association *Potentillo heptaphyllae-Festucetum rupicolae* (alliance *Koelerio-Phleion phleoidis*) and heathlands of the association *Euphorbio cyparissiae-Callunetum vulgaris* (*Euphorbio cyparissiae-Callunion vulgaris*) developed here as the main types of semi-natural vegetation, encompassing also small patches of pioneer communities of the association *Festuco-Veronicetum dillenii* (*Arabidopsion thalianae*) on shallow soils adjacent to rock outcrops. In the 1990s, the competetively strong grass *Arrhenatherum elatius* expanded in the area, probably due to increased atmospheric nitrogen deposition. The shallow valleys between the flat elevations used to support patches of wet *Calthion palustris* meadows, most of which have been destroyed. *Carex cespitosa*, *Cirsium canum* and *Iris sibirica* occurred here until recently.

The heathland vegetation comprises an unusual combination of plant geographic elements, all being more or less xerophilous. Pannonian species are well represented and some of them reach their western distribution limits here (e.g. *Cytisus procumbens, Iris pumila*, *Linaria genistifolia*, *Pulsatilla grandis* and *Saxifraga bulbifera*). Acidophilous heathland species, some of them with sub-Atlantic distribution ranges, form another distinct group, including *Armeria vulgaris, Calluna vulgaris*, *Gagea bohemica*, *Scleranthus perennis, Sedum reflexum*, *Veronica dillenii* and *V. verna*. Species of sand grasslands, such as *Corynephorus canescens*, *Filago minima* and *Vulpia myuros*, are confined to granite outcrops and coarse sand produced through granite weathering. *Avenella flexuosa*, *Danthonia decumbens, Nardus stricta* and *Sambucus racemosa* are typical Hercynian elements. *Biscutella laevigata* subsp. *varia* and *Cotoneaster integerrimus* have perialpine distribution ranges. Endangered species *Helichrysum* *arenarium, Melampyrum arvense* and *Orchis morio* still form large populations in this area.

Heathland management

Heathland is an Atlantic vegetation type, which becomes increasingly rare in the more continental climate of dry areas of Central Europe. As a secondary vegetation, they require regular disturbance to prevent succession into scrub or woodland. The heathlands in the area were grazed by sheep in the 19th century, but no other details on the traditional management are known. In the 20th century the land was largely abandoned. In the 1990s, some parts of the heathland area were covered with open scrub, groups of *Betula pendula* and *Pinus sylvestris* trees. Competitive grasses *Arrhenatherum elatius* and *Calamagrostis epigejos* started to expand in many places. In 1992 a series of management experiments was established to test whether some management practices used in Western European heathlands are applicable for the dry, continental, and species-rich heathlands in the Podyjí National Park.

The management practices tested were burning, sod-cutting with vegetation and topsoil removal, and cutting of the above-ground biomass. Burning promoted successful regeneration of *Calluna vulgaris*. Dense heathlands containing large amount of woody biomass support medium-intensity fire, which destroys moss mats and litter. On bare ground *Calluna* regeneration by seed can take place, in addition to vegetative regrowth. In contrast, open heathlands with patches of herbaceous vegetation support only low-intensity fires, which do not open bare mineral soil. Almost all *Calluna* regeneration is vegetative in this case, and regrowth is slower.

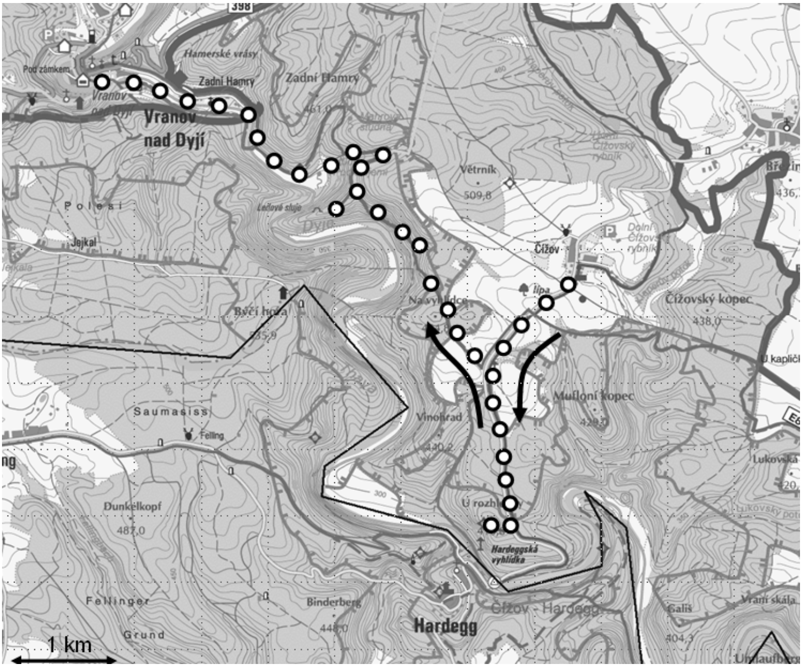
Heathland recovery after sod-cutting depends on whether or not *Calluna* seed germination occurs in the plot. With germination, the community develops towards heathland; otherwise it changes into dry grassland. Cutting of the above-ground biomass leads to a striking increase in grass cover, which is followed by a slow recovery of *Calluna*.

All of these management practices result in an increased species richness of vascular plants, bryophytes, and lichens which are natural constituents of the community. No spread of alien species was observed. The number of species in experimental plots peaks 3–4 years after the disturbance. The highest increase in species richness is in the sod-cut plots, where species germinate on the exposed mineral soil. This experiment suggests that proper nature conservation management of heathland can be based on sheep grazing combined with rotational sod-cutting or burning of restricted patches.

Serious threat to the heathland biodiversity is the rapid expansion of *Arrhenatherum elatius,* which started in the mid 1990s. Spread of this grass is probably caused by nitrogen accumulation due to long-time abandonment combined with increased atmospheric deposition. The National Park staff are trying to stop this expansion by sheep grazing, mowing, and litter removing, but so far the results are unsatisfactory.

Dyje valley near Hardegg (Appendix 2)

The site worth visiting includes the surroundings of the Hardegg observation point (Hardeggská vyhlídka) and the slope opposite the town of Hardegg (Hardeggská stráň). It is situated in the region where the Dyje River valley and its right-side tributary Fugnitz deeply cut through different layers of the Moravicum rock series. Various sorts of rock, such as base-rich marble and amphibolite on the one hand, and acidic orthogneiss on the other, strongly affect the local distribution pattern of plant species and vegetation types.



