Dry grasslands in the Western Carpathians and northern Pannonian Basin: a numerical classification

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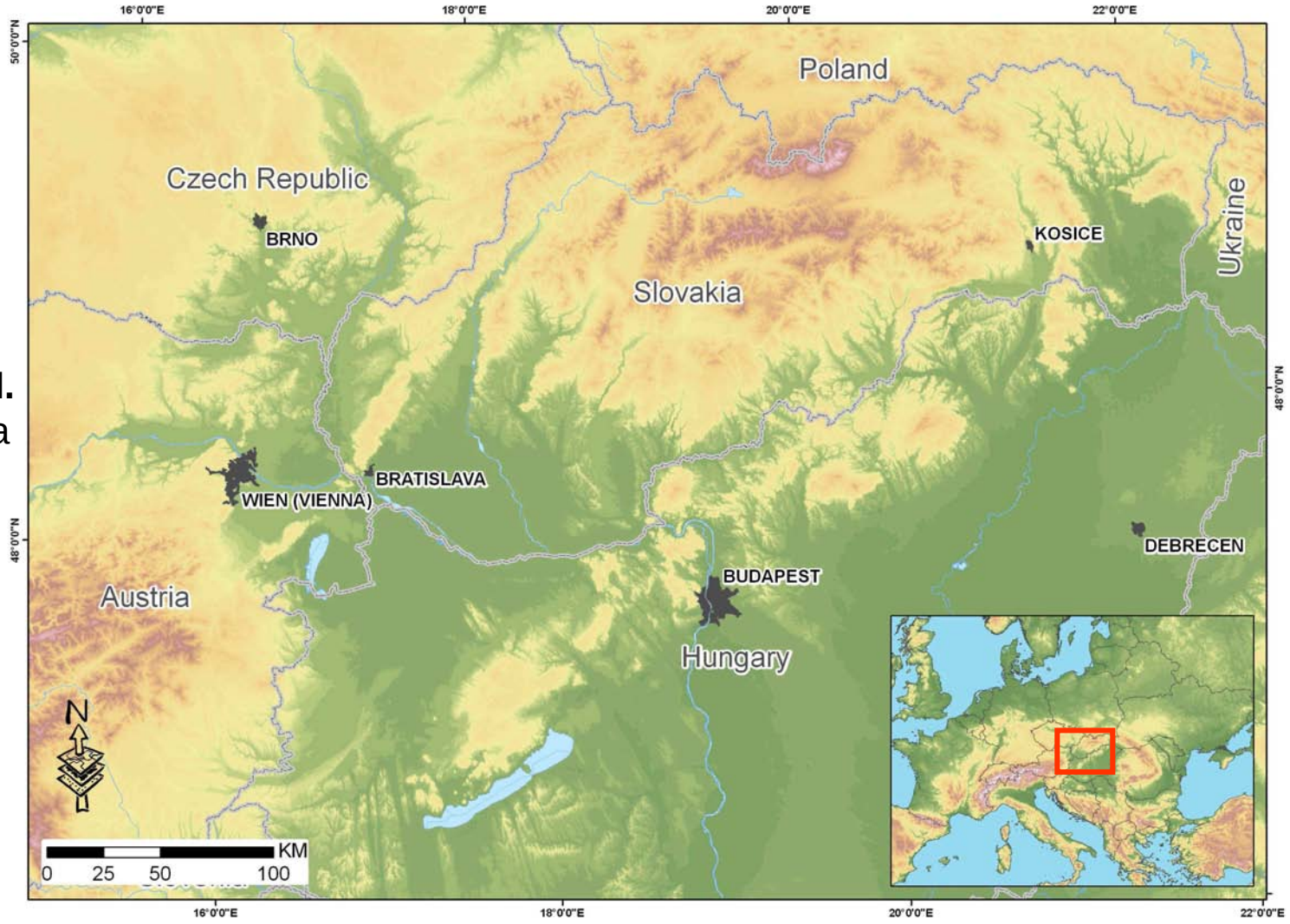
Study area - Western Carpathians and northern Pannonian Basin

Slovakia

N Hungary

SE Czech Republ.
- southern Moravia

NE Austria
- federal states of Burgenland, Lower Austria, and Vienna



Main aims

1. to perform numerical classification of dry grasslands in the study area using a large geographically stratified data set

2. to identify geographical ranges and diagnostic, constant and dominant species of the main types of dry grasslands

3. to summarize broad-scale patterns of floristic variation in dry grasslands of the studied regions

4. to interpret clusters from numerical classification as syntaxa described in phytosociological literature

5. to perform a syntaxonomical revision to simplify the previous syntaxonomical systems used in the involved countries (SK, CZ, HU, AT)

6. to solve problems in nomenclature of the dry grassland associations

Habitats of interest

Class: ***Festuco-Brometea*** Br. Bl. et Tüxen ex Soó 1947

Alliances:

Bromo pannonici-Festucion pallentis Zólyomi 1966
- Pannonian rocky grasslands on limestone and dolomite outcrops

Festucion valesiacae Klika 1931
- narrow-leaved continental basiphilous dry grasslands on deeper soils

Koelerio-Phleion phleoidis Korneck 1974
- acidophilous dry grasslands

Vegetation data

Data sources

Czech, Slovak and Hungarian national phytosociological databases
Austrian relevés were newly computerised.
Some unpublished relevés from Hungary were used.

Data structure

Relevés made by the standard Central-European method
Between 1927 and 2007 (48 % were made during last two decades 1988–2007)
Plot size 4–100 m^2
Number of vascular plants per relevé varied from 10 to 95

Data selection

- from an initial database - 10 600 relevés - all grassland types of the area

1. Based on dominance: cover values > 5% of *Bothriochloa ischaemum*, *Carex humilis*, *Festuca pallens*, *F. pseudodalmatica*, *F. pseudovina*, *F. valesiaca*, *Koeleria macrantha* and *Stipa* spp.

2. Based on diagnostic taxa presence: We identified diagnostic species of this group and added relevés with presence of $\geq$ 7 species from a group of 20 taxa, which were diagnostic for the dominance datase.

3. Removal of ecologically related vegetation types: we removed relevés with cover > 25% of *Agrostis capillaris, Arrhenatherum elatius,Brachypodium pinnatum, Bromus erectus, Sesleria albicans* and *S. heufleriana.*

The stratified data set – 2 686 relevés

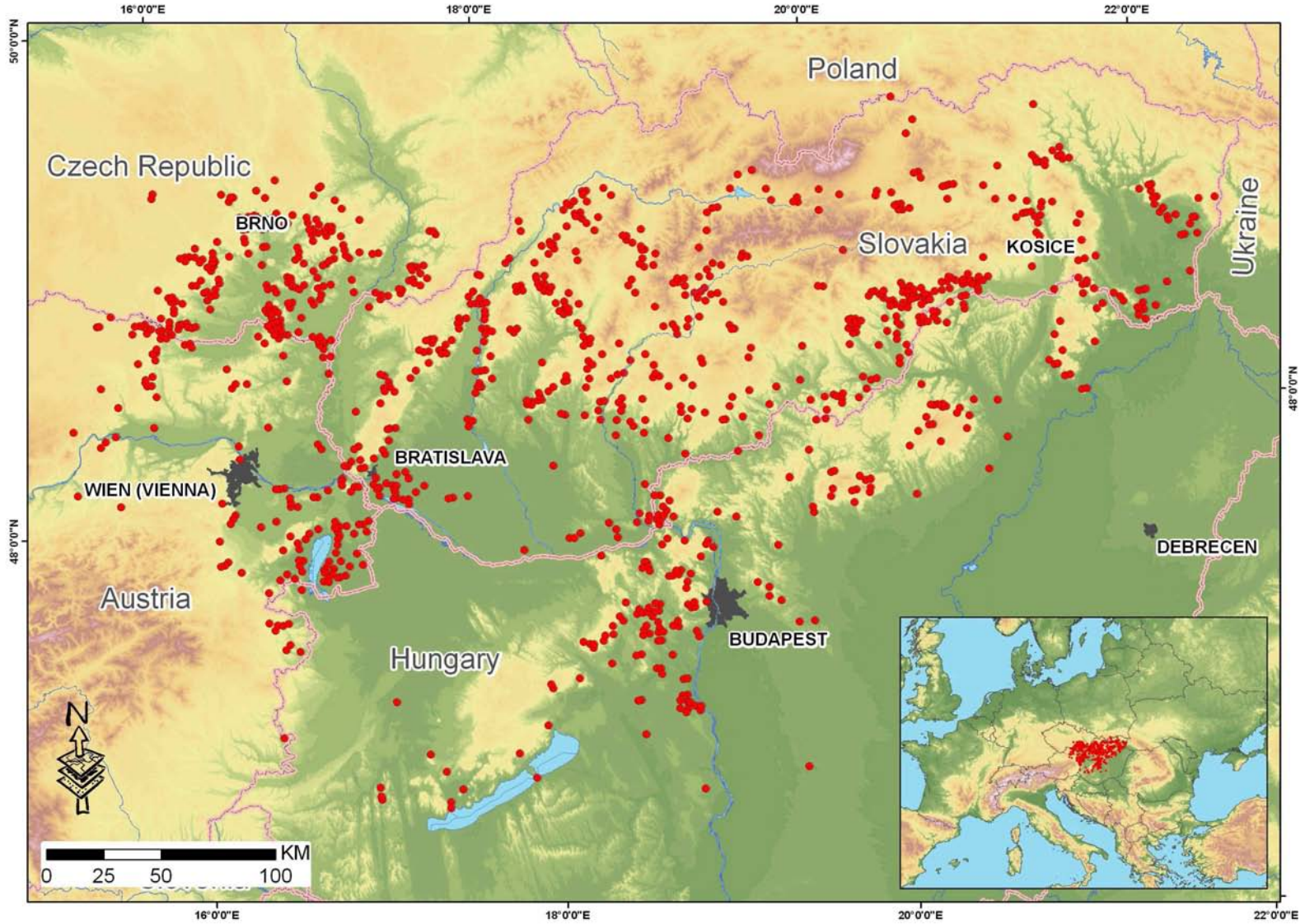
Geographical stratification: grid cells 10 longitudinal x 6 latitudinal minutes (12 x 11 km)
selection of 20 relevés from each grid cell at random

SK – 1 180 r.

HU – 624 r.

CZ – 552 r.

AT – 330 r.



Data analysis

1. Outlier analysis

2. Modified TWINSPAN analysis (Roleček et al. 2009)

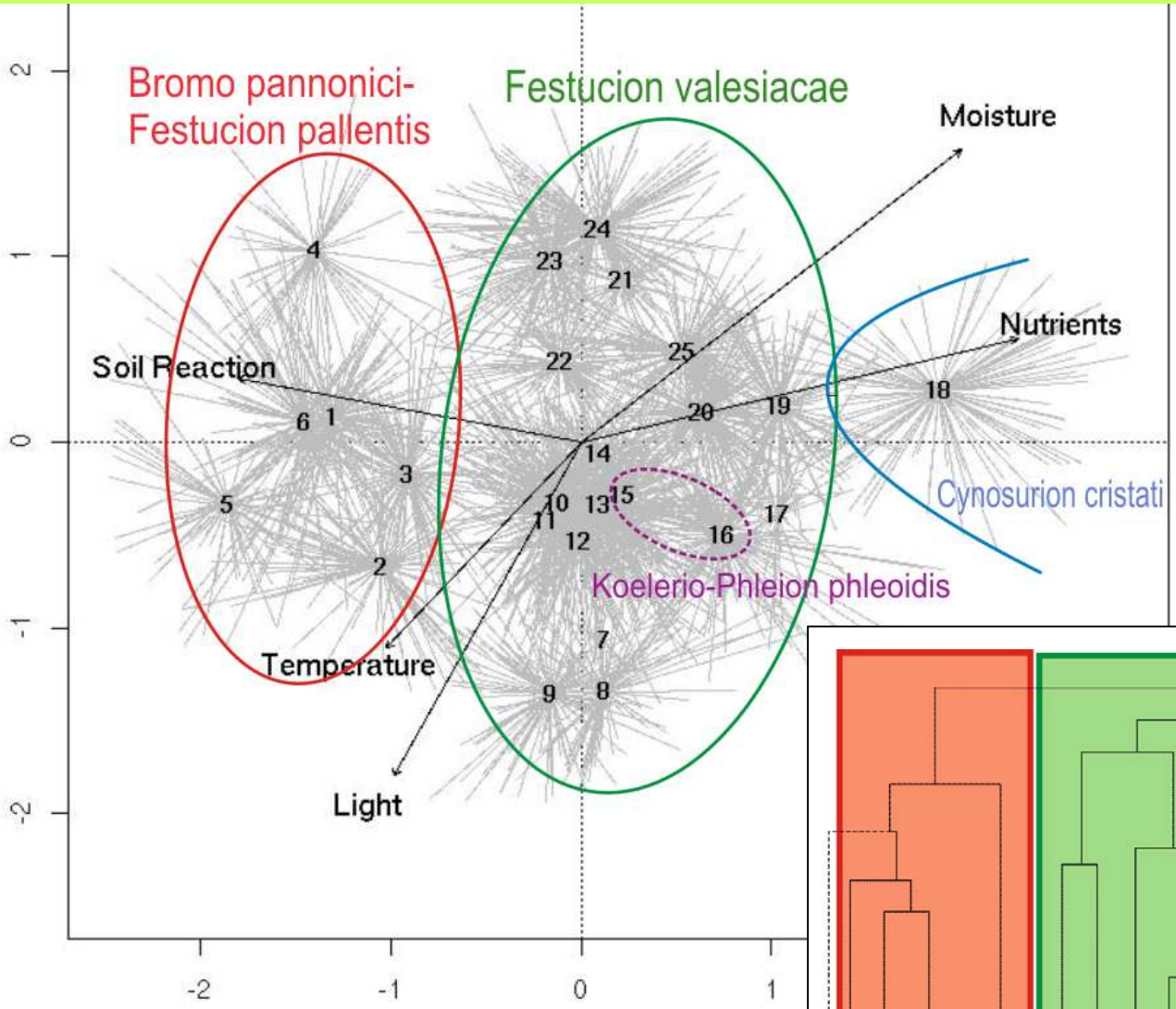
- three pseudospecies cut levels (0 %, 5 %, 25 %)
- total inertia as a measure of cluster heterogeneity
- 25 clusters (+ 2 local types - uninterpreted)

