

# UNIVERSITY OF PÉCS

Doctoral School in Biology  
Botany Program

## Dry grasslands of Bakony region

Regional syntaxonomical and phytogeographical study

PhD dissertation

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## 1. Introduction and aims

Dry grassland vegetation of Hungary is well-researched in main lines but the local differences in the deep of the description are outstanding. Fine-scale differences of grasslands among regions and within regions have been less-known. The sandy grasslands of the Hungarian Great Plain and some middle-mountainous area (e.g. Budai Mts, Pilis Mts and Bükk Mts) are well documented but dry- and rocky-grasslands of other sites have been marginally studied yet. The Bakony Region belongs to this group. Thanks for the work of Gábor Fekete description of some forest associations and plant geographical foundation were taken in the most intensive interval of the Hungarian vegetation researches. Over the early publications of Rezső Soó dry grasslands of the region are marginally present in foundations of Bálint Zólyomi and Attila Borhidi. Xerothermic grassland associations of the Balaton Uplands were examined in detail later by Zsolt Debreczy on the hills above Balatonfüred. Newly Attila Kovács J. has reported about the vegetation of the Southern Bakony. These and further papers give just scattered and local information and do not mirror the diversity of the dry grasslands of the region.

In the Transdanubian Mts the steppe-type dry and rocky grasslands in the largest extension are present in the Bakony Region, especially in the Eastern and Southern Bakony. Further the spreading of semi-dry grasslands and sandy grasslands are also remarkable in middle mountainous comparison. Dry grassland associations of the Bakony Region are low-represented in the Hungarian phytosociological studies and databases.

Aims of my study were: documentation, classification and description of types of natural dry grasslands belonging to Festuco-Brometea and Koelerio-Corynephoretea classes; estimation and depiction of the distribution of the revealed associations.

I sought significant relations among the species and macroclimate parameters on the basis of the dry grassland relevés of the Bakony Region merged at the level of the CEU quarter-quadrates.

I studied relation of original and own relevés of dolomite grassland associations published from the Transdanubian Mts (*Seselio leucospermi-Festucetum pallentis*, *Stipo eriocauli-Festucetum pallentis*, *Chrysopogono-Caricetum humilis*, *Festuco pallenti-Brometum pannonicum*, *Cariceto humilis-Artemisietum albae*): could these associations be separated and could they be classified into main groups?

After the merging of the relevés of the established dolomite grassland associations at the level of the landscape region (from the Keszthelyi Mts to the Budai Mts) I studied the plant geographical features of the subregions based on the differences of species composition and relative frequency of the taxa: could geographical determination of the differences be detected? Further, could subtypes characterized by special features and related to subregions be detected?

I mapped (based on the relevés and complement with herbarium /BP/ data and further own data) distribution of the species having plant geographical importance and determinant in the separation of the regional subtypes (~geographical races) of the studied vegetation-types.

## 2. Material and methods

The Bakony Region is the largest mesoregion of the Transdanubian Mts. Sampling of the dry grasslands reaches almost the overall area of the Bakony Region. Relevés were not collected in the area of the geologically separated Pannonhalmi-dombság (Sokoró) which is characterized by modified vegetation and lack of rocky and other natural open grasslands. Naming of the studied regions follows landscape region categories of MOLNÁR et al. (2008), with small additions: Keszthelyi Mts, Balaton Uplands /including basalt hills, Tihany Peninsula and shore of Lake Balaton named Riviera of Balaton in the landscape geography/; Western Bakonyalja, Southern Bakony, Inner Bakony, Eastern Bakony.

Further, I sampled stands of the other parts of the Transdanubian Mts (Vértes Mts, Gerecse Mts, Pilis Mts and Budai Mts) and of the dolomite hills of Austria and Lower-Austria (hills around Hainburg) characterized by Pannonian vegetation for best comparison of dolomite grasslands

Main points of view were: a) proportionality and enough covering; b) sampling with standardized methods; c) using outgroups in analyses of dolomite grasslands. Samplings were carried out from 1999 to 2010 by quadrat method (size of 2×2 in open grasslands and contacting steppe meadows; size of 4×4 in semi-dry grasslands). Cover values were recorded in percentage (+ values were handled as 0.1 in the analyses). 3–5 relevés were taken per stands, which were seen similar during the field work. Altogether 1628 relevés were collected. I studied dry grasslands of the Bakony Region based on 1409 own relevés. Detailed analyses of the dolomite grasslands were carried out with the use of 957 relevés. This matrix included relevés of own outgroups and the reference relevés of the published associations (relevés of ZÓLYOMI from the COENODATREF database, PENKSZA et al. 2002).

