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Phytosociological affiliation of *Tephoseris longifolia* ssp. *moravica* and two related species in the Western Carpathians

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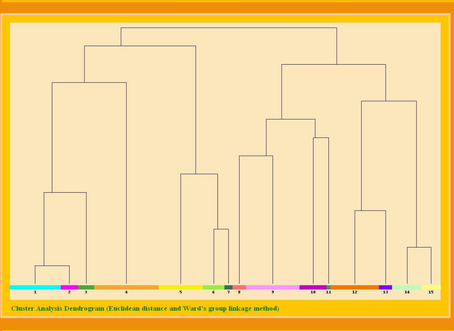
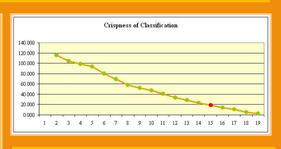
Introduction

***Tephroseris longifolia* ssp. *moravica* is a critically endangered endemic taxon of Carpathian flora included in the European list of important species. Recently, nine localities are known and monitored (4 in the Czech Republic and 5 in Slovakia). Its occurrence is restricted to very specific and vulnerable habitats. We studied phytosociological affiliation of *T. longifolia* ssp. *moravica* in comparison with two related species, *Tephroseris integrifolia* and *Tephroseris crispa*, which distribution overlaps in the Western Carpathians.**

Results

Grassland syntaxa were classified according to the electronic expert system, while other communities were classified according to the original authors. From relevés belonging to classes *Festuco-Brometea* and *Molinio-Arrhenatheretea* 44 % were classified by expert system (*Tephroseris longifolia* ssp. *moravica* 17 %, *T. integrifolia* 40 %, *T. crispa* 43 %).The communities with the occurrence of *T. longifolia* ssp. *moravica* can be classified within the alliances *Bromion erecti* and *Arrhenatherion elatioris*. Some populations grow in the ecotone zone between meadows and beech forests which is difficult to classify (clusters 1- 4). The coenological affiliation of *T. integrifolia* is rather broad - it was recorded in communities of the alliances *Cirsio-Brachypodion pinnati, Bromion erecti, Bromo pannonici-Festucion pallentis, Diantho lumnitzeri-Seslerion, Festucion valesiacae, Nardo strictae-Agrostion tenuis, Violion caninae, Geranion sanguinei* and *Quercion pubescentis-petraeae* (clusters 1, 4-7). *T. crispa* occurs mostly in communities of the *Calthion palustris*, but occasionally it grows in wetlands of the alliances *Alnion incanae, Caricion remotae, Caricion davallianae, Caricion fuscae, Petasiton officinalis, Seslerin tatrae* and *Sphagno warnstorfiani-Tomenthypnion* (clusters 8-15).





On the base of the Cluster Analysis 15 clusters were distinguished from 9 classes: *Alnetea glutinosae, Festuco-Brometea, Molinio-Arrhenatheretea, Mulgedio-Aconitetea, Elyno-Seslerietea, Carici rupestris-Kobresietea bellardii, Nardetea strictae, Querco-Fagetea, Scheuchzerio-Caricetea fucae.*

Cluster 1 – heterogenous grassland vegetation with occurence of all three study species (relation to submontane and montane *Arrhenatherion elatioris* Luquet 1926 communitites a transition to the alliance *Violion caninae* Schwickerath 1944) (38 relevés, 19 CZ, 19 SK)

Diagnostic species: *Campanula patula, Stellaria graminea, Quercus petraea, Tragopogon orientalis, Poa pratensis agg., Hypericum maculatum, Trommsdorffia uniflora*

Constant species: *Ranunculus acris, Campanula patula, Potentilla erecta, Hypericum maculatum, Acetosa pratensis, Cruciata glabra, Achillea millefolium agg., Alchemilla spec. div., Veronica chamaedrys agg., Tephroseris longifolia, Lathyrus pratensis, Dactylis glomerata, Anthoxanthum odoratum agg., Ajuga reptans, Vicia cracca, Primula veris, Luzula luzuloides*

Dominant species: *Agrostis capillaris, Rhytidiadelphus squarrosus, Calamagrostis arundinacea, Brachypodium pinnatum, Avenula preusta, Trisetