



COENOLOGICAL DIFFERENTIATION OF PEUCEDANUM SPECIES (SECT. PEUCEDANUM) STANDS IN THE CARPATHIAN BASIN

KOVÁCS J.A.

*Institute of Biology, Department of Botany, University of West Hungary, 9700 – Szombathely,
e-mail: kja@ttk.nyime.hu*

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ABSTRACT - Species of *Peucedanum* (sect. *Peucedanum*) with closer botanical relationships were source of taxonomic, ecologic and coenologic uncertainties. Coenological studies of grassland vegetation in the Carpathian basin completed with the ecological indicators contributed to the foundation some coeno-ecological species groups, which can express and characterize the coenological differentiation of the *Peucedanum*-species and stands. Thus, various stands of *P. officinale* are characterized by distinctive group of species for dry, humid and semi-dry salt meadows, *P. longifolium* by groups for rupicolous submediterranean habitats, *P. rochelianum* by a group of fen and wet meadows, *P. tauricum* by a group of xerothermic fringe vegetation and an other for stepic grasslands. It is presented the vegetation structure, local diagnostics, constant and dominant species of recently described plant community: *Inulo ensifoliae-Peucedanetum tauricae*.

KEY WORDS: PEUCEDANUM-SPECIES, COENO-ECOLOGICAL GROUPS, GRASSLAND VEGETATION, INULO ENSIFOLIAE-PEUCEDANETUM TAURICAE

INTRODUCTION

In the area of the Carpathian basin the genus *Peucedanum* (sect. *Peucedanum*) includes mostly species of South East European origine: *P. officinale* L., *P. longifolium* Waldst. & Kit., *P. rochelianum* Heuff. and *P. tauricum* M. Bieb. These taxa have strong relationships with *P. ruthenicum* M. Bieb., *P. paniculatum* Loisel. and *P. coriaceum* Reichenb., about all remained several taxonomical and ecological uncertainties (Shishkin, 1951; Tutin, 1968; Strid, 1986; Pimenov, 2007). The species in the sect. *Peucedanum* s. str. having leaf lamina ternat-multisect with geniculate rhachis and segment, which are not situated in one plane (versus pinnate leaf lamina in the sect. *Palimbioidea* Boissier). Other characters as fruit anatomy, secondary metabolites (ex. furanocoumarins by Bartnik & Glowniak, 2007), calyx teeth etc. contribute to the species differences also. Taxonomical and ecological uncertainties have been multiplied after the monography of Frey (1989), who recognized for the Carpathian basin only two taxa: *P. officinale* L. and *P. ruthenicum* (Bieberstein) Rochel, with some ambiguous synonymes and infrataxa. The are noted transitional forms, mostly between *P. officinale* and

P. longifolium or *P. ruthenicum* (Boşcaiu, 1965; Strid, 1986; Frey, 1989). However, several uncertain floristical and ecological records have been reported in the earlier and in the recent regional botanical literature (Barth, 1866; Schur, 1866; Simonkai, 1887; Jávorka, 1925; Todor, 1958; Strid, 1986; Kovács, 2003; Jakab et al., 2007; Oroian & Sămărghitan, 2007). For this reason it was necessary to use representative populations and stands to extend the scarce ecological data and to evidence the coenological differentiation of closely related taxa. In the present contribution we can accept and treat only four species (*P. officinale*, *P. longifolium*, *P. rochelianum* and *P. tauricum*) (Tutin, 1968; Kovács, 2009) for the research area, affiliated mainly to particular coenological alliances in the Carpathian basin (Fig. 1a.). Using the regional ecological indicators (TB, WB, RB, especially the moisture W-values) after Ellenberg et al., (1992), Borhidi (1993) and Kovács (1979), coenological and ecological differences were established between the four *Peucedanum*-species and stands.

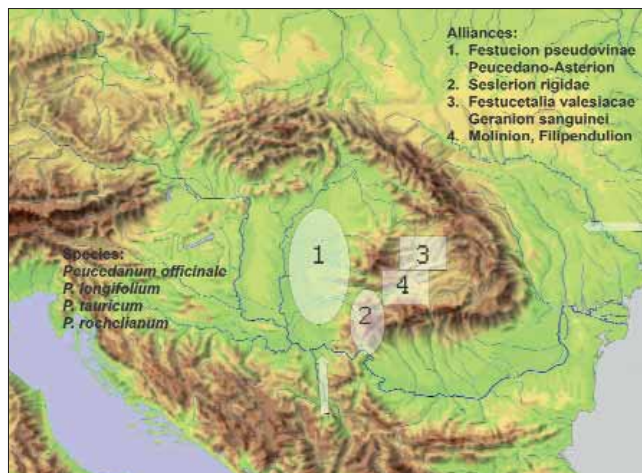


Fig. 1a. Map of Carpathian basin with the distribution of main alliances and *Peucedanum* species stands investigated.

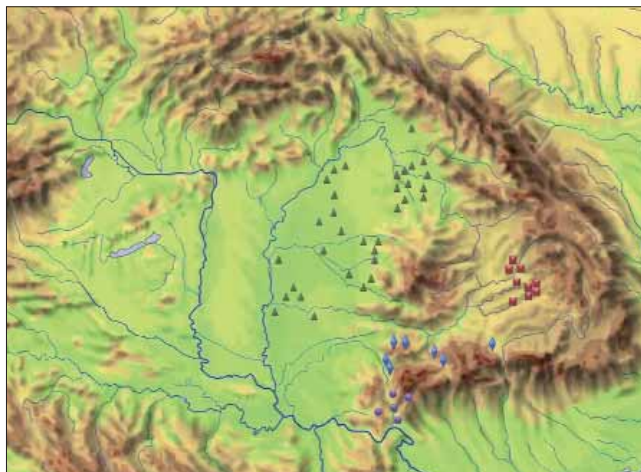


Fig. 1b. Map of Carpathian basin with the distribution of sampling sites: ▲ *Peucedanum officinale*, ● *P. longifolium*, ◆ *P. rochelianum*, ■ *P. tauricum*

ABOUT THE TAXONOMIC STATUS

***Peucedanum officinale* L.** The species has a central position in the section *Peucedanum* s. str., with the lower leaves 30–60 cm, (2-) 4- to 6-ternate, lobes 1–3 mm linear, with margins slightly recurved, petals yellow, broad ellipsoid fruits 7–10 mm, narrowly elliptical to oblong-obovate, pedicels 3–4x longest than fruits. It is a tall glabrous perennial, rhizomatous hexaploid ($2n=66$) plant, distributed mostly in South and C. Europe, but sporadic in Transylvania.

***P. longifolium* Waldst. & Kit.:** It was described in 1812 with a dispersed chorology, mostly in the Balkan Peninsula. Basal leaves like the former taxa, but leaf-lobes rarely more than 1mm wide, keeled, ripe fruit about as long as pedicels. This species in the monographical work (Frey, 1989) appear as: *P. officinale* L. subsp. *longifolium* (Waldstein & Kitaibel) R. Frey. ***P. rochelianum* Heuffel:** Described firstly in 1858

from Banat (Făget, Romania), stem erect, leaves (2-) 3- ternate with 3 prominent veins and 2 less conspicuous ones between them. In his monography Frey (1989) treat and subordinate this species to the compiled taxa *P. ruthenicum* (Bieberstein) Rochel, but the recent chromosome count indicate as a diploid species, $2n=22$ (Ștefureac & Tăcina 1982; Hadaček & Samuel, 1994). ***P. tauricum* M. Bieb.:** It was described by M. Bieberstein (1808) from Tauria (Crimea), who delimited after the leaves as „foliis quinques tripartitis, pinnulis linearibus acutis, brevibus” against other taxa with leaves as „foliis triternatis pinnulis linearibus, acutis longissimis” which belongs to the taxon *P. ruthenicum* M. Bieb. However for *P. tauricum* the lower leaves are (4) 5–6 (7)-ternate and fruits oblong-obovoids. After the synthesis of Simonkai (1876) and Jávorka (1925), were recognized only *P. officinale* and *P. rochelianum* as different taxa in the research area. Other source of confusion is Frey’s work (1989), subordinating it to the compiled taxa *P. ruthenicum* (Bieberstein) Rochel. Regional works of Nyárády (1939), Boșcaiu (1965), Boșcaiu & Rațiu (1965), and Soó (1966), gives real evidences about the species presence in the Carpathian basin.

MATERIAL AND METHODS

The coenological data were collected between 2005–2008 in *Peucedanum* (sect. *Peucedanum*) species rich stands distributed in various sites in the Carpathian basin, mostly in the Pannonian Plain, Banat Mountains, Hațeg Depression, Sibiu Depression, Transylvanian Plain and Subcarpathians, according to the Hungarian Phytosociological Database (Lájet et al., 2007) and the Romanian habitat directives (Doniță et al., 2005). It was used some published data also (Boșcaiu, 1965; Pop, 1968; Karácsonyi, 1982). The studied area is located in Central Europe, in the eastern part of Hungary (Tisza-Plain) and in the central and western part of Romania (Transylvania) (Fig. 1a.). Localities name for sampling following the official uses. The relevés plot size ranged between 16–25 to 100 m², most often 25 m². For the cover values registration in the field (A–D%) we used the more common notation in Europe, the modified Braun-Blanquet scale: += cover <1%, individuals 1–5; 1= cover <5%, individuals 6–50; 2m= cover <5%, individuals >50; 2a= cover 5–12%, various individuals; 2b= cover 12–25%, various individuals; 3= cover 25–50%, various individuals; 4= cover 50–75%, various individuals; 5= cover 75–100%, various individuals (Dieschke, 1994, Kovács, 2004). It was used the coenological group of species, which express the regional coenotic affinities between the species, their closeness social behaviour and, they have been founded after the species frequency and constancy values. Threshold values are for constant species 50 (frequency value) and for

diagnostic species 40 (frequency value). Average ecological indicator values (TWR and especially W-values) (Ellenberg et al., 1992; Borhidi, 1993; Kovács, 1979) have been calculated on the species groups resulting from the classifications. The nomenclature of species follows Tutin (1968), Oprea (2005), Simon (2002), and Ciocârlan (2009).

RESULTS AND DISCUSSION

Coenological studies carried out on grassland vegetation in the Carpathian basin completed with the ecological indicators (Ellenberg et al., 1992; Borhidi, 1993; Kovács, 2009) contributed to the foundation of coeno-ecological species groups, which can express and characterize the coenological differentiation of the *Peucedanum*-species and stands.

Peucedanum officinale L.

Is the widespread taxon of the sect. *Peucedanum* s. str. in the investigated area. Important coenological stands are localized mostly in the Pannonian Plain (Tisza-Plain, Someş-Plain), Crişana (Körös) and Banat area (Fekete et al., 1997; Molnár & Borhidi, 2003). In the historical region of Transylvania only sporadic appearances were signed (Nyárady, 1939; Kovács, 2004). In our investigations characteristic stands have been reported near several localities: Dévaványa, Bélmegyer, Gyomaendrőd, Szeghalom, Fűzesgyarmat, Szerep, Geszt, Biharugra, Hencida, Nagykereki, Pród, Újszentmargita, Bagota, Hetefejércse (Hungary), Carei, Craidorolţ, Hotoan, Sătmărel, Galoşpetreu, Eriu, Roşiori, Tăşnad, Cehăluţ, Santău Mare-Oradea, Ateaş, Rădvani-Salonta, Adea, Agrişu Mare, Mocrea, Ciala-Arad, Turnu, Sânnicolau Mare (Fig. 1b.) (Romania). In the Tisza-Plain area this taxon cohabited with a rare butterfly species (*Gortyna borellii-lunata*). The coenological relevés realized on the basis of characteristic and constant species indicate that the most frequent coeno-ecological species group (Fig. 2-4. and 8.) is structured as **a**): *Peucedanum officinale*, *Aster sedifolius*, *Artemisia pontica*, *Lotus angustissimus*, *Limonium gmelini*, *Gypsophila muralis*, *Serratula tinctoria*, *Alopecurus pratensis*, *Clematis integrifolia*, belonging to the tall herb salt meadows, with a medium moisture (WB: 4,8) value (*Peucedano-Asteretum sedifolii*, Table 1.). This type can be found in an other „humid” (WB=6,3) variant also **b**): *Peucedanum officinale*, *Alopecurus pratensis*, *Aster sedifolius*, *Lychnis flos-cuculi*, *Serratula tinctoria*, *Festuca pratensis*, *Iris spuria*, *Gentiana pneumonanthe*, *Thalictrum lucidum*, *Euphorbia lucida*. Transitions to the salt meadows are indicated by the following group (WB= 3,9) **c**): *Peucedanum officinale*, *Aster sedifolius*, *Festuca pseudovina*, *Limonium gmelinii*, *Artemisia santonicum*, *Rumex pseudonatronatus*, *Podospermum canum*, *Plantago schwarzenbergiana*, *Ranunculus pedatus* (*Achilleo-*

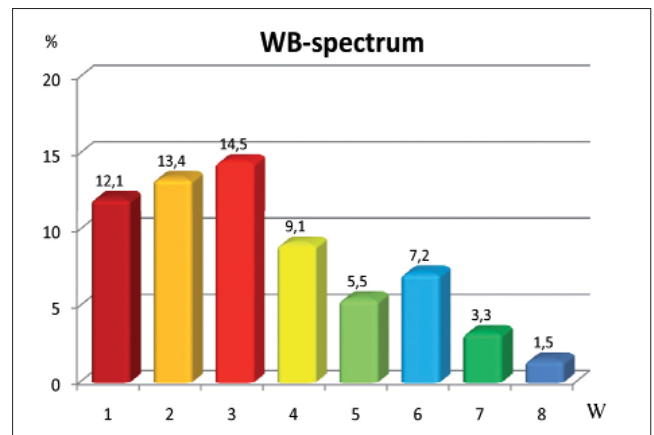


Fig. 2. *Peucedanum officinale* „semi-dry” (*Peucedano-Asteretum sedifolii*, Salonta).

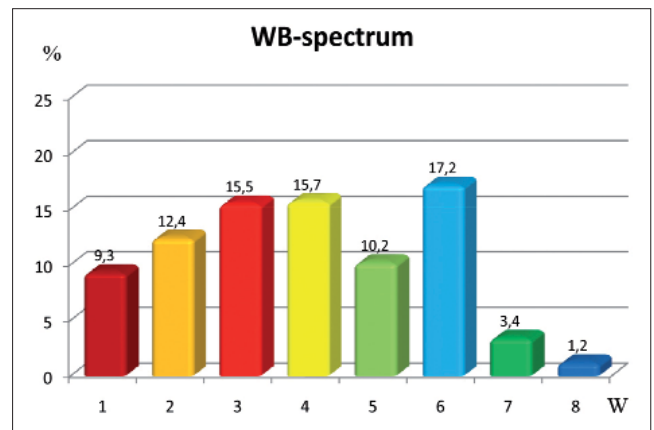


Fig. 3. *Peucedanum officinale*: „humid” (*Peucedano-Asteretum sedifolii*, Carei).

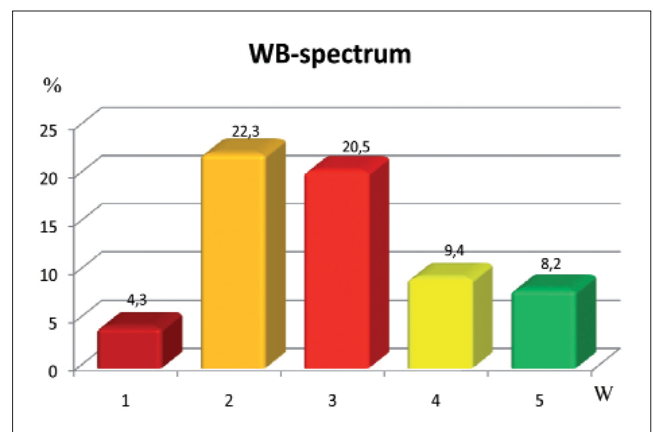


Fig. 4. *Peucedanum officinale*: „dry” (*Peucedanum officinale-Festuca rupicola*, Cehăluţ).

Festucetum pseudovinae asteretosum). Successions to the dry and semi-dry meadows are expressed (WB = 2,9) by the following species group **d**): *Peucedanum officinale*, *Festuca rupicola*, *Aster linosyris*, *Elymus hispidus*, *Artemisia pontica*, *Fragaria viridis*, *Filipendula vulgaris*, *Achillea collina*,

Dianthus pontederiae. The comparative analysis of 29 stands demonstrated that *P. officinale*, a Central-european (-submediterranean) floral element is characteristic for semi-dry and semi-humid habitats, tall herb salt meadows, salt meadows and salt marshes, represented by the following plant communities: *Peucedano-Asteretum sedifolii* Soó 1947 corr. Borhidi 1996, *Achilleo-Festucetum pseudovinae* Soó (1933) 1947 corr. Borhidi 1996, and partially the *Galatello-Quercetum roboris* Zólyomi & Tallós 1967; alliances: *Festucion pseudovinae*, *Peucedano officinalis-Asterion sedifolii* and *Aceri tatarico-Quercion*.

Table 1. The *Peucedanum* species groups and their relative TWR-values

Species group	TB	WB	RB
<i>Peucedanum officinale</i> (a)	8	4	8
<i>Aster sedifolius</i>	7	4	8
<i>Artemisia pontica</i>	8	3	8
<i>Lotus angustissimus</i>	8	2	8
<i>Limonium gmelini</i>	7	6	7
<i>Gypsophila muralis</i>	6	7	6
<i>Scorzonera cana</i>	8	4	8
<i>Serratula tinctoria</i>	6	6	6
<i>Alopecurus pratensis</i>	5	6	6
<i>Clematis integrifolia</i>	5	6	8
	6,9	4,8	7,3
<i>Peucedanum longifolium</i>	8	2	8
<i>Sesleria filifolia</i>	8	2	9
<i>Allium flavum</i>	7	2	7
<i>Erysimum comatum</i>	8	3	7
<i>Dianthus spiculifolius</i>	8	3	7
<i>Silenem flavescens</i>	9	1	9
<i>Campanula crassipes</i>	8	2	8
<i>Seseli gracile</i>	8	3	8
<i>Helictotrichon decorum</i>	7	3	8
<i>Asperula tenella</i>	8	2	8
	7,7	2,3	7,9
<i>Peucedanum rocheliamum</i>	6	7	6
<i>Molinia caerulea</i>	6	7	6
<i>Narcissus radiifolius</i>	4	6	4
<i>Sanguisorba officinalis</i>	5	6	7
<i>Gentiana pneumonanthe</i>	5	8	6
<i>Iris sibirica</i>	6	8	8
<i>Inula salicina</i>	5	5	6
<i>Cirsium canum</i>	6	8	6
<i>Serratula tinctoria</i>	6	6	6
<i>Euphorbia villosa</i>	8	7	6
	5,7	6,8	6,1
<i>Peucedanum tauricum</i>	7	3	8
<i>Inula ensifolia</i>	7	3	7
<i>Thalictrum minus</i>	7	3	8
<i>Galium glaucum</i>	7	2	9
<i>Dictamnus albus</i>	8	3	8
<i>Anthericum ramosum</i>	6	3	7
<i>Asparagus officinalis</i>	7	3	7

Species group	TB	WB	RB
<i>Elymus hispidus</i>	7	3	8
<i>Agrimonia eupatoria</i>	6	4	7
<i>Teucrium chamaedrys</i>	6	3	8
	6,8	3,0	7,7

Peucedanum longifolium Waldst. & Kit.

Contrasting with the former species, *P. longifolium* a Balcanic species is less frequent in the research area (Fig. 1b.). Dispersed populations appear mostly in xeric calcareous rocky places like: Cernei Mts., Cheile Glodului, Cheile Rudăriei (Domaşnea-Mehadia-Herculane area), Miniş Gorges (Nera-Beuşniţa NP), Aninei Mts., Semenic Mts., Valea Cioclovei, Cazane Mari area (South-Western Romania). The carstic relief and the Mediterranean influences conferred particular habitat condition for the calcophile vegetation of xerophile grasslands and xerothermophile forests. Characteristic small stands have been reported from the area of the following localities: Bozovici, Anina, Jablaniţa, Mehadia, Herculane (Fig. 1b.) (Antal et al., 2005; Nicolin et al., 2007; Imbrea et al., 2008). This rare taxon, generally present slow abundancy and constancy values (I-II). Analysing the accompanied species and their ecological values (TB, TW, TR) it was possible to establish various coeno-ecological species groups: **a)** *Peucedanum longifolium*, *Sesleria filifolia*, *Allium flavum*, *Centaurea atropurpurea*, *Erysimum comatum*, *Dianthus spiculifolius*, *Silene flavescens*, *Campanula crassipes*, *Seseli gracile*, *Helictotrichon decorum*, *Asperula tenella* (*Seslerietum filifoliae*); **b)** *Peucedanum longifolium*, *Festuca rupicola*, *Phleum montanum*, *Allium flavum*, *Stachys recta*, *Cerastium banaticum*, *Iris reichenbachii*, *Asperula tenella*, *Melica ciliata* (*Cytiso-Festucetum rupicolae*); **c)** *Peucedanum longifolium*, *Sesleria rigida*, *Campanula grosekii*, *Allium flavum*, *Athamanta turbith* subsp. *hungarica*, *Dianthus spiculifolius*, *Asperula tenella*, *Digitalis lanata* (*Asperulo capitatae-Seslerietum rigidae*). The species groups demonstrating characteristics of the rupicolous-calcareous and basophile vegetation (TB: 7,4-7,9; WB: 2,3-2,6; RB: 7,6-7,9). The comparative analysis of 7 stands, the moisture spectrum (Fig. 5. and 8., Table 1.) indicate that the species is adapted to xerothermic rocky sites, slopes more exposed to solar radiation, with lower shade, the domination of Banatic flora of the plant communities: *Seslerietum filifoliae* Zólyomi 1939, *Helictotrichon decori* Domin, *Cytiso-Festucetum rupicolae* Peia 1978, *Asperulo capitatae-Seslerietum rigidae* (Zólyomi, 1939) Coldea 1991, belonging to the Banatic mountain vegetation of the *Seslerion rigidae* alliance. Relations with the submediterranean forests

indicated several taxa of the Syringo-Carpinion orientalis alliance. The coenology and ecology of this species differ substantially from those of the *P. officinale*, so the taxonomic subordination is doubtful.

Peucedanum rochelianum Heuffel

The distribution of this species is restricted only to the region of Banat, Transylvania and a few population in Muntenia (Pauca-Comănescu & Negrean, 1994) and partially in Croatia (Boşcaiu, 1965). The important populations and stands of this Balcanic-Dacian floral element are concentrated near the Caransebeş Depression, Poiana Rusca Hills, Haţeg Depression and Sibiu Depression (Boşcaiu, 1965; Drăgulescu, 1986). Several records indicated from Central and Eastern Transylvania can be dubious (Barth, 1866; Todor, 1958; Jakab et al., 2007). Coenotic stands have been recorded from the area of the following localities: Zerveşti–Turnu Ruieni, Zlagna (Caransebeş), Făget and Margina alongside the river Bega (Lugoj-Deva), Pui-Ponor and Sălaşul de Sus–Nuşoara (Haţeg area), Veştem (Sibiu) (Fig. 1b.). The stands of *P. rochelianum* differ from the other species-stands treated, because their habitats belong to the wet and fen meadows, depressions evidenced by the following coenological species group: *Peucedanum rochelianum*, *Molinia caerulea*, *Narcissus radiiflorus*, *Sanguisorba officinalis*, *Gentiana pneumonanthe*, *Iris sibirica*, *Inula salicina*, *Cirsium canum*, *Serratula tinctoria*, *Euphorbia villosa*, which explain the particular ecological values (TB: 5,5; WB: 6,8; RB: 6,1; Table 1). The endemic plant community: *Peucedano rocheliani-Molinietum* Boşcaiu 1965 is very rich in Molinion coenological elements: *Selinum carvifolia*, *Succisa pratensis*, *Lychnis flos-cuculi*, *Deschampsia caespitosa*, *Carex flava*, *Valeriana officinalis*, *Ranunculus polyanthemus*, *Gladiolus imbricatus*, *Carex hirta*, *Veratrum album*, *Galium palustre*, *Potentilla erecta*, *Trifolium hybridum* etc. The frequency of character and constant species indicate fundamental coenological and ecological differences against to other taxa of sect.

Peucedanum s. str. (Fig. 6. and 8., Table 1.). The participation of *P. rochelianum* in the constitution of the regional *Molinietum*-plant community, evidences a particular successional trend, a kind of admission in the moist-wet and mesic habitats. Coenological relations and ecology of the species help us to eliminate the taxonomic uncertainties.

Peucedanum tauricum M. Bieb.

This West Pontic floral element were recorded from central Transylvania, but former and recent studies frequently indicate confuse data (*P. rochelianum*, *P. ruthenicum*). Important populations can be found in the area of the Transylvanian Plain (Mezőség), Turda Gorges, Târnava Hilly Region, Hills of Sibiu. Coenotic stands used in the present study were identified in Eastern Transylvania, at the neighbourhood of the following localities: Band, Săbed, Şardu Nirajului, Cristuru-Secuiesc, Şoimosu Mic, Şoimosu Mare, Eliseni, Boiu, Păucea (Fig. 1b.). The stands of *P. tauricum* occupies large surfaces, situated in the contact area of the dry, semi-dry grasslands with the thermophile fringe vegetation. The stands develop on steep, warm, south-western facing slopes, over marl, marlstone or sandstone. Most sites (abandoned grasslands) are burned annually, but *P. tauricum* and several accompanied rhizomatous species can resist well to the early spring disturbances and burning. This taxon is a good indicator of the xerothermic sites (Fig. 7. and 8., Table 1.) (TB: 6,9; WB: 3,0; R: 7,7;) and participate peculiarly in two related coenological groups: **a)** *Peucedanum tauricum*, *Inula ensifolia*, *Thalictrum minus*, *Galium glaucum*, *Anthericum ramosum*, *Muscari tenuiflorum*, *Asparagus officinalis*, *Elymus hispidus*, characterizing the xerothermic fringe habitats (*Inulo ensifoliae-Peucedanetum tauricae* Kovács 2009; alliance: Geranion sanguinei) and **b)** *Peucedanum tauricum*, *Festuca rupicola*, *Bothriochloa ischaemum*, *Astragalus monspessulanus*, *Iris aphylla*, *Salvia nutans*, *S. transylvanica*, *Cephalaria radiata*, *Vinca herbacea*, characterized the dry, (steppic) and xerothermic grasslands

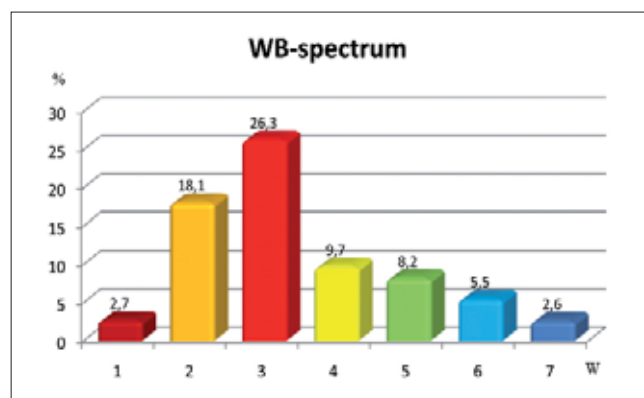


Fig. 5. *Peucedanum longifolium* (Seslerietum rigidae, Miniş Gorges).

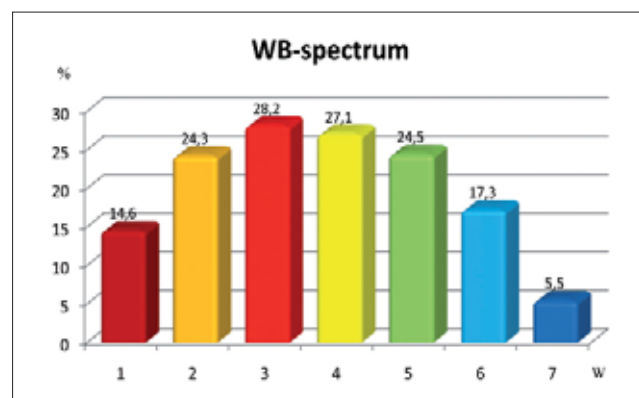


Fig. 6. *Peucedanum rochelianum* (Peucedano rocheliani-Molinietum, Margina).

(*Cariceto humulis-Festucetum rupicolae* Soó 1947, *Bothriochloetum ischaemi* (Krist.1937) Pop 1977, alliance: *Festucion rupicolae*). The plant community *Inulo ensifoliae-Peucedanetum tauricae* Kovács J. A. 2009 (Table 2.) constitutes a transitional association between the Geranion and *Festuco-Brometea* syntaxa, with a particular role in the dynamic relations of dry/semi-dry grasslands and fringe vegetation, expressing the Pontic relations of the Transylvanian vegetation.

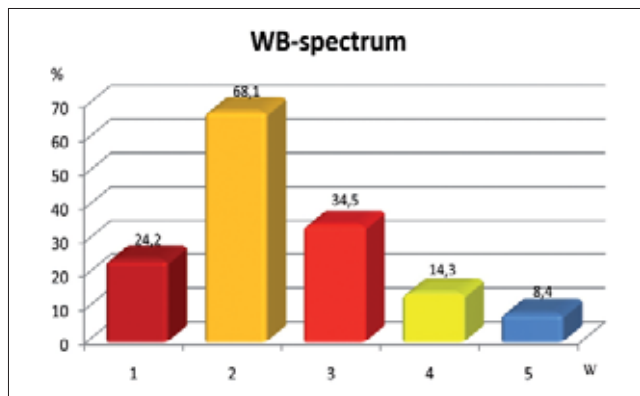


Fig. 7. *Peucedanum tauricum* (*Inulo ensifoliae-Peucedanetum tauricae*, Cristur).

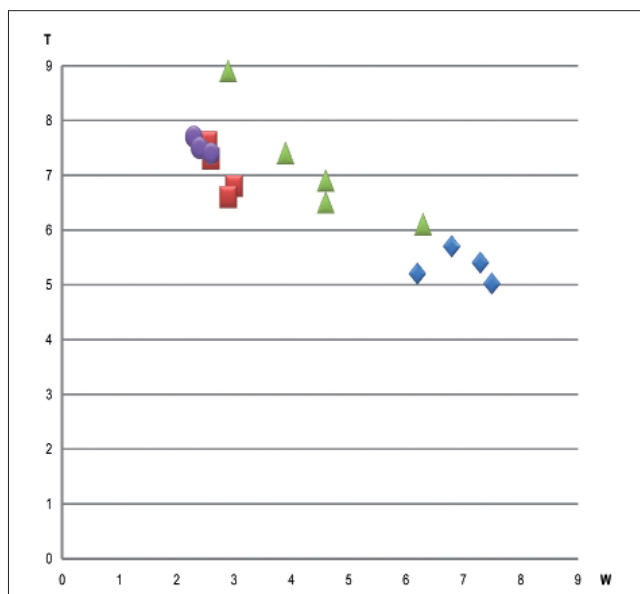


Fig. 8. Distribution of *Peucedanum* stands in relation with the T (temperature) and W (moisture) values: ▲ *P. officinale*, ● *P. longifolium*, ◆ *P. rochelimum*, ■ *P. Tauricum*

Considerations on the plant community: *Inulo ensifoliae-Peucedanetum tauricae* Kovács J. A. 2009 (Table 2).

The *Peucedanum tauricum* stands distributed in the central part of Romania (Transylvania) often had been confounded with stands of *P. officinale* and/or *P. rochelimum*. In the field research and studies this impact can be eliminated using the

particular species groups. For this reason we present the coenological relations of *Inulo ensifoliae-Peucedanetum tauricae* plant community. In Transylvania along the distribution area of dry and semi-dry grasslands, coenological references to the reliable *P. tauricum* stands had been reported sporadically (Soó, 1949; Csűrös, 1973; Schneider-Binder, 1977). The problematic origin and the confusions are related to values of taxonomical and ecological information about the species. After the synthesis of Simonkai (1887), and Jávorka (1925), in the keys of identification there were recognized only the species *P. officinale* and *P. rochelimum* as different taxa. Due to the contributions of Nyárády (1939) the morphological and ecological differences were demonstrated between the related *Peucedanum*-species in Transylvania. His work and considerations were continued by Boşcaiu (1965), so the modern botanical literature recognizes the presence of *P. tauricum* in Transylvania (Todor, 1958; Tutin et al., 1968; Oprea, 2005; Ciocârlan, 2009).

The taxon *P. tauricum* belongs to the Pontic species group of dry grasslands with a relatively limited certain distribution in Krym (Crimea) and in central Transylvania (România). The species was described by M. Bieberstein from Tauria (Krym, Crimea), who it delimited morphologically after the leaves as „foliis quinque tripartitis, pinnulis linearibus acutis, brevibus ..Hab. Tauria pratis” (*P. tauricum*), against to the taxa with the leaves as „foliis triternatis pinnulis linearibus, acutis longissimis...Hab. Rossiae meridionalis” (*P. ruthenicum*) (Nyárády, 1939). The populations prefer warm, sunny places inside of dry, semi-dry grasslands and fringe communities. Data related to the certain presence and distribution of *Peucedanum tauricum* populations and stands in various grassland communities (*Stipion lessingianae*, *Festucion rupicolae*, *Festucetalia valesiacae*) in the research area and the surroundings can be found in various publications related to the vegetation of Transylvania (Soó, 1949; Schneider-Binder, 1977). There are ambiguous and untrue floristical/coenological records in the former and in the current Transylvanian literature also: *P. campestre* (Barth, 1866), *P. officinale* agg. (Schur, 1866; Todor, 1958; Kovács, 2003), *P. rochelimum* (Jakab et al., 2007), *P. ruthenicum* (Oroian & Sămărghișan, 2007).

During our survey related to the structure and distribution of grassland plant communities in Eastern Transylvania, we identified coenologically important stands dominated by *P. tauricum* at the neighbourhood of the following localities: Band, Săbed, Șardu Nirajului, Șoimoșu Mic, Cristuru-Secuiesc (Fig. 1b.). The stands of *P. tauricum* occupies hundred square meters surfaces, situated in the contact area of the dry, semi-dry grasslands with the thermophile fringe vegetation. They develop on steep, warm, south-western facing slopes, over marl, marlstone, sandstone, on moderate deep soil, or soils without boulders or debris, with bare parent

rock. Most sites/niches have been abandoned, they are burned annually, but *Peucedanum tauricum* and several accompanying rhizomatous species can resist to the early spring disturbances and burning (Fig. 9).



Fig. 9. Aspect with the *Inulo ensifoliae*-*Peucedanetum tauricae* after the spring burning (Cristur).

Basically after the coenological structure of the species composition the stands of *P. tauricum* belong to the *Geranion sanguinei* alliance. We described them as a new plant community named: *Inulo ensifoliae*-*Peucedanetum tauricae* (Table 2). The most important diagnostic species of this association are: *Peucedanum tauricum*, *Inula ensifolia*, *Thalictrum minus*, *Anthericum ramosum*, *Muscari tenuiflorum*, *Galium glaucum*, *Asparagus officinalis*. The species *P. cervaria* have only a slowly presence or lacks. There are several dominant and constant species of the *Origanetalia - Trifolio-Geranietaea* (*Elymus hispidus*, *Teucrium chamaedrys*, *Agrimonia eupatoria*), *Cirsio-Brachipodion* (*Carex humilis*, *Dorycnium herbaceum*, *Brachypodium pinnatum*) and the *Festucion rupicolae - Festuco-Brometea* syntaxa (*Artemisia campestris*, *Festuca rupicola*, *Stipa capillata*, *Bothriochloa ischaemum*, *Aster linosyris*) etc. The particularity of the species composition is given by the taxa with deep roots, rhizomatous plants: *Peucedanum tauricum*, *Elymus hispidus*, *Bothriochloa ischaemum*, *Anthericum ramosum*, *Asparagus officinalis*, *Muscari tenuiflorum*, *Phlomis tuberosa*, which resist to the disturbance and frequent burning and ensure the annually good regeneration of the stands.

By the species composition and habitat characteristics, the community of *Inulo ensifoliae*-*Peucedanetum tauricae* is a transitional association between the *Geranion* and *Festuco-Brometea* syntaxa. The presence of the Pontic-subcontinental and subendemic species group (*Vinca herbacea*, *Salvia*

nutans, *S. transsylvanica*, *Ajuga laxmannii*, *Cephalaria radiata*, *Astragalus monspessulanus*, *Iris aphylla*, *Phlomis tuberosa*) give to this xerothermic vegetation unit a particular colouring. The important coverage values realized by the dominant and character species (*P. tauricum* A-D: 2b-4), its role in the dynamic relations of the dry/semi-dry grasslands and the fringe vegetation, emphasise the priorities for maintenance and protect the habitats with Pontic species in Eastern Transylvania.

CONCLUSIONS

Coenological studies of grassland vegetation in the Carpathian basin completed with the ecological indicators contributed to the foundation some coeno-ecological species groups, which can express and characterize the coenological differentiation of the *Peucedanum* (sect. *Peucedanum*) species and stands. From the four species studied, the distribution of *Peucedanum officinale* stands showing the largest geographical spreading, occurring various ecological sites in the region, characterized by distinctive groups of species for dry, semi-dry, mesic, semi-humid, salt marshes and salt meadows, with a dispersed appearances especially in the region of Pannonian Plain (Tisza-Plain), and in the adjacent territories. The vegetation ecology of these groups are related mostly to the *Festuca pseudovina* and *Aster sedifolius* grasslands and tall herbs. In the historical region of Transylvania coenotic stands of *P. officinale* are limited to sporadic occurrences. The social behaviour of *Peucedanum longifolium* stands are circumscribed by species groups for rupicolous submediterranean habitats (karstic relief, rocky sites, xeric grasslands, xerothermic forests), conditions realized particularly in the Banat Mountain area (SW Romania). The coenotic stands are related to the *Sesleria* grasslands and showing strong relationships with other dispersed populations and stands in Balkan Peninsula. The coenotic structure of *Peucedanum rochelianum* stands differ essentially from the other species stands analysed, their habitats belong to the fen and wet meadows, mesic sites and depressions evidenced by species like *Molinia caerulea*, *Narcissus radiifolius*, *Gentiana pneumonanthe* etc. The fen and wet meadows with the participation of *P. rochelianum* in the region of Banat and in southern Transylvania, were considered as an indigenous vegetation unit for the Carpathian basin. The stands of *Peucedanum tauricum* are well related to the ecology of dry, semi-dry and abandoned grasslands. They have been characterized by distinctive group of species for xerothermic fringe vegetation on the one hand and, the stepic grasslands on the other hand. The coenotic groups indicate continental and Pontic relations historically established in central and eastern part of Transylvania. These coenotic stands develop on steep slopes,

warm places, on marlstone and sandstone and, they maintenance several indicator species (*Inula ensifolia*, *Muscari tenuiflorum*, *Astragalus monspessulanus*, *Salvia nutans* etc.) of south-eastern and continental origin. Related to the investigations on *P. tauricum* stands can be concluded, that the xerothermic sites with particular coenotic structure of *Inulo ensifoliae*-*Peucedanetum tauricae* plant community, expressing well the Pontic relations of the Transylvanian grassland vegetation.

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Table 2. *Inulo ensifoliae-Peucedanetum tauricae* Kovács J. A. 2009

Number of relevé	1	2	3	4	5	6	7	K
Cover (%)	75	70	80	80	80	85	75	(%)
Ch. ass.								
<i>Peucedanum tauricum</i>	2b	2b	3	4	3	3	3	V
<i>Inula ensifolia</i>	2a	2m	2b	2a	2a	2a	1	V
Geranium sanguinei								
<i>Thalictrum minus</i>	+	+	1	+	1	+	1	V
<i>Anthericum ramosum</i>	+	+	+	+	+	+	-	V
<i>Muscari tenuiflorum</i>	+	+	+	1	+	-	-	IV
<i>Galium glaucum</i>	+	-	2m	1	+	-	2m	IV
<i>Asparagus officinalis</i>	+	-	+	+	+	-	+	IV
<i>Bupleurum falcatum</i>	+	-	+	+	+	+	-	IV
<i>Tanacetum corymbosum</i>	+	+	+	-	1	-	-	III
<i>Vincetoxicum hirsutum</i>	+	+	-	-	+	+	-	III
<i>Peucedanum oreoselinum</i>	-	+	-	+	+	+	-	III
<i>Polygonatum odoratum</i>	-	-	-	+	-	+	+	III
<i>Inula salicina</i>	-	+	+	-	1	+	-	III
<i>Peucedanum cervaria</i>	-	-	1	+	-	+	-	II
<i>Dictamnus albus</i>	1	2m	-	-	-	-	+	II
<i>Melampyrum cristatum</i>	+	-	-	-	-	+	-	II
<i>Campanula rapunculoides</i>	+	+	-	-	-	-	+	II
<i>Hieracium bauhini</i>	-	+	+	-	-	-	-	II
<i>Clematis recta</i>	+	+	-	-	-	-	-	II
<i>Inula hirta</i>	1	-	-	-	-	+	-	II
<i>Verbascum lychnitis</i>	+	-	-	-	+	-	+	II
<i>Inula germanica</i>	-	+	-	-	-	-	-	I
<i>Trifolium alpestre</i>	-	+	-	-	-	-	-	I
Origanetalia – Trifolio-Geranietea								
<i>Elymus hispidus</i>	+	+	2m	2m	1	-	1	V
<i>Teucrium chamaedrys</i>	1	1	1	+	-	+	2m	V
<i>Agrimonia eupatoria</i>	+	-	+	+	-	+	+	IV
<i>Centaurea scabiosa</i>	+	+	+	1	+	-	-	IV
<i>Trifolium medium</i>	-	+	-	-	+	+	-	III
<i>Astragalus glycyphyllos</i>	-	-	-	+	-	+	+	III
<i>Stachys officinalis</i>	-	+	-	-	+	+	+	III
<i>Lathyrus sylvestris</i>	+	+	-	-	+	+	-	III
<i>Digitalis grandiflora</i>	-	-	-	+	-	-	+	II
<i>Lembotropsis nigricans</i>	-	-	-	-	+	+	-	II
<i>Origanum vulgare</i>	-	-	+	-	+	-	-	II

Number of relevé	1	2	3	4	5	6	7	K
Cirsio-Brachypodium – Brometalia								
<i>Carex humilis</i>	+	-	2m	+	1	+	2m	V
<i>Dorycnium herbaceum</i>	1	-	1	1	+	1	+	V
<i>Fragaria viridis</i>	+	1	+	1	+	2m	-	V
<i>Brachypodium pinnatum</i>	+	2m	1	1	2m	-	1	V
<i>Linum flavum</i>	+	+	+	-	+	+	-	IV
<i>Orchis tridentata</i>	-	+	+	+	+	+	-	IV
<i>Cirsium pannonicum</i>	-	+	-	+	1	+	-	III
<i>Onobrychis viciifolia</i>	+	-	+	+	-	+	+	III
<i>Polygala major</i>	-	-	+	+	+	+	-	III
<i>Securigera varia</i>	-	+	+	-	+	-	+	III
<i>Ferulago sylvatica</i>	-	-	+	+	-	+	-	III
<i>Bromus erectus</i>	-	+	+	+	+	-	-	III
<i>Sesleria heufleriana</i>	+	-	-	-	-	+	-	II
<i>Senecio integrifolius</i>	+	+	-	-	-	-	-	II
Festucion rupicolae-Festucetalia valesiacae								
<i>Astragalus monspessulanus</i>	+	+	1	+	+	+	-	V
<i>Artemisia campestris</i>	+	+	2m	+	2m	-	1	V
<i>Festuca rupicola</i>	-	1	1	+	+	-	1	V
<i>Stachys recta</i>	+	+	+	+	+	-	+	V
<i>Aster amellus</i>	+	+	1	-	1	+	+	V
<i>Campanula sibirica</i>	+	+	1	+	+	+	+	V
<i>Stipa capillata</i>	+	1	1	1	-	-	2m	IV
<i>Verbascum phoeniceum</i>	+	-	+	+	-	+	+	IV
<i>Jurinea mollis</i>	-	+	+	+	+	+	-	IV
<i>Phlomis tuberosa</i>	+	2m	2m	1	-	+	+	IV
<i>Chamaecytisus albus</i>	+	+	-	+	+	+	-	IV
<i>Vinca herbacea</i>	+	+	+	-	+	-	+	IV
<i>Astragalus austriacus</i>	+	+	+	-	+	+	-	IV
<i>Anchusa barrelieri</i>	+	+	+	-	+	-	-	IV
<i>Achillea setacea</i>	+	+	+	-	+	-	-	III
<i>Thesium linophyllum</i>	+	+	1	-	+	+	-	IV
<i>Melica ciliata</i>	-	+	1	+	+	+	-	IV
<i>Centaurea biebersteinii</i>	-	+	-	+	-	+	-	III
<i>Silene otites</i>	-	+	+	+	+	-	-	III
<i>Onobrychis arenaria</i>	+	+	+	-	-	+	-	III
<i>Nepeta nuda</i>	-	+	+	+	+	-	-	III
<i>Brassica elongata</i>	+	+	+	+	-	-	-	III
<i>Leontodon crispus</i>	-	+	+	+	-	+	-	III
<i>Salvia austriaca</i>	+	-	-	+	-	-	+	III
<i>Salvia transsylvanica</i>	-	-	+	+	+	1	-	III
<i>Helianthemum nummular.</i>	-	+	-	+	-	+	+	III
<i>Cephalaria radiata</i>	-	-	+	+	+	-	-	III
<i>Artemisia austriaca</i>	+	+	2m	-	-	-	+	III
<i>Pulsatilla montana</i>	-	-	1	-	+	+	-	III
<i>Allium flavum</i>	-	+	+	-	-	-	-	III
<i>Salvia nutans</i>	+	-	2m	-	-	-	1	III
<i>Ajuga laxmannii</i>	+	+	-	-	-	-	+	III
<i>Teucrium polium</i>	+	+	-	-	-	-	-	II
<i>Medicago minima</i>	+	+	-	-	-	-	-	II
<i>Iris aphylla</i>	-	-	1	2m	-	-	-	II
<i>Sanguisorba minor</i>	-	-	-	+	-	+	-	II
<i>Thymus pannonicus agg.</i>	+	-	-	+	-	-	-	II
<i>Cephalaria uralensis</i>	+	+	-	-	-	-	-	II
<i>Linum tenuifolium</i>	+	+	-	-	-	-	-	II
<i>Astragalus onobrychis</i>	+	+	-	-	-	-	-	II
<i>Oxytropis pilosa</i>	+	+	-	-	-	-	-	II
<i>Scorzonera hispanica</i>	+	+	-	-	-	-	-	II
<i>Adonis vernalis</i>	+	+	-	-	-	-	-	II
<i>Tragopogon dubium</i>	-	-	+	-	-	+	-	II
<i>Melampyrum arvense</i>	+	-	-	-	-	-	-	I
<i>Stipa lessingiana</i>	-	+	-	-	-	-	-	I
<i>Serratula radiata</i>	+	-	-	-	-	-	-	I
Festuco-Brometea								
<i>Bothriochloa ischaemum</i>	+	+	2m	1	+	-	2m	V

Number of relevé	1	2	3	4	5	6	7	K
<i>Galium verum agg.</i>	+	+	+	+	+	-	+	V
<i>Aster linosyris</i>	+	2m	1	+	-	+	-	V
<i>Euphorbia cyparissias</i>	+	+	+	+	+	+	+	V
<i>Poa angustifolia</i>	+	-	1	1	+	+	-	IV
<i>Medicago falcata</i>	+	+	+	-	+	-	+	IV
<i>Salvia nemorosa</i>	1	+	+	+	-	-	1	IV
<i>Phleum phleoides</i>	+	+	+	-	+	+	-	IV
<i>Acinos arvensis</i>	-	+	+	-	+	+	+	IV
<i>Eryngium campestre</i>	+	+	+	+	+	+	-	IV
<i>Potentilla arenaria</i>	+	+	2m	1	+	-	+	IV
<i>Koeleria cristata</i>	-	-	+	+	-	+	+	III
<i>Filipendula vulgaris</i>	-	-	+	+	+	-	+	III
<i>Salvia pratensis</i>	-	+	-	-	+	+	+	III
<i>Pimpinella saxifraga</i>	-	+	-	+	+	-	+	III
<i>Pseudolysimachion orchid</i>	-	-	+	+	-	+	-	III
<i>Euphorbia esula</i>	-	+	-	-	+	+	-	III
<i>Veronica austriaca-teucrium</i>	+	-	-	+	-	+	+	III
<i>Dianthus carthusianorum</i>	-	+	-	-	-	+	+	III
<i>Salvia verticillata</i>	-	+	-	+	-	-	+	III
<i>Nonea pulla</i>	-	+	+	-	+	-	+	III
<i>Bromus inermis</i>	+	-	1	+	-	-	-	III
<i>Carex caryophylla</i>	-	+	-	-	-	+	-	II
<i>Trifolium montanum</i>	-	-	-	-	+	+	-	II
<i>Anthyllis vulneraria</i>	-	-	-	-	+	+	-	II
<i>Cerinth minor</i>	-	+	+	-	-	-	-	II
<i>Asperula cynanchica</i>	-	-	+	-	-	-	-	I
<i>Potentilla recta</i>	-	+	-	-	-	-	-	I
<i>Muscari comosum</i>	-	-	+	-	-	-	-	I
<i>Viola hirta</i>	-	+	-	-	-	-	-	I
<i>Hypochoeris maculata</i>	-	-	-	-	+	-	-	I
Varia								
<i>Senecio jacobea</i>	+	+	+	-	+	+	-	IV
<i>Plantago lanceolata</i>	+	-	+	+	+	+	-	IV
<i>Briza media</i>	-	-	+	+	+	-	+	III
<i>Cruciata laevipes</i>	-	+	+	-	-	+	+	III
<i>Carlina vulgaris</i>	-	+	+	+	-	+	-	III
<i>Echium vulgare</i>	-	-	+	+	-	+	+	III
<i>Falcaria vulgaris</i>	+	-	+	+	-	+	-	III
<i>Genista sagittalis</i>	-	+	+	+	+	-	-	III
<i>Achillea millefolium</i>	-	-	+	+	-	+	-	III
<i>Calamagrostis epigeios</i>	-	-	-	1	+	+	-	III
<i>Rosa gallica</i>	-	-	+	+	-	-	2m	III
<i>Buglossoides purp-coerul.</i>	+	+	-	+	-	-	+	III
<i>Orchis morio</i>	+	+	-	-	-	+	-	III
<i>Eryngium planum</i>	-	+	-	+	-	+	-	III
<i>Arrhenatherum elatius</i>	-	-	-	+	+	-	-	II
<i>Melilotus officinalis</i>	-	-	-	+	-	+	-	II
<i>Carex pallescens</i>	-	-	-	-	+	-	-	II
<i>Trifolium campestre</i>	-	-	+	-	-	+	-	II
<i>Knautia arvensis</i>	-	+	-	-	+	+	-	II
<i>Heracleum sphondylium</i>	-	-	-	+	-	+	-	II

The place and data of relevés: 1: Sábéd (Szabéd), 'Földvár-Szölőhegy' alt. 380 m, SW, 30°, 25 m2, 23.04.2006, 28.05.2007; 2: Band (Mezőbánd), 'Omlás-Kiskoporsók' alt. 370 m, W, 25°, 25m2, 01.05.2007; 3-4: Cristuru-Secuiesc (Székelykeresztúr), 'Szőlők-alja' alt. 475 m, S, 35°, 25 m2, 02.05.2006, 10.05.2007; 5-6: Cristuru-Secuiesc (Székelykeresztúr), 'Szilas', alt. 450 m, S, 35°, 25 m2, 02.05.2006, 29.05.2007; 7: Şardu Nirajului (Székelysárd), 'Bokos', alt. 360 m, SW, 30°, 25 m2, 27.05.2007.