Dyje valley in the western part of the Podyjí National Park between the towns of Vranov nad Dyjí and Hardegg. Dots indicate the excursion route.

From the Hardegg observation point, located on the upper edge of the Dyje valley on the Czech side of the state border, there is a romantic view of the small Austrian town of Hardegg with its castle, built on the cliff above the confluence of the Dyje and Fugnitz rivers. It was built at the turn of the 11th and 12th centuries as one of the fortresses that protected the Austrian border. A parallel chain of fortresses was built on the Czech (Moravian) side of the border. In the 17th century the castle lost its original purpose, and was turned into hunting lodge, and after a major restoration at the end of 19th century, it became a public museum dedicated to Emperor Maximilian of Mexico, brother of Emperor Franz-Josef of Austria.

This area is very rich in species. During the detailed grid mapping of the flora in the 1990s more than 600 vascular plant species per 1' × 0.6' square (about 1.2 km^2) were recorded. This number is even more striking when we consider the low human influence in the area. Arable fields and ruderal habitats are almost absent, and even in the past no settlements other than the Austrian town of Hardegg existed here.

The plateau above the valley is covered by Hercynian oak-hornbeam forests (association *Melampyro nemorosi-Carpinetum betuli*, alliance *Carpinion betuli*) with *Dentaria bulbifera, Hepatica nobilis* and *Stellaria holostea* in the herb layer, accompanied by perialpidic species *Carex pilosa* and *Cyclamen purpurascens*. *Abies alba* is remarkable here not only for its presence but also for its natural regeneration. In a stand of an oak-hornbeam forest over a marble outcrop, *Cypripedium calceolus* grows together with *Corallorhiza trifida, Daphne mezereum, Euphorbia angulata* and *Hierochloë australis*.

The south-facing slopes with outcrops of amphibolite and amphibolitic gneiss support thermophilous oak forests of the association *Sorbo torminalis-Quercetum* (alliance *Quercion petraeae*) with acidophilous species *Agrostis vinealis, Avenella flexuosa* and *Festuca ovina* in the herb layer. Acidophilous dry grasslands of the alliance *Alysso-Festucion pallentis* are confined to the gneiss outcrops. *Gagea bohemica* and *Veronica dillenii* occur here on rock edges and narrow terraces. On marble, acidophilous oak forests are replaced by basiphilous ones, represented here by the associations *Corno-Quercetum* and *Pruno mahaleb-Quercetum pubescentis* (alliance *Quercion pubescenti-petraeae*); *Quercus pubescens* is, however, absent from this part of the valley due to its isolated location outside the Pannonian region. In open places, forest edge communities of the alliance *Geranion sanguinei* with *Buphthalmum salicifolium, Dictamnus albus, Geranium sanguineum, Inula hirta* and *Peucedanum cervaria* are found, together with dry grasslands of the alliance *Festucion valesiacae*, including *Carex humilis, Festuca valesiaca, Inula ensifolia, Orchis militaris, Polygala major* and *Stipa pennata*. Grasslands dominated by *Sesleria caerulea*, accompanied by *Aster amellus* and *Hypochaeris maculata*, occur rarely on west-facing slopes. Pioneer communities of the association *Cerastietum* (alliance *Alysso alyssoidis-Sedion*) with spring therophytes, such us *Arabis auriculata, Saxifraga tridactylites* and *Veronica praecox*, are restrictedto marble outcrops. *Sorbus hardeggensis*, named after the town of Hardegg, occurs here among scattered shrubs. This recently described hybridogenous apomictic species is derived from a crossing between *S. aria* s. lat. and *S. torminalis*.

The species composition of most forest stands is nearly natural. Plantations of Scots pine (*Pinus sylvestris*), Norwegian spruce (*Picea abies*) and European larch (*Larix decidua*) will be gradually replaced by autochthonous tree species according to the management plan of the National Park. Rock vegetation, thermophilous oak forests, their thermophilous fringes and dry grasslands require no management in the area. The bottom of the Dyje River valley used to be farmed. It was covered mainly with the *Arrhenatherion elatioris* meadows but also with strips of arable land. They have been regrassed since the mid 1990s. The meadows will be preserved here as a valuable component of the cultural landscape.

Ledové sluje (Ice Caves)

Ledové sluje (in German Eisleiten) is a system of pseudocarst caves situated in the Dyje valley between the towns of Vranov nad Dyjí and Hardegg. Since several centuries these caves have been famous for containing ice until late summer. In a broader sense, Ledové sluje is a local name for the whole ridge where these caves occur.

The ridge of Ledové sluje is located above the left bank of the Dyje river, between flat hills of Větrník (510 m) and Býčí hora (514 m). The river flows in deeply entrenched meanders between these two hills at an altitude of ca. 300 m. The ridge is formed of Proterozoic orthogneiss. On the steep valley slopes there are several slope failures, which gave rise to about twenty crevice-type caves. The longest cave system is more than 400 m long. On the NW-facing slopes of the ridge there is a talus slope formed of large gneiss blocks originated through rock falls from the above cliffs.

The Ledové sluje ridge is remarkable for a large diversity of habitats, including south- and north facing slopes, rock outcrops, steep slopes, rock debris and deep soils on the lower slopes and in the narrow river floodplain. This is reflected both in the species-rich flora and the high number of vegetation types recognized in this rather small area (< 0.5 km^2).

Vegetation

Most of the area of Ledové sluje is forested. Mesic and deep cambisols on the middle and lower slopes are occupied by oak-hornbeam forests with Carpinus betulus and *Quercus petraea* (association *Melampyro nemorosi-Carpinetum betuli*, alliance *Carpinion betuli*) and species of mesic broad-leaved forests in the herb layer, e.g. *Campanula persicifolia*, *Cyclamen purpurascens*, *Dactylis polygama*, *Galium odoratum*, *G. sylvaticum*, *Hepatica nobilis*, *Poa nemoralis* and *Stellaria holostea*. Shallower cambisols (up to 40 cm deep) on the upper north-facing slopes support acidophilous oak forests dominated by *Quercus petraea* (association *Luzulo luzuloidis-Quercetum petraeae*; alliance *Genisto germanicae-Quercion*). These open-canopy forests have a species-poor herb layer with calcifuge species such as *Avenella flexuosa*, *Luzula luzuloides*, *Festuca ovina* and *Vaccinium myrtillus*. Their rich moss layer contains *Dicranum scoparium*, *Hypnum cupressiforme*, *Polytrichum formosum*, *P. juniperinum* and other species. In similar topographic situations on south-facing slopes acidophilous oak forests are replaced by thermophilous oak forests (association *Sorbo torminalis-Quercetum petraeae*; alliance *Quercion petraeae*). Their canopy is also dominated by *Quercus petraea*, but they contain a number of shrubs (e.g., *Cornus mas*, *Ligustrum vulgare* and *Rosa canina* agg.) and a species-rich herb layer. It is mostly dominated by *Festuca ovina*, which is accompanied by *Anthericum* *ramosum*, *Bupleurum falcatum*, *Euphorbia cyparissias*, *Hylotelephium maximum*, *Poa nemoralis*, *Polygonatum odoratum*, *Teucrium chamaedrys*, *Trifolium alpestre*, *Vincetoxicum hirundinaria* and other species. Broad-leaved ravine forests (association *Aceri-Carpinetum betuli*; alliance *Tilio-Acerion*) are found on steep lower slopes with accumulation of rock debris. They have a species-rich tree layer, including *Acer platanoides*, *A. pseudoplatanus*, *Carpinus betulus*, *Tilia cordata* and *Tilia platyphyllos* and shrub layer with C*orylus avellana*, *Euonymus verrucosa*, *Lonicera xylosteum* and *Ribes uva-crispa*. There is a species-poor herb layer with nutrient-demanding and shade-tolerant forest species, such as *Dryopteris filix-mas*, *Galeobdolon montanum*, *Geranium robertianum* and *Urtica dioica*. Moss layer is luxuriant, with most common species including *Dicranum scoparium*, *Hypnum cupressiforme* and *Polytrichum formosum*. Small patches of natural pine forests (association *Cardaminopsio petraeae-Pinetum sylvestris*, alliance *Dicrano-Pinion sylvestris*) are found on the tops and faces of gneiss outcrops. Besides *Pinus sylvestris* they contain some individuals of *Quercus petraea* and *Betula pendula*. Their species-poor herb layer is dominated by *Festuca ovina* and contains also *Avenella flexuosa*, *Genista pilosa* and *Polypodium vulgare*. Moss layer contains *Dicranum scoparium*, *Hypnum cupressiforme*, *Polytrichum piliferum* and a number of lichens, including *Parmelia conspersa*, *P. pulla*, *P. saxatilis* and *P. somloensis*.

Natural treeless vegetation is found on the open talus slopes and rock faces. Talus slopes have a rich flora of lichens and bryophytes. Most common macrolichen is *Cladonia rangiferina* and most common bryophytes include *Antitrichia curtipendula*, *Dicranum scoparium*, *Hypnum cupressiforme* and *Polytrichum formosum*. Large areas of the talus slopes contain only cryptogamic vegetation with abundant epilithic microlichens. Vascular plant flora in this habitat is species-poor, including *Dryopteris filix-mas*, *Festuca ovina*, *Poa nemoralis* and *Polypodium vulgare*. Well-insolated rock faces harbour *Aurinia saxatilis*, *Festuca ovina* and *Polypodium vulgare*. In contrast, shaded rocks are covered with moss polsters, mainly by *Hypnum cupressiforme* and contain some ferns growing in crevices, most frequently *Polypodium vulgare*.

Flora (Appendix 3)

Detailed inventories done in the early 1990s recorded 163 species of lichens, 28 species of liverworts, 95 species of mosses and 502 species of vascular plants. Lichen *Endocarpon psorodeum* was found here as the first record for the Czech Republic. Several species of lichens and bryophytes occurring on talus slopes in Ledové sluje are more typical of high-altitude areas, but they occur here in places influenced by cold air flowing out of the ice caves. These include lichens *Cladonia squamosa subsp. subsquamosa*, *Fuscidea cyathoides*, *Peltigera aphtosa*, *Pertusaria corallina*, *Rhizocarpon geographicum* subsp. *geographicum* and *Umbilicaria polyphylla*, liverworts *Anastreptophyllum minutum*, *Barbilophozia hatcheri*, *Calypogeia muelleriana*, *Jamesoniella autumnalis*, *Lophozia longidens*, *Porella cordeana* and *Tritomaria quinquedentata* and moss *Polytrichum alpinum*.

Flora of vascular plants is dominated by Central European (35%) and temperate Eurasian (34%) species, but submediterranean species are also relatively common (13%), the latter represented for example by *Allium flavum, Arabis turrita* and *Cornus mas*. Particularly remarkable is the occurrence of *Carex pediformis, Cimicifuga europaea* and *Rubus saxatilis,* species typical of southern Siberian hemiboreal forests, which are rather rare in Central Europe. Ledové sluje is an isolated locality for some thermophilous species which are more common in the dry lowlands of southern Moravia east of the town of Znojmo, but they largely disappear in the Bohemian Massif. In this area, they are confined to sunny slopes and rock outcrops in the river vallyes. This group of species includes both submediterranean and temperate continental species such as *Allium flavum, Dictamnus albus, Iris variegata* (westernmost locality in Moravia), *Lithospermum purpurocaeruleum* and *Melica picta*. *Aconitum anthora*, a species belonging to a group of closely related taxa with temperate continental distrubution, is found at sunny forest edges on the ridge summit. In Moravia this species is confined to the river valleys of the Bohemian Massif. *Carex cespitosa* and *Pseudolysimachion maritimum*, species of wet continental meadows, are found in a small wetland on the river terrace west of the Ledové sluje ridge.

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Appendix 1. Selected species of vascular plants in the heathlands near Popice and Havraníky

Agrimonia eupatoria
Agrostis vinealis
Achillea collina
A. setacea
Allium flavum
Anthriscus cerefolium
  subsp. *trichosperma*
Arabidopsis thaliana
Aristolochia clematitis
Armeria vulgaris
Arrhenatherum elatius
Artemisia campestris
Asparagus officinalis
Asperula cynanchica
Aster linosyris
Avenella flexuosa
Avenula pratensis
Berteroa incana
Biscutella laevigata
  subsp. *varia*
Bromus tectorum
Calluna vulgaris
Cardaria draba
Carex humilis
C. supina
Carlina vulgaris
Centaurea stoebe
Cerastium glutinosum
Chamaecytisus
  ratisbonensis
Chondrilla juncea
Conium maculatum
Cotoneaster integerrimus
Cytisus procumbens
C. scoparius
Danthonia decumbens
Dianthus carthusianorum
D. deltoides
Echium vulgare
Elytrigia intermedia
Erodium cicutarium
Euphorbia cyparissias
E. waldsteinii
Festuca ovina
F. pallens
F. pseudovina
F. valesiaca
Ficaria calthifolia
Filago arvensis
F. minima
Filipendula vulgaris
Fragaria viridis
Frangula alnus
Gagea bohemica
G. pusilla
G. villosa
Galium valdepilosum
Genista pilosa
G. sagittalis
Helichrysum arenarium
Hieracium echioides
H. umbellatum
Hypochaeris maculata
H. radicata
Inula britannica
Iris pumila
Jasione montana
Jovibarba globifera
Koeleria macrantha
Linaria genistifolia
Luzula campestris
Lychnis viscaria
Melampyrum arvense
Melica transsilvanica
Mercurialis annua
Myosotis ramosissima
M. stricta
Nardus stricta
Odontites vernus
  subsp. *serotinus*
Onopordon acanthium
Orthantha lutea
Petrorhagia prolifera
Phleum phleoides
Picris hieracioides
Plantago media

Poa bulbosa
Polygonatum odoratum
Potentilla arenaria
Prunus fruticosa
Pseudolysimachion spicatum
Pulsatilla grandis
Ranunculus bulbosus
Rhinanthus minor
Rosa gallica
R. jundzilii
R. rubiginosa
R. spinosissima
Rumex acetosella
Salvia nemorosa
S. pratensis
Sanguisorba minor
Saxifraga bulbifera
S. granulata
Scabiosa canescens
S. ochroleuca
Scleranthus perennis
S. polycarpos
Scorzonera cana
S. acre
S. reflexum
S. sexangulare
Senecio jacobaea
Seseli annuum
S. hippomarathrum
S. osseum
Silene otites
Sisymbrium altissimum
Stachys recta
Stipa capillata
S. pennata
Taraxacum sect. *Erythrosperma*
Teucrium chamaedrys
Thlaspi perfoliatum
Thymus praecox
Trifolium alpestre
T. arvense
T. campestre
T. montanum
T. retusum
Valerianella locusta
Verbascum lychnitis
V. phoeniceum
Veronica dillenii
V. prostrata
V. triphyllos
V. verna
V. vindobonensis
Vicia pannonica subsp. *striata*
Vincetoxicum hirundinaria
Viola canina

Appendix 2. Selected species of vascular plants in the Dyje valley near Hardegg

Abies alba
Acer campestre
Aconitum anthora
Adoxa moschatellina
Agrostis vinealis
Achillea nobilis
A. pannonica
Ajuga genevensis
Allium flavum
Allium senescens subsp. *montanum*
Alnus glutinosa
Alyssum alyssoides
Anemone ranunculoides
A. sylvestris
Anthemis tinctoria
Anthericum ramosum
Arabis brassica
Artemisia campestris
Asarum europaeum
Asparagus officinalis
Asperula cynanchica
Asplenium ruta-muraria
A. septentrionale
Aster amellus
A. linosyris
Aurinia saxatilis

Avenella flexuosa
Batrachium fluitans
Berberis vulgaris
Brachypodium pinnatum
Bromus benekenii
Buphthalmum salicifolium
Bupleurum falcatum
Calamagrostis arundinacea
Campanula persicifolia
Cardaminopsis arenosa
Carex brizoides
C. buekii
C. flacca
C. humilis
C. michelii
C. montana
C. pilosa
C. supina
Carpinus betulus
Centaurea scabiosa
C. stoebe
C. triumfettii
C. pumilum
C. semidecandrum
Chamaecytisus ratisbonensis
Clematis recta
Convallaria majalis
Corallorhiza trifida
Cornus mas
Corydalis solida
Cotoneaster integerrimus
Crepis praemorsa
Cyclamen purpurascens
Cypripedium calceolus
Dactylis polygama
Daphne mezereum
Dentaria bulbifera
Dictamnus albus
Echium vulgare
Eryngium campestre
Euonymus europaea
E. verrucosa
Euphorbia angulata
E. cyparissias
E. dulcis
E. epithymoides
Fagus sylvatica
Festuca ovina
F. pallens
F. valesiaca
Gagea bohemica
G. minima
Galanthus nivalis
Galeopsis speciosa
Galium glaucum
G. odoratum
G. sylvaticum
G. valdepilosum
Genista germanica
G. pilosa
Gentiana cruciata
Geranium phaeum
G. sanguineum
Glechoma hirsuta
Helianthemum grandiflorum subsp. *obscurum*
Hepatica nobilis
Hesperis sylvestris
Hieracium echioides
H. umbellatum
Hierochloë australis
Hypericum montanum
Hypochaeris maculata
Inula conyzae
I. salicina
I. ensifolia
Inula ensifolia × *I. germanica*
I. hirta
I. oculus-christi
Iris variegata
Isopyrum thalictroides
Juniperus communis
Knautia drymeia
Lactuca quercina
L. viminea
Lappula squarrosa
Lathyrus vernus
Libanotis pyrenaica
Ligustrum vulgare
Lilium martagon
Linaria genistifolia
Lonicera xylosteum

Loranthus europaeus
Luzula divulgata
L. luzuloides
Lychnis viscaria
Maianthemum bifolium
Medicago falcata
Melampyrum nemorosum
Melica ciliata
M. picta
M. uniflora
Melittis melissophyllum
Mercurialis perennis
Milium effusum
Minuartia fastigiata
Neottia nidus-avis
Omphalodes scorpioides
Orchis militaris
O. purpurea
Origanum vulgare
Orobanche lutea
Phalaris arundinacea
Phleum phleoides
Phyteuma spicatum
Pinus sylvestris
Poa bulbosa
P. nemoralis
Polygala major
Polygonatum multiflorum
P. odoratum
Potentilla arenaria
P. recta
Primula elatior
P. veris
Prunus fruticosa
P. mahaleb
Pseudolysimachion spicatum
Pulsatilla grandis
P. pratensis subsp. *bohemica*
Quercus petraea
Qu. robur
Ranunculus bulbosus
Rumex acetosella
R. aquaticus
Salix fragilis
Salvia glutinosa
S. pratensis
Sanicula europaea
Saxifraga tridactylites
Scabiosa ochroleuca
Scleranthus perennis
Scrophularia umbrosa
Sedum album
S. reflexum
Senecio germanicus
Seseli osseum
Sesleria caerulea
Silene nutans
Sisymbrium strictissimum
Sorbus aria agg.
S. hardeggensis
S. torminalis
Stachys recta
Stellaria holostea
S. nemorum
Stipa capillata
S. dasyphylla
Stipa pennata
Stipa pulcherrima
Symphytum tuberosum
Tanacetum corymbosum
Taxus baccata
Teucrium chamaedrys
Thesium linophyllon
Thlaspi caerulescens
Th. perfoliatum
Thymus praecox
Tilia cordata
T. platyphyllos
Trifolium alpestre
T. montanum
Ulmus glabra
U. laevis
Vaccinium myrtillus
V. chaixii subsp. *austriacum*
Verbascum nigrum
Veronica dillenii
V. praecox
Veronica prostrata
V. teucrium
V. vindobonensis
Viburnum lantana
Vicia sylvatica

V. tenuifolia
Vincetoxicum hirundinaria
Viola mirabilis
V. tricolor subsp. *saxatilis*
Viscum album subsp. *austriacum*

Appendix 3. Vascular plants species recorded on the ridge of Ledové sluje

Abies alba
Acer campestre
A. platanoides
A. pseudoplatanus
Achillea collina
A. distans s. lat.
A. millefolium
Aconitum anthora
Actaea spicata
Adoxa moschatellina
Aegopodium podagraria
Agrostis capillaris
A. gigantea
A. stolonifera
Ajuga genevensis
A. reptans
Alchemilla gracilis
Alliaria petiolata
Allium flavum
A. oleraceum
A. senescens subsp. *montanum*
Alnus glutinosa
Alopecurus aequalis
A. pratensis
Anchusa officinalis
Anemone nemorosa
A. ranunculoides
Angelica sylvestris
Anthemis tinctoria
Anthericum ramosum
Anthoxanthum odoratum
Anthriscus sylvestris
Apera spica-venti
Arabidopsis thaliana
Arabis glabra
A. pauciflora
A. turrita
Arctium lappa
A. minus
A. tomentosum
Arenaria serpyllifolia
Arrhenatherum elatius
Artemisia absinthium
A. vulgaris
Asarum europaeum
Asplenium septentrionale
A. trichomanes
Astragalus glycyphyllos
Astrantia major
Athyrium filix-femina
Atropa bella-donna
Aurinia saxatile
Avenella flexuosa
Avenochloa pubescens
Ballota nigra
Batrachium fluitans
Berteroa incana
Betonica officinalis
Betula pendula
Brachypodium pinnatum
B. sylvaticum
Briza media
Bromus benekenii
B. hordeaceus subsp. *hordeaceus*
B. inermis
B. tectorum
Bupleurum falcatum
Calamagrostis arundinacea
C. epigeios
Calluna vulgaris
Caltha palustris
Calystegia sepium
Campanula glomerata
C. patula
C. persicifolia
C. rapunculoides
C. rotundifolia
C. trachelium

Capsella bursa-pastoris
Cardamine amara
C. impatiens
C. pratensis
Cardaminopsis arenosa
Cardaria draba
Carduus acanthoides
C. crispus
Carex acutiformis
C. brizoides
C. buekii
C. cespitosa
C. curvata
C. digitata
C. gracilis
C. hartmanii
C. hirta
C. michelii
C. muricata s. str.
C. ovalis
C. pallescens
C. pediformis
C. pilosa
C. remota
C. spicata
C. sylvatica
C. vesicaria
C. ×vratislaviensis (= *C. acuta × C. buekii*)
Carlina acaulis
Carpinus betulus
Centaurea jacea
C. triumfettii
Centaurium erythraea
Cerastium arvense
C. glutinosum
C. holosteoides
Chaerophyllum aromaticum
C. temulum
Chamaecytisus supinus
Chelidonium majus
Chenopodium album
C. hybridum
Chrysosplenium alternifolium
Cichorium intybus
Cimicifuga europaea
Circaea lutetiana
Cirsium arvense
C. canum
C. oleraceum
C. palustre
C. vulgare
Clinopodium vulgare
Conium maculatum
Convallaria majalis
Convolvulus arvensis
Conyza canadensis
Cornus mas
C. sanguinea
Corydalis intermedia
C. solida
Corylus avellana
Cotoneaster integerrimus
Crataegus laevigata
C. monogyna
Crepis biennis
C. paludosa
Cruciata laevipes
Cuscuta europaea
Cyclamen purpurascens
Cynosurus cristatus
Cystopteris fragilis
Cytisus nigricans
Dactylis glomerata
D. polygama
Dactylorhiza majalis
Daphne mezereum
Daucus carota
Dentaria bulbifera
D. enneaphyllos
Deschampsia caespitosa
Descurainia sophia
Dianthus carthusianorum
D. deltoides
Digitalis grandiflora
Dryopteris carthusiana
D. dilatata
D. filix-mas
Echium vulgare
Elymus caninus
Elytrigia intermedia
E. repens

Epilobium angustifolium
E. ciliatum
E. montanum
Equisetum arvense
E. palustre
E. pratense
Erigeron annuus
Erophila verna
Eryngium campestre
Euonymus europaea
E. verrucosa
Eupatorium cannabinum
Euphorbia cyparissias
E. dulcis
E. esula
E. polychroma
Fagus sylvatica
Falcaria vulgaris
Fallopia convolvulus
F. dumetorum
Festuca gigantea
F. firmula
F. ovina
F. pallens
F. pratensis
F. rubra
Ficaria verna subsp. *bulbifera*
Filago arvensis
Filipendula ulmaria
F. vulgaris
Fragaria moschata
F. vesca
Fraxinus excelsior
Fumaria schleicheri
Gagea lutea
G. minima
Galanthus nivalis
Galeobdolon montanum
Galeopsis pubescens
Galium album
G. aparine
G. glaucum
G. odoratum
G. pumilum
G. sylvaticum
G. uliginosum
G. valdepilosum
G. verum
Genista germanica
G. pilosa
G. tinctoria
Geranium columbinum
G. divaricatum
G. pratense
G. pusillum
G. robertianum
G. sanguineum
Geum urbanum
Glechoma hederacea
G. hirsuta
Glyceria maxima
Gnaphalium sylvaticum
Gymnocarpium dryopteris
Hedera helix
Helianthemum grandiflorum subsp. *obscurum*
Hepatica nobilis
Heracleum sphondylium
Herniaria glabra
Hesperis sylvestris
Hieracium bifidum
H. lachenalii
H laevigatum
H. murorum
H. pilosella
H. sabaudum
Holcus lanatus
Humulus lupulus
Hylotelephium maximum
Hypericum hirsutum
H. montanum
H. perforatum
Hypochaeris radicata
Impatiens noli-tangere
I. parviflora
Inula conyza
Iris variegata
Isopyrum thalictroides
Jasione montana
Juncus bufonius
J. conglomeratus

J. effusus
J. tenuis
Juniperus communis
Knautia arvensis
Lactuca quercina
L. serriola
Lamium album
L. maculatum
L. purpureum
Lapsana communis
Larix europaea
Lathraea squamaria
Lathyrus niger
L. pratensis
L. vernus
Lemna minor
Leontodon autumnalis
L. hispidus
Leucanthemum ircutianum
Libanotis pyrenaica
Ligustrum vulgare
Lilium martagon
Linaria genistifolia
L. vulgaris
Lithospermum arvense
L. purpurocaeruleum
Lolium perenne
Lonicera xylosteum
Lotus corniculatus
Lupinus polyphyllus
Luzula campestris
L. divulgata
L. luzuloides
Lychnis flos-cuculi
L. viscaria
Lycopus europaeus
Lysimachia nummularia
L. vulgaris
Lythrum salicaria
Maianthemum bifolium
Matricaria discoidea
Medicago falcata
M. lupulina
Melampyrum nemorosum
M. pratense
Melica nutans
M. picta
M. uniflora
Mentha longifolia
Mercurialis perennis
Milium effusum
Moehringia trinervia
Molinia caerulea
Mycelis muralis
Myosotis arvensis
M. laxiflora
M. ramosissima
M. sylvatica
M. stricta
Myosoton aquaticum
Neottia nidus-avis
Neslia paniculata
Oenothera biennis
Omphalodes scorpioides
Origanum vulgare
Oxalis acetosella
Papaver confine
P. rhoeas
Paris quadrifolia
Persicaria amphibia
P. hydropiper
P. lapathifolia
Phalaris arundinacea
Phleum phleoides
P. pratense
Phragmites australis
Phyteuma spicatum
Picea abies
Pimpinella major
P. saxifraga
Pinus sylvestris
Plantago lanceolata
P. major
Poa angustifolia
P. annua
P. bulbosa
P. compressa
P. nemoralis
P. palustris
P. pratensis
P. trivialis
Polygonatum multiflorum

P. odoratum
Polygonum aviculare
Polypodium vulgare
Populus alba
P. tremula
Potentilla anserina
P. arenaria
P. argentea
P. erecta
P. reptans
P. tabernaemontani
Prenanthes purpurea
Primula elatior
P. veris
Prunella vulgaris
Prunus mahaleb
P. spinosa
Pseudolysimachion maritimum
Pulmonaria officinalis agg.
Pyrethrum corymbosum
Pyrus communis
Quercus petraea
Ranunculus acris
R. auricomus agg.
R. bulbosus
R. repens
Reynoutria japonica
Rhamnus cathartica
Ribes alpinum
R. uva-crispa
Rorippa sylvestris
Rosa canina
R. gallica
R. pendulina
Rubus caesius
R. fruticosus agg.
R. idaeus
R. saxatilis
Rumex acetosa
R. acetosella
R. aquaticus
R. conglomeratus
R. crispus
R. obtusifolius
Sagina procumbens
Salix alba
S. caprea
S. cinerea
S. fragilis
S. purpurea
S. rosmarinifolia
S. triandra
Salvia glutinosa
S. pratensis
Sambucus ebulus
S. nigra
S. racemosa
Sanguisorba minor
S. officinalis
Sanicula europaea
Saxifraga granulata
Scirpus sylvaticus
Scleranthus annuus
S. perennis
Scrophularia nodosa
S. umbrosa
Securigera varia
Sedum acre
S. sexangulare
S. reflexum
Senecio erraticus
S. germanicus
S. viscosus
S. vulgaris
Seseli osseum
Silene dioica
S. latifolia subsp. *alba*
S. nutans
S. vulgaris
Solidago gigantea
S. virgaurea
Sonchus arvensis
S. oleraceus
Sorbus aria
S. aucuparia
S. torminalis
Spergularia rubra
Stachys recta
S. sylvatica
Staphylea pinnata
Stellaria graminea
S. holostea

S. media
S. nemorum
Symphytum officinale
S. tuberosum
Tanacetum vulgare
Taraxacum sect. *Erythrosperma*
T. sect. *Ruderalia*
Tephroseris crispa
Teucrium chamaedrys
Thesium linophyllon
Thlaspi arvense
T. caerulescens
Thymus pulegioides
Tilia cordata
T. platyphyllos
Torilis japonica
Tragopogon orientalis
Trifolium alpestre
T. arvense
T. aureum
T. dubium
T. hybridum
T. medium
T. pratense
T. repens
Tussilago farfara
Typha latifolia
Ulmus glabra
Urtica dioica
Vaccinium myrtillus
Valeriana excelsa subsp. *sambucifolia*
Valerianella locusta
Verbascum chaixii subsp. *austriacum*
V. nigrum
V. phlomoides
Veronica anagallis-aquatica
V. arvensis
V. chamaedrys
V. dillenii
V. officinalis
V. sublobata
V. vindobonensis
Viburnum opulus
Vicia cracca
V. hirsuta
V. pisiformis
V. sepium
V. tenuifolia
V. tetrasperma
V. villosa subsp. *villosa*
Vincetoxicum hirundinaria
Viola arvensis
V. mirabilis
V. reichenbachiana
V. tricolor subsp. *saxatilis*
V. ×*scabra* (= *V. hirta* × *V. odorata*)
Viscum album subsp. *abietis*
V. album subsp. *austriacum*

Practical information

Money exchange in Brno

It is most convenient to change money in front of the main train station (*Hlavní nádraží*). There are three exchange offices (one of them is open daily 8–21), which do not charge commission fees. Other exchange offices are on the way to the central square (*Náměstí Svobody*) of the old town (*Masarykova* street). You can also withdraw money from cash machine (ATM, one is close to workshop venue – check the map), which can accept most of international credit cards (you will be charged additional fee for transaction). On working days you can change money also in most of the banks (branch of *Česká spořitelna* is close to the workshop venue – see the map, open Mo + We + Fr 9–12, 13:30–17, and Tue + Thu 9–12, 13:30–16).

Public transport in Brno

Tickets

You need to buy the ticket before getting to the bus/tram – either in a vendor machine on the platform, or in a tobacconist shop (*Tabák*, *Trafika*). If necessary, you can get a ticket also from the driver, but with additional fee, and you need to have change. Stamp the ticket after getting to the bus/tram – it will indicate the time when you started your travel, and you can travel up to the validity of your ticket. You do not need to pay for luggage. The ticket controller may come occasionally; he identifies himself with a badge.

Ticket prices

10 minutes (you cannot change to other lines)	10 CZK
60 minutes (you can change to other lines)	15 CZK
90 minutes (you can change to other lines)	21 CZK
60-min ticket bought from the driver	20 CZK

Generally, a 15 CZK ticket is suitable for most situations.

How to get...

from the main train station (and bus station Hotel Grand) to Hotel Continental: take tram no. 1 (destination *Řečkovice*), get off at *Moravské* náměstí (2nd or 3rd stop), walk 200 m to the left (with a park on your left-hand side), turn right around the car parking house to *Kounicova* street. Hotel is a high house on the right-hand side of the street 150 m from its beginning.

from the main train station (and bus station Hotel Grand) to Hotel Garni Vinařská: take tram no. 1 (destination *Bystrc*), get off at *Lipová* (7th stop), walk up *Lipová* street, turn to the right after 150 m and find the hotel.

from the main train station (and bus station Hotel Grand) to the workshop and JUICE course venue (Faculty of Education, Poříčí 9): take tram no. 2 (destination *Modřice*), get off at *Poříčí* (4th stop). The building of the Faculty of Education is next to the tram stop.

from Hotel Continental to the workshop and JUICE course venue (Faculty of Education, Poříčí 9): walk 300 m towards two churches (yellowish baroque one and gothic one with green roof) until you encounter tram line at the *Česká* station. Take tram 5, 6 or 7 (destinations *Starý Lískovec*, *Bohunice* or Ústřední hřbitov), get off at *Poříčí* (4th stop). The building of the Faculty of Education is next to the tram stop.

from Hotel Garni Vinařská to the workshop and JUICE course venue (Faculty of Education, Poříčí 9): take tram no. 1 from *Lipová* station (destination *Řečkovice*), get of at *Mendlovo náměstí* (3rd stop), walk 400 m to the right along *Křížová* street up to its crossing with *Poříčí* street, where you find Faculty of Education building on your left-hand side.

Night busses

Night busses to all directions departure from the main train station (*Hlavní nádraží*) between 23:00 and 02:00 every half an hour and from 02:00 to 05:00 every hour.
To Hotel Garni Vinařská, take bus no. 97 (destination *Jírovcova*) and get off in station *Lipová*.
To Hotel Continental, take bus no. 90 (destination *Ořešín*), 91 (destination *Ivanovice*), 92 (destination *Halasovo náměstí*) or 93 (destination *Útěchov*) and get off in *Moravské náměstí*, or take bus no. 93 (direction to *Kolejní*) and get off in *Česká*.

Connection summary

From the main train station (*Hlavní nádraží*) and bus station (Grand Hotel)
to the workshop venue (*Poříčí* station)
- tram no. 2 (destination *Ústřední hřbitov*)

to Garni Hotel Vinařská (*Lipová* station)
- tram no. 1 (destination *Bystrc*)

to Hotel Continental (*Česká* station)
- tram no.12 or 13 (destination *Červinkova*)

From the main bus station (*Autobusové nádraží Zvonařka*)
to the workshop venue (*Poříčí* station)
- bus no. 84 (destination *Mendlovo náměstí*)

to Garni Hotel Vinařská (*Lipová* station)

- to *Mendlovo náměstí* (bus 84) and change to tram no. 1 (destination *Bystrc*)

to Hotel Continental (*Česká* station)

- tram no.12 (destination *Červinkova*)

From the workshop venue (*Poříčí* station)

to main train station (*Hlavní nádraží*)

- tram no. 2 (destination *Stará Osada*)
- to *Mendlovo náměstí* (tram 5, 6, 7 or bus 84) and change to tram 1 (destination *Řečkovice*)

to Garni Hotel Vinařská (*Lipová* station)

- to *Mendlovo náměstí* (tram 5, 6, 7 or bus 84) and change to tram no 1 (destination *Bystrc*)

to Hotel Continental (*Česká* station)

- tram no. 5, 6, 7 (destination *Mendlovo náměstí* or *Štefánikova čtvrť* or *Královo pole nádraží*)

to Botanical Garden for Garden party (*Konečného náměstí* station)

- get to *Mendlovo náměstí* (tram 5, 6, 7 or bus 84) and change to trolleybus no. 25 or 26 (destination *Novolíšeňská* or *Pálavské náměstí*)
- get to *Česká* (tram 5, 6, 7) and change to tram 3 (dest. *Ečerova*), 11, 12 or 13 (destination *Červinkova* or *Rakovecká*)

Restaurants, wine houses and pubs near the workshop venue

See enclosed map for a list of restaurants in the vicinity of the workshop venue. During the lunch time (11–13:00 on working days), you can also get *menu*, which is usually advertised outside the restaurant for fixed price and includes soup and main dish. You pay after you finish your food and decide to leave. Some restaurants offers payment by credit card, but it is more convenient to have cash. The bill does not include service – you may add some tip (up to 10% of the total price) when paying, usually by rounding the price up.

At Mendel square (*Mendlovo náměstí*) you will find several shops with fast food (*Občerstvení*) of various types and quality. You could also buy small snacks in some tobacconists (*Tabák*, *Trafika*). There is also supermarket Albert at Mendel’s square (open Mon–Thu 7–20, Fri 7–19, Sat 7–13, Sun closed).

Selected restaurants (see the map)

1. Restaurant *Pivovarská pivnice*, open daily 11–24 (Starobrno beer)
2. Café-Bar-Pizzeria *La Peda*, open Mon–Thu 10–22, Fri 10–23, Sat 11–23, Sun 11–22.
3. Pizzeria *Gingilla*, open daily 11–24, offer sitting outside until 22:00.

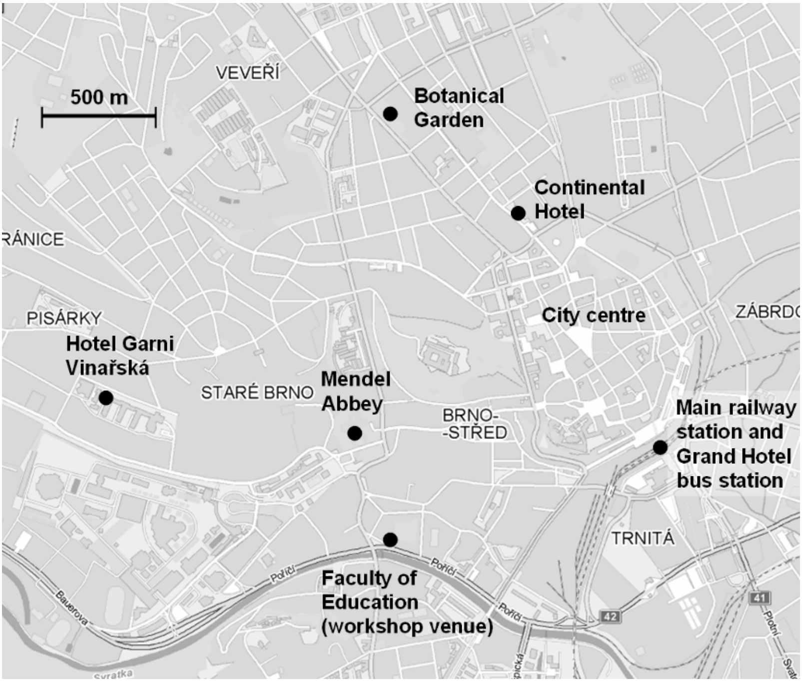
4. Pub-Restaurant *U Putny*, open Mon–Thu 10–22, Fri 10–23, So 15–22, Sun closed, non-smoking time between 11:30–13:30 (Černá Hora beer)
5. Restaurant *Evropa*, open Mon–Fri 11:00–23:30, Sat–Sun closed (Starobrno beer)
6. Hare Krishna style vegetarian restaurant *Avatár*, Mon–Fri 11–18, Sat closed, Sun 11–16.
7. Winehouse *U královny Elišky*, open Tue–Sat from 19.
8. Restaurant *Pekanda*, open daily non-stop except 9–11 (Starobrno beer directly from the brewery).
9. Restaurant *La Pede*, open Mon-Thu 10:30–23:00, Fri–Sat 10:30–24:00, Sun 10:30–23:00.
10. Restaurant *Skanzeen*, open daily 11–24.
11. Restaurant *U Napoleona*, open Mon–Fri 11–22, Sat 14–22, Sun closed.
12. Winehouse *U kola*, Mon–Fri 11–23, Sat 15–23, Sun closed.
13. Internet Café *La Caresse*, open Mon–Fri 14–21, Sat–Sun closed, offers WiFi internet (but no computers).
14. Internet Café *Vídeňka*, cross the river and continue 200 m along the main road, open Mon–Fri 7–22, Sat–Sun closed, offers WiFi internet (but no computers).

Other important places (see the map)

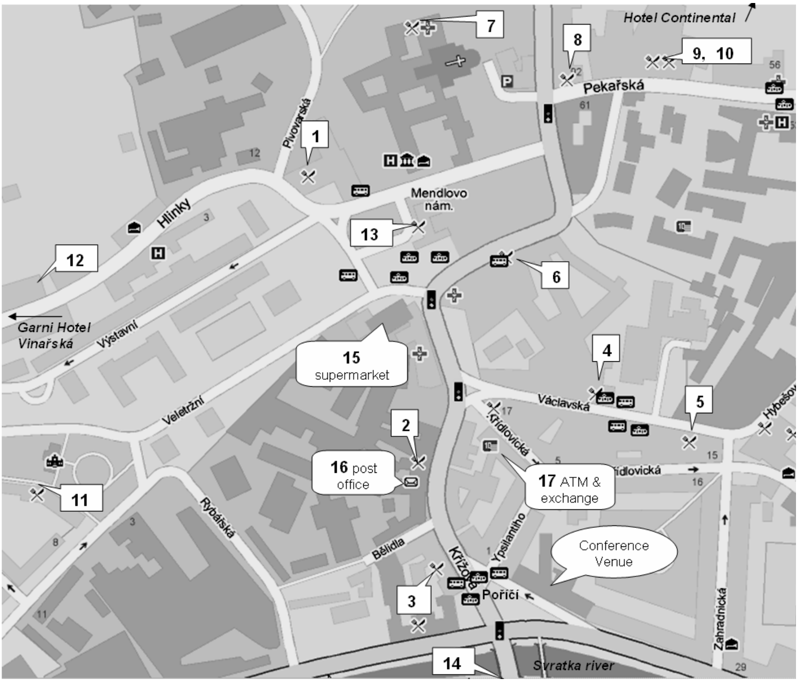
15. Supermarket *Albert*, open Mon–Thu 7–20, Fri 7–19, Sat 7–13, Sun closed.
16. Post office, open Mon–Fri 8–18.
17. Bank of *Česká Spořitelna* with cash machine, open Mon+Wed+Fri 9–12, 13:30–17, Tue+Thu 9–12, 13:30–16, cash machine accessible 24h.

Important phone numbers

Firemen, police and ambulance	112
Taxi service nonstop:	+420 5 4221 4221 +420 602 584 843 (also to Vienna or Prague airport)



Brno city centre



Surroundings of the workshop venue;
numbers 1–14 indicate restaurants (see the above text)

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17th International Workshop European Vegetation Survey
Using phytosociological data to address ecological questions

1-5 May 2008, Masaryk University, Brno, Czech Republic
Abstracts and Excursion Guides

Edited by
Milan Chytrý

Excursion Guides by
Jiří Danihelka, Milan Chytrý, Jan Roleček & Vít Grulich

Published by Masaryk University, Brno
1st edition, 2008
Serial number Př-4/08-02/58
Printed by www.knihovnicka.cz, Tribun EU s. r. o.

ISBN 978-80-210-4585-9