3. Ordination (DCA)

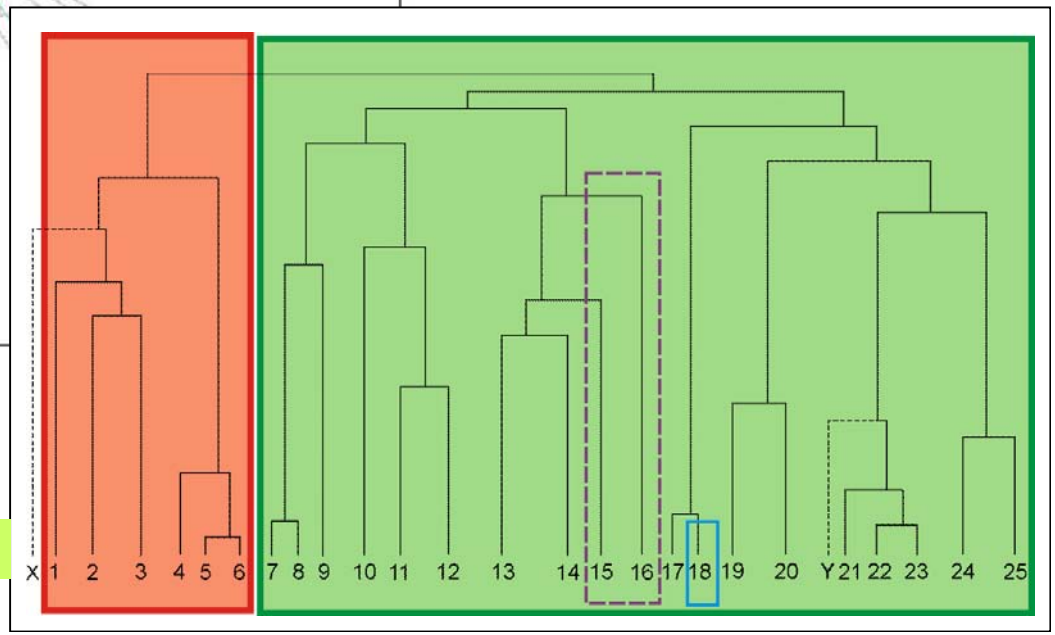
- square-root transformation of species percentage covers
- detrending by segments
- mean indicator values (Borhidi 1993) for relevés were plotted onto the diagram as supplementary variables

Results

DCA ordination diagram (1st and 2nd ordination axes)



- 25 clusters arranged along the gradient of soil nutrient availability
- separation of the *Bromo pannonici-Festucion pallentis* (clusters 1-6) and *Festucion valesiacae* (clusters 7-14, 17, 19-25)
- *Koelerio-Phleion phleoidis* (clusters 15 and 16) included in clusters of the *Festucion valesiacae*



Dendrogram of the modified TWINSPAN analysis

Festuco-Brometea Br. Bl. et Tüxen ex Soó 1947

Stipo pulcherrimae-Festucetalia pallentis Pop 1968

***Bromo pannonici-Festucion pallentis* Zólyomi 1966**

Campanulo divergentiformis-Festucetum pallentis Zólyomi (1936) 1966
Poo badensis-Caricetum humilis (Dostál 1933) Soó ex Michálková in Janišová et al. 2007
Orthantho luteae-Caricetum humilis Kliment et Bernátová 2000
Seselio leucospermi-Festucetum pallentis Zólyomi (1936) 1966 / Zólyomi (1936) 1958
Stipo eriocaulis-Festucetum pallentis (Zólyomi 1958) Soó 1964
Festuco pallentis-Caricetum humilis Sillinger 1930 corr. Gutermann et Mucina 1993
Poo badensis-Festucetum pallentis Klika 1931 corr. Zólyomi 1966 nom. invers. propos.

Festucetalia valesiacae Br.-Bl. et Tüxen ex Br.-Bl. 1949

***Festucion valesiacae* Klika 1931**

Teucrio botryos-Andropogonetum ischaemi Sauberer & Wagner in Sauberer 1942
Inulo oculi-christi-Festucetum pseudodalmaticae Májovský et Jurko 1956
Festucetum pseudodalmaticae Mikyška 1933
Alysso heterophylli-Festucetum valesiacae (Dostál 1933) Kliment in Kliment et al. 2000
Festuco valesiacae-Stipetum capillatae Sillinger 1930
Astragalo exscapi-Crambetum tatariae Klika 1939 nom. invers. propos.
Avenastro besseri-Stipetum joannis Klika 1951 corr. Kolbek in Moravec et al. 1983
Potentillo arenariae-Festucetum pseudovinae Soó 1955
Salvio nemorosae-Festucetum rupicolae Zólyomi ex Soó 1964
Stipetum tirsae Meusel 1938
Festuco rupicolae-Caricetum humilis Klika 1939

***Koelerio-Phleion phleoidis* Korneck 1974**

Avenulo pratensis-Festucetum valesiacae Vicherek et al. in Chytrý et al. 1997
Potentillo heptaphyllae-Festucetum rupicolae (Klika 1951) Toman 1970

Molinio-Arrhenatheretea Tüxen 1937

Arrhenatheretalia elatioris Tüxen 1931

***Cynosurion cristati* Tüxen 1947 nom. cons. propos.**

Alopecuro pratensis-Festucetum pseudovinae Juhász-Nagy 1957

Results

Cluster 15 – Avenulo pratensis-Festucetum valesiacae – an example

Dry grasslands with Festuca valesiaca on acidic soils

Syntaxonomical classification:
Avenulo pratensis-Festucetum valesiacae Vicherek et al. in Chytrý et al. 1997

Syn.: *Acetosello tenuifoliae-Festucetum valesiacae* Vicherek 1962 prov. (Art. 3b), *Agrostio pusillae-Festucetum valesiacae* Vicherek in Vicherek et Unar 1971 ms. (Art. 1)

Number of relevés: 88

Diagnostic species: ***Acetosella multifida* agg.**, *Acosta rhenana*, ***Agrostis vinealis***, *Achillea millefolium* s. lat., *A. setacea*, *Anthoxanthum odoratum*, ***Armeria vulgaris***, *Artemisia campestris*, *Avenella flexuosa*, ***Avenula pratensis***, *Berteroa incana*, *Calluna vulgaris*, *Carex humilis*, *C. supina*, ***Dianthus carthusianorum* s. lat.**, *Euphrasia stricta* agg., ***Festuca ovina* agg.**, *Gagea bohemica*, ***Genista pilosa***, ***Helichrysum arenarium***, *Hypericum perforatum*, *Iris arenaria*, *Jasione montana*, *Linaria genistifolia*, *Phleum phleoides*, *Pilosella echioides*, *P. officinarum*, *Potentilla verna* agg., *Pseudolysimachion spicatum* agg., *Pulsatilla grandis*, *Scleranthus perennis*, *Sedum rupestre*, *Silene otites* agg., ***Thymus praecox***

Constant species: *Acetosella multifida* agg., ***Acosta rhenana***, ***Agrostis vinealis***, ***Achillea millefolium* s. lat.**, *Artemisia campestris*, ***Asperula cynanchica***, ***Avenula pratensis***, ***Carex humilis***, ***Dianthus carthusianorum* s. lat.**, ***Eryngium campestre***, ***Festuca valesiaca***, *Galium verum* agg., *G. pilosa*, ***Hypericum perforatum***, ***Koeleria macrantha* s. lat.**, ***Phleum phleoides***, *Pilosella officinarum*, *Pimpinella saxifraga* agg., *Plantago lanceolata*, ***Potentilla verna* agg.**, ***Pseudolysimachion spicatum* agg.**, *Sedum sexangulare*, *Seseli osseum*, *Silene otites* agg., ***Thymus praecox***

Dominant species: *Avenula pratensis*, *Carex humilis*, *Festuca ovina* agg., ***F. valesiaca***

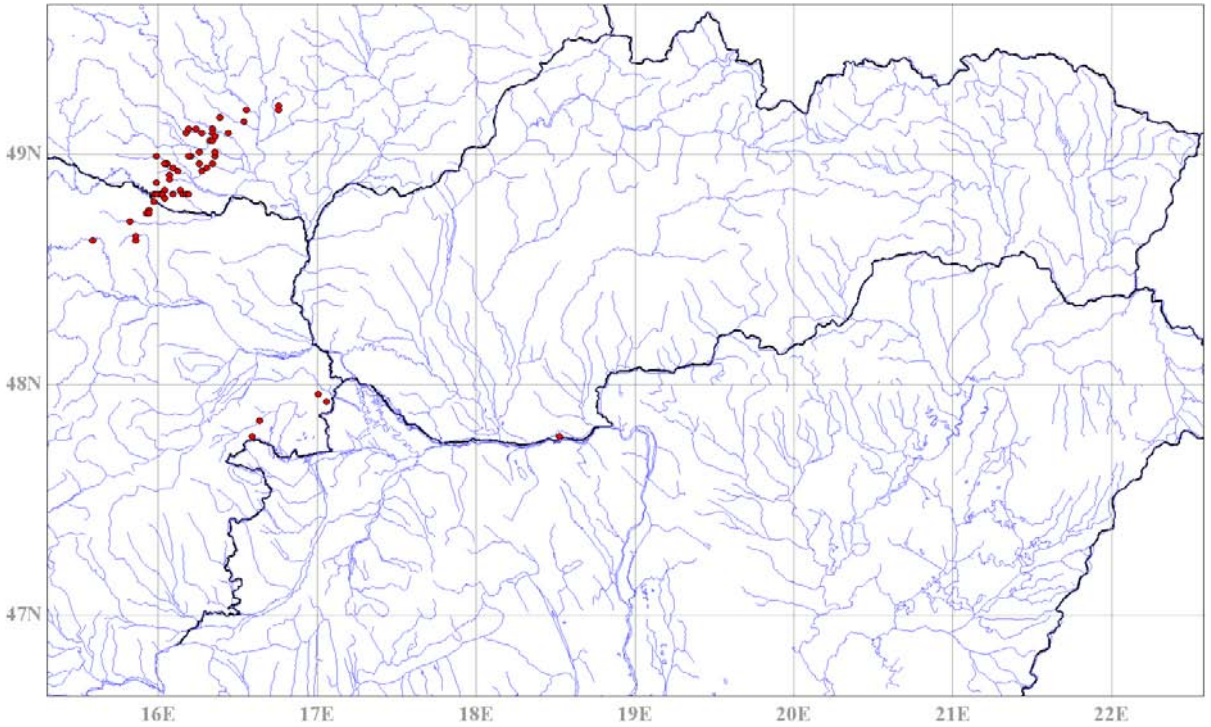
Results

Cluster 15 – an example

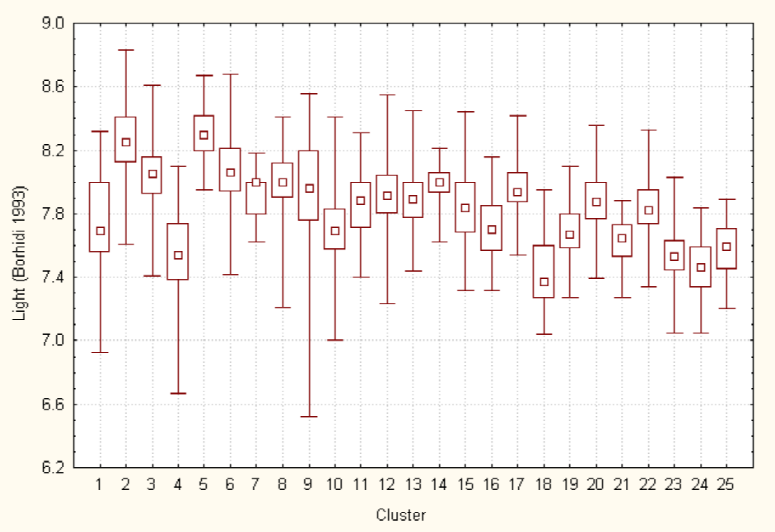
Description:

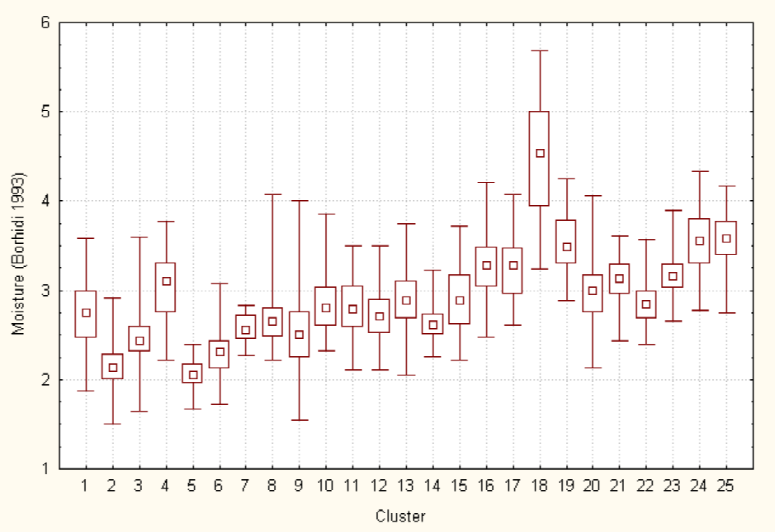
These closed acidophilous grasslands are dominated mostly by *Festuca valesiaca* and *Avenula pratensis*. Besides the generalist species of dry grasslands numerous acidophilous and psammophytic species are present (e. g. *Acetosella multifida* agg. ~ *Acetosella vulgaris*, *Agrostis vinealis*, *Armeria vulgaris*, *Calluna vulgaris*, *Jasione montana* and *Trifolium arvense*). These stands occur in extremely dry areas with acidic bedrocks (granite, gneiss, fluvial sediments) at the SE edge of the Bohemian Massif in SW Moravia and NW Lower Austria and in the area NE and W of the Neusiedler See Lake (Chytrý et al. 1997). They are found on moderate slopes or flat surfaces with shallow rocky soil of ranker type. The association is classified in the *Koelerio-Phleion phleoidis* alliance.

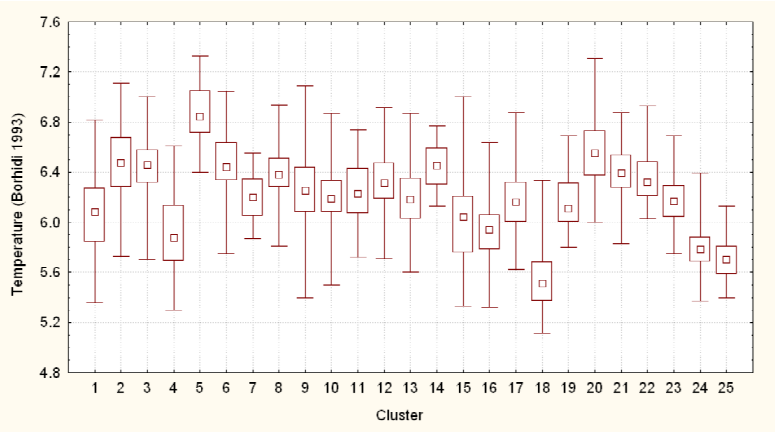
Distribution:

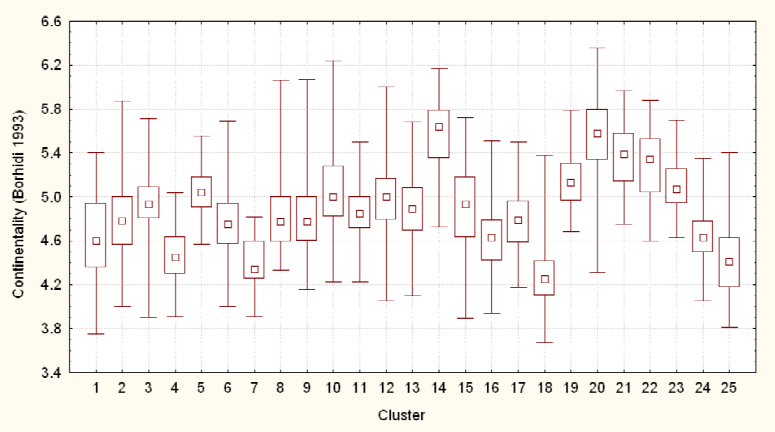


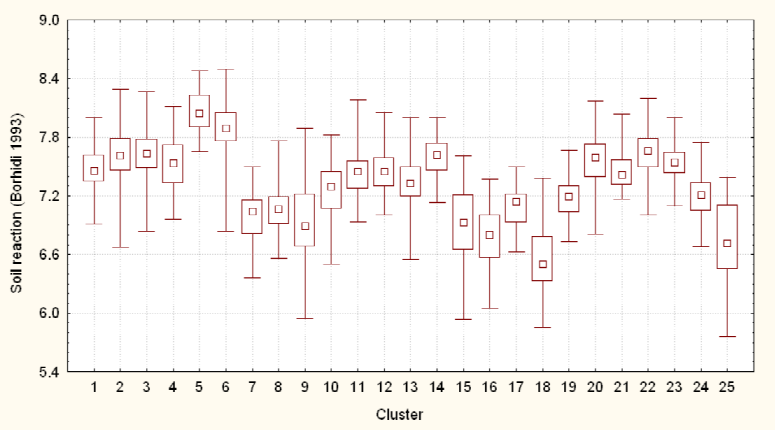
Comparison of clusters – indicator values of Borhidi (1993)

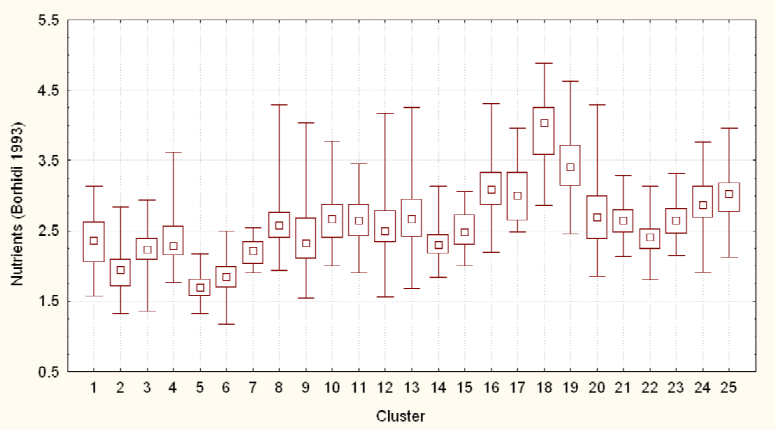












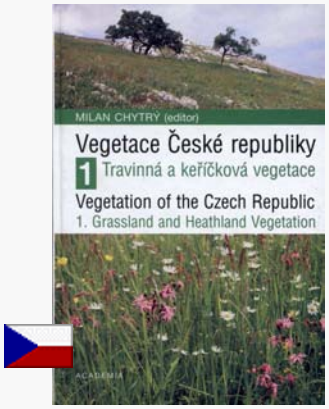
Conclusions

Syntaxonomical revision

➢ we present our view of all associations classified within the studied alliances and occuring in the study area mentioned in the most recent national vegetation handbooks:

Austria
Mucina et al., eds (1993)

Hungary
Borhidi (2003)



the Czech Republic
Chytrý et al. (2007)

Slovakia
Janišová et al. (2007)

➢ syntaxonomical revision simplified the previous syntaxonomical systems used in the four countries

➢ number of valid associations recognisable at the geographically large scale decreased considerably

➢ solving of the problems in nomenclature of dry grassland associations

➢ contributing to setting up well-founded standards for international habitat classification

Thank you for your attention