1490 relevés collected in the Bakony Region were classified both by agglomerative and disjunctive methods. My stand about the studied grasslands is based on these results. Classification was carried out with SYN-TAX 2000 (PODANI 2001) programme package and modified TWINSpan (ROLEČEK et al. 2009). Optimal number of clusters was determined by OptimClass (TICHÝ et al. 2010). Diagnostic, constant and dominant species were determined by JUICE 7.0 software (TICHÝ 2002). Determination of diagnostic species is based on fidelity measure using the *phi* coefficient (TICHÝ & CHYTRÝ 2006). The analysed matrix represents enough ecological types, but its fidelity values have to consider as relative preference values valid on this database (BORHIDI ex verbis).

Comparison of the ecological character of the segregated vegetation units was taken with the help of Ellenberg indicator values modified for the Pannonian Region (BORHIDI 1993). Life-form and flora-element spectra of the segregated grasslands were drawn based on the relative frequency of the species within the grassland-types. In my opinion, the comparison in the base of group-frequency gives more objective results related to the plant geographical character of the segregated grasslands.

After the classification of the dolomite grasslands matrix of 957 relevés I defined the main groups estimated as associations. The species relative frequencies per associations were counted, correlation analyses (Pearson correlation,  $p < 0.05$ ) among associations and species were also taken. Within the main groups handled as segregated associations the relevés were studied after a merging process at the level of the landscape region and of the CEU quarter-quadrates. For the examination of the relations and distance among associations and the local stands of the associations multi-dimensional scaling (MDS) of relevés merged at different levels was taken. Important background variables of the associations ordered and differences in plant geographical and ecological circumstances of subregional stands were sought by canonical correspondence analyses.

Sampling sites of the segregated vegetation units were mapped. Relations of detected types and of important diagnostic species with topographical units and abiotic factors (bedrock, macroclimate etc.) were revealed by correlation analyses. I studied frequency of the species using relevés merged at landscape region for the exploration of elements restricted or centred to the vegetation-based mesoregions of the Bakony Region

### 3. Results

#### Characteristic dry grassland associations of the Bakony Region

I stated presence of 16 dry grassland associations based on classification of 1409 own relevés. Some dry grassland types which are recognizable in the field but rare in the Region were ignored from the used matrix (e.g. *Stipa tirsia*, *Danthonia alpina* grasslands; grasslands similar to dry grasslands, but point to mountain meadows, for example *Nardus stricta*–*Helictotrichon adsurgens*–*Festuca rubra* grasslands in the Bakonyalja).

Calciphobe sandy grasslands (*Thymo angustifolii*-*Corynephorum*) and calciphilous sandy grasslands (*Festucetum vaginatae*) were clearly defined based on the completed classifications. Open sandy grassland fragments named *Festuco vaginatae*-*Corynephorum* occur around Fenyőfő, but these are rare and restricted presumably caused by the intensive Scotch pine plantations of the last 50 years.

Consequently species-poor calciphilous chasm grasslands (*Asplenio rutae-murariae*-*Melicetum ciliatae*) of the Old Bakony are seen as an individual unit of the chasm grasslands. Chasm grasslands of the warmer subregions (Balaton Uplands, Southern Bakony) of the studied area belong to the steppe slopes (of which usually neighbouring them) based on the classifications. Separation of chasm grasslands and secondary opened steppe slopes is very problematic (seen a continuous transition) based on the species composition (borders also not clear in the field).

Based on the species composition the isolation of *Sedum* debris slope grasslands represented with a few relevés is doubtful. These are recognized by their physiognomy and dominant association character (having just some permanent species competitive on debris slopes). I identified *Geranio rotundifolii*-*Sedetum albi* on the piles of small clastic rocks of basalt hills and *Alyso alyssoidis*-*Sedetum albi* on the mainly artificial piles of carbonated sedimentary bedrocks (in vineyards and mines).

In the Transdanubian basalt hills (Csobánc, Szent György Hill, Badacsony, Tátika) *Festuco pallentis-Aurinetum saxatilis* association occurs usually on north facing, steep slopes and rocks. This association having Central-European distribution in Hungary was recognized by CSIKY (2003). Great importance in protection of relict species of this rocky grassland and wall vegetation is confirmed by the populations of *Cardaminopsis petraea*, *Saxifraga paniculata*, *Dianthus lumnitzeri*, *Hieracium wiesbaurianum* growing on different island hills and of *Galium austriacum* giving special character for the Hungarian stands.

In my opinion it is absolutely necessary to segregate xerotherm steppe grasslands of the Transdanubian Mts from the *Potentillo-Festucetum pseudodalmaticae* grasslands having Carpathian character. These stands are handled in this study under the *Inulo oculi christi-Festucetum pseudodalmaticae* association characterized by West-Slovakian centre. I segregated the recorded stands at subassociation level (*orlayetosum grandiflorae*) based on their significant submediterranean character. It is not impossible that these grasslands characteristic on the Transdanubian basalt hills are handled as individual association, but this statement needs confirmation based on comprehensive analyses of silicate steppe slopes at a larger geographical scale.

The most frequent dominant species in the stands of the semi-dry grasslands occurring in the Bakony Region is *Bromus erectus*. In this area the *Brachypodium pinnatum* grasslands are rare. They occur mostly in species rich, natural forest steppe mosaics and in abandoned vineyards on good soil (e.g. loessy). The two main types caused by the different physiognomy of the dominant species stands diverge microclimatically from each other. *Brachypodium pinnatum* grasslands are more humid than *Bromus erectus* grasslands of which show transitive features toward the steppe slopes characterized by narrow-leaved grass species. Semi-dry grasslands dominated by *Bromus erectus* common in the Bakony Region belong to *Sanguisorbo minoris-Brometum erecti* association (ILLYÉS et al. 2009). Former association names (*Lathyro pannonici-Brometum erecti*, *Potentillo arenariae-Brometum erecti* ISÉPY 1998, KOVÁCS 2000) mentioned provisionally without valid publication regard also this vegetation unit. Classification of the studied *Brachypodium pinnatum* stands is problematic. They are mostly similar to the *Polygalo majoris-Brachypodietum pinnati* association published from the middle-mountainous dolomite area of Lower-Austria. The most species rich forest steppe grasslands with *Cirsium pannonicum*, *Danthonia alpina*, *Polygala major*, *Prunella grandiflora*, *Crepis praemorsa* are usually dominated by *Brachypodium pinnatum*. It is have to note, that transitional stands toward xerothermous steppe slopes or plakor steppe grasslands and toward plain-centred dry grasslands are present (influences of the semi-dry grasslands of Mezőföld are detected in the south-eastern margin of the studied are). Rare, in this dissertation does not studied semi-dry grassland types (*Stipa tirsza*, *Danthonia alpina*) are also present.

During the classification the dry grasslands of the carbonate bedrock dominated by narrow-leaved grass species (mainly *Festuca valesiaca* agg., *Stipa* spp.) were the worst identifiable units in the Bakony Region. These grasslands handled earlier as stands of the *Cleistogeni-Festucetum sulcatae* association, but I defined them under the *Festuco*

*valesiaca*-*Stipetum capillatae* association (central ass. of *Festucion valesiaca*) based on the large scale analyses. This is a common association of Central-Europe (used in a hard extended meaning), which may originate on degradation of several dry grassland association.

I used this association name at several subunits separated by different classifications, but do not ratify by consentaneous results. I discussed these groups as units under the association level. Obviously, in this way I work with heterogeneous units based on dominant species (*Festuca valesiaca*, *Stipa* spp., *Bothriochloa* stb.). In my opinion these types can handle at subassociation or facies level, caused by the lack of differential species. Their formation can allow as a differentiation by an ecological, successional/degradational gradient of the association.

Loess grasslands and closed sandy grasslands are rare in the Bakony Region, their stands are species-poor and mentioned under the conventional names (*Salvio nemorosae-Festucetum rupicolae*, *Astragalo austriaci-Festucetum sulcatae*) in this study. Marginal stands of the area did not separate or separate just at a low level from the closed dry grasslands occurring on compact bedrocks supposedly caused by low number of relevés.

Classification of the dry grasslands of the Bakony Region pointed out that special localvariants unclassified into published associations exist. These may form individual group beside large relevé number, but definition of them as a new coenotaxon is unreasoned caused by their local features. These need experiences and characterization, but if similar, repetitive stands can not find at regional scale, it will be handled as variant (localvariant) of some association (e.g. neighbouring grassland association).

Dolomite rocky grasslands and steppe grasslands well distributed in the Bakony Region are separated from the other dry grassland groups at high level during all the used classification method. I studied these grasslands based on a matrix completed with relevés originated from other dolomite areas (other parts of the Transdanubian Mts: Vértes Mts, Gerecse Mts, Pilis Mts, Budai Mts; dolomite hills around Hainburg).

Classification of the dolomite grasslands confirmed existence of four dolomite grassland associations at the level of the Transdanubian Mts (*Seselio leucospermi-Festucetum pallentis*, *Stipo eriocauli-Festucetum pallentis*, *Chrysopogono-Caricetum humilis*, *Festuco pallenti-Brometum pannonici*). Transitional status (species composition, structure) of *Stipa eriocaulis* rocky grasslands well-distributed in the Bakony Region is clear, based on several analyses.

Significant correlations were detected among some macroclimate parameter and species' distribution at the scale of CEU quarter-quadrates (all the significant relations in direction of 642 taxa, 70 CEU-quadrates and 8 macroclimate parameter were in 480 cases). This fact does not mean certainly cause and effect relations, namely the macroclimate is not the only one potential variable of restricted distribution of the species within the region, further correlation analyses may produce statistical artifact. For example it is possible that occurrence of a taxon with distribution limited by bedrock types shows significant positive correlation with some parameters of the local macroclimate. Based on this I exposed just some important, supposedly concrete results from the results of correlation analyses. I neglected the species related to narrow-

spreading bedrocks or having occurrences just in a few quadrates. Species related to basalt and calcareous sandy grasslands belong to the above mentioned cases. Contemporaneously, dolomite bedrock occurs in several subregions characterized by individual macroclimatic circumstances of the Bakony Region. Further dolomite grasslands mean a type documented large number of relevés, so typical species of them appear large case-number in the matrix. Character species of the dolomite grasslands having min. two significant relations with macroclimate parameters in correlation analyses enlisted below.

**Annual rainfall** (negative correlations): *Stipa capillata*, *Artemisia alba*, *Thymus praecox*, *Linum tenuifolium*, *Helianthemum canum*, *Hornungia petraea*, *Plantago argentea*, *Cerastium pumilum*; **Annual mean temperature** (positive correlations): *Xeranthemum annuum*, *Stipa capillata*; **Mean temperature of the summer half-year** (positive correlations): *Thymus praecox*, *Linum tenuifolium*, *Chrysopogon gryllus*, *Stipa capillata*; **Mean temperature of the winter half-year** (positive correlations): *Chrysopogon gryllus*, *Convolvulus cantabrica*, *Plantago argentea*; **Average of the annual minimum temperature** (positive correlations): *Plantago argentea*, *Scilla autumnalis*, *Convolvulus cantabrica*, *Linum tenuifolium*; **Average of the annual maximum temperature** (positive correlations): *Stipa capillata*, *Xeranthemum annuum*, *Chrysopogon gryllus*, *Plantago argentea*; **Insolation in April** (positive correlations): *Helianthemum canum*, *Thymus praecox*, *Linum tenuifolium*, *Hornungia petraea*, *Cerastium pumilum*, *Scilla autumnalis*, *Artemisia alba*, *Convolvulus cantabrica*, *Chrysopogon gryllus*.

### **Plant geographical results of the studies on dolomite grasslands**

Non-metric multidimensional scaling, canonical correspondence analyses and spectra of flora elements show fine-scale differences among association-stands of the subregions. Plant geographical importance of the regional differences in spectra of flora elements is known since long time ago (BECK 1901). Spectra of the flora elements for comparison of the associations are also used for a long time (e.g. SOÓ 1947b). Examination of flora elements spectra of areas and vegetation-types is usually based on group-contingents. This dissertation declines from this method: comparisons of the local stands of the associations were taken with the use of (flora elements-) group-frequency based on the species relative frequency. Analyses of the flora elements spectra of the dolomite rocky grasslands areas occurring in the Transdanubian Mts confirmed former distinguished (SOÓ 1958) differences. Submediterranean character of the Balaton Uplands and the similarity of Eastern Bakony and Vértes Mts are unequivocally seen. By this method I revealed formerly unknown differences and further tendencies within vegetation-based mesoregions of the Bakony Region. Using these landscape regions (MOLNÁR et al. 2008) characterized by individual vegetation and macroclimatic features for exploration of regional subtypes is seen perspective.

Regional differences of the rocky grassland associations of the Transdanubian Mts sorted areal basic are shown more explicit than tendency. Species restricted to subregions and in that area being locally frequent are very important in definition of regional subtypes of the associations. Classification of the dolomite grasslands shows that in the Transdanubian Mts plant geographically the rocky grasslands of the Keszthelyi Mts and Southern Bakony segregate in the most characteristic way. The most important diagnostic species (e.g. *Festuca pallens*, *Seseli leucospermum*, *Stipa eriocaulis*, *Carex humilis*) of the studied dolomite rocky grassland associations are the same in the different mountains.

Within the region typical plant geographical differences can be found. Characteristic elements of the subregions are present in various associations (related to this type using level of var./subass is considered in the syntaxonomic system). Individual character of the Keszthelyi Mts and Southern Bakony is based on the presence and distribution centre of some Central-European and Alpine species and lack of species having eastern centre in their Bakony Regional distribution. The most important example for this feature is the presence of *Leontodon incanus* restricted to this subregion. The species occur in just in the above mentioned subregion of the Transdanubian Mts with occurrences connected to Moravian and Lower-Austrian dolomite grasslands. Further arguments are seen in local absence or rarity of species reach from the rocky grasslands occurring in the eastern part of the Balaton Uplands and in the Eastern Bakony to the Budai Mts (e.g. *Helianthemum canum*, *Allium moschatum*), to the Vértes Mts (e.g. *Plantago argentea*, *Artemisia alba*) or to the southern dolomite region of the Gerecse Mts (*Aethionema saxatile*). Contrary to the stands occurring in the Budai Mts and Pilis Mts *Helianthemum nummularium* being important common element of the dolomite grasslands of the Bakony Region and the Vértes Mts is absent from the Dunazug Mts. Areal comparison of the dolomite grasslands is confirmed importance of some former detected (see ZÓLYOMI 1942, BOROS 1954, FEKETE 1964) species having characteristic local distribution, improved considerably the related results and corrected the known borders.

Significant differences in the macroclimate of the western and eastern/south-eastern part of the Bakony Region and detected relations among regional distribution of the colouring elements of the dolomite grasslands and some macroclimate parameters may established the manifold enrichment of the original dolomite vegetation. The process determined by macroclimate and vegetation history can be detected in colouring elements typical regionally. Dry eastern areas (Eastern Bakony and Balaton Uplands) contacted originally with zonal forest steppe (Mezőföld) are influenced by continental and ponto-mediterranean affects from east and south-west. The more humid western areas (Keszthelyi Mts, Southern Bakony vegetation-based mesoregion /~dolomite areas around Sümeg and Tapolca/) are affected by Central-European-Alpine influences from west and north-west. Differences in regional distribution of the colouring elements can be caused by the large differences in climatic and other tolerance of the species, so their distribution is determined considerably by geomorphological and geological capabilities.

Submediterranean character is typical in dolomite grasslands of the Bakony Region but this influence is most evident in the South-Eastern two-thirds of the region. In the Eastern-Bakony and in the Eastern part of the Balaton Uplands strong Eastern- and ponto-mediterranean influences are seen. These elements (*Artemisia alba*, *Scilla autumnalis*, *Plantago argentea*) with the species of the eastern part of the Transdanubian Mts (e.g. *Helianthemum canum*, *Allium moschatum*) give individual character for the original dolomite vegetation.

These species are absent in the more humid western areas (Keszthelyi Mts, Southern Bakony), segregation of which are based on the presence of *Leontodon incanus* and *Cardaminopsis petraea* and on the high-frequency of some Central-European

mountainous species (e.g. *Polygala amara*, *Phyteuma orbiculare*). All of these facts are the arguments of the strong Central-European–Alpine influences.

Several submediterranean rocky species reach to the Keszthelyi Mts but their centre of the local distribution is in the South-Eastern two-thirds of the Bakony Region. Some of them are present, others are absent in dolomite areas of Sümeg and Tapolca. Occurrent species (e.g. *Ononis pusilla*, *Aethionema saxatile*) are found in all of the dolomite areas from Tapolca to Veszprém. Some thermophilous rocky species (e.g. *Convolvulus cantabrica*, *Medicago prostrata*) are absent around Sümeg and Tapolca and occur in the dolomites of the Keszthely Mts – just on the most thermophytic Southern margins of them. These species grow also on other bedrock types (e.g. basalt) in the western part of the Balaton Uplands, so distribution of them may be determined by the thermophytic climate of the area close to Lake Balaton.

Differences between Western and Eastern part of the Bakony Region are increased by the fact that the Western dolomite areas are in contact with sandy and gravelly areas (Bakonyalja, Kisalföld) and there the incompact sediments among dolomite hills are formed by sand. It resulted that species common in sandy vegetation (*Viola rupestris*, *Helichrysum arenarium*, *Gypsophila arenaria*) are frequent in that area.

Conversely, Eastern dolomite area of the Bakony Region is neighboured with a loessy area (Mezőföld). There the loess patches of the valleys and plateaus provide occurrences of loess-preferent species (e.g. *Silene bupleuroides*, *Seseli varium*, *Amygdalus nana*, *Serratula radiata*, *Hypericum elegans*). The low dolomite plateau extends from Várpalota to Veszprém–Nagyvázsony and to Veszprém–Márkó gives a good geomorphological basis for the steppe, forest-steppe species having eastern, south-eastern centre of distribution. Loess occurrences of that area are characterized by good soil circumstances forward the penetration of the species come from south-east. Dry, warm climate of the south-eastern part of the Bakony Region is characterized by descending blasts what also helped the dolomite flora enriched with eastern and submediterranean species to remain.

My results coincides with the opinion of VOJTKÓ (1998) based on his studies of the Bükk Mts: diversity of the grasslands determined by abiotic factors (bedrock, microclimate, etc.) is modified by different plant geographical influences and landuse history. Minimum two flora gradients of the dolomite vegetation of the Bakony Region are similar to that of which was revealed in sandy grasslands by studies of FEKETE et al. (2002) carried out in some representative plainy areas of that grassland type. There the influence of closed forest zone from north, and the influence of forest steppe zone from south are robust. Geological and macroclimatic heterogeneity of the Bakony Region give a good chance for the examination of different affections in vegetation history and manifold flora enrichment in detail. Correction of the knowledge about biogeographical characteristics of the Bakony Region is possible by detailed analyses of further vegetation types and statistical analyses of phytosociological, floristic and faunistic databases.

#### 4. Summary of the most important new scientific results

- Confirmation of the presence of 16 dry grassland associations, description of 6 new subassociations and 6 new localvariants based on the documentation and classification of the dry grasslands of the Bakony Region;
- Recognition, documentation and mapping of the calciphob sandy grasslands of the Bakony Region (BAUER 2006);
- Validation of the *Geranio rotundifolii-Sedetum albi* Jakucs ex Soó 1973 association (BAUER 2005);
- Description of *Sanguisorbo minoris-Brometum erecti* Illyés et al. 2009 association, with co-authors (ILLYÉS et al. 2009);
- Recognition of the presence of *Alyssso alyssoidis-Sedetum albi* Oberdorfer et Müller in Müller 1961, *Festuco valesiaca-Stipetum capillatae* Sillinger 1930 associations in Hungary (BAUER 2003 /coenol. wg./, BAUER 2009);
- Rejection of *Carici humilis-Artemisietum albae* (PENKSZA et al. 2001, 2002) and *Artemisio austriacae-Festucetum rupicolae* (DEBRECZY 1988) association names and description of these types as variants;
- Exploration of Hungarian distribution of biogeographically important taxa of rocky and dry grasslands (*Cardaminopsis petraea*, *Primula auricula*, *Valerianella pumila*) (BAUER et al 2008a, b, SOMLYAY & BAUER 2007), revelation of regional distribution pattern of further several species (e.g. *Artemisia alba*, *Helianthemum canum*, *Ononis pusilla*, *Medicago prostrata*);
- Confirmation and character species determination of *Festuco pallenti-Brometum pannonici*, *Seselio leucospermi-Festucetum pallentis*, *Fumano-Stipetum eriocaulis*, *Chrysopogono-Caricetum humilis* associations based on statistical analyses of a matrix included own relevés collected in the studied region, original (Zólyomi) reference-relevés of dolomite grassland associations, own relevés collected in the Vértes Mts, Gerecse Mts, Pilis Mts, Budai Mts and on dolomite hills around Hainburg;
- I have admitted transitional status (species composition, structure) of *Fumano-Stipetum eriocaulis* by statistical analyses, but I have considered differentiation of the type at association level, caused by the significant cover values;
- Markant submediterranean character is a general feature of the dolomite grasslands occurring in the Bakony Region, but it is most characteristic in the Balaton Uplands and in the Eastern Bakony on the base of my examination on the spectra of flora elements of local stands and on the accurate distribution of several submediterranean co-occurring species;
- Distinct emergence of flora-element types is seen as a confirmation of propoundment of KUN et al. (2002) of which contradicted macroclimate-independency of edafic rocky vegetation;
- I have demonstrated that between the climatically different eastern and western dolomite areas of the Bakony Region the change is more abrupt than in the relation of the Eastern Bakony and Vértes Mts;

- Dolomite grasslands of the Keszthelyi Mts and Southern Bakony are separated the most harshly in the Transdanubian Mts (*Seselio leucospermi-Festucetum pallentis*, *Fumano-Stipetum eriocaulis* on the same base);
- I allow as subregional localvariants of the dolomite grasslands those types of which were revealed by fine-scale plant geographical studies (*Leontodon incanus* variant in western, *Helianthemum canum* variant in eastern dolomite areas);
- In the Eastern, South-Eastern two-thirds of the Bakony Region (Eastern-Bakony and Eastern part of the Balaton Uplands) marked Eastern- and ponto-mediterranean influences are seen. These colouring elements (e.g. *Plantago argentea*, *Artemisia alba*) give individual character to the original dolomite rocky vegetation, and strict relation with the eastern part of the Transdanubian Mts (e.g. *Helianthemum canum*, *Allium moschatum*) is detected;
- Distribution patterns show that regional occurrences of some (having eastern centre in the Bakony Region) rocky grassland species are limited by the bedrock (e.g. *Aethionema saxatile*), others are limited by climatic features (e.g. *Convolvulus cantabrica*);
- Dolomite grasslands of the Keszthelyi Mts and the Southern Bakony are characterized by considerable presence of some Central-European-Alpine species and lack of several species having eastern distribution centre in the Bakony Region;
- Differences between Western and Eastern part of the Bakony Region are increased by the facts that the Western dolomite areas are in contact with sandy and gravelly areas (Bakonyalja, Kisalföld) and there the incompact sediments among dolomite hills are formed mainly by sand. Contemporaneously, the Eastern, South-Eastern dolomite area of the Bakony Region is neighboured with a loessy area (Mezőföld). There in the valleys and plateaus occurrences of loess-patches are typical;
- Results admit manifold enrichment of the original dolomite flora of the Bakony Region. Distribution of the taxa caused the subregional differences argue not only the similar plant geographical possesses, but similar climate and flora historical cases of the subregions.

[The list of publications can be found at the end of the Hungarian text.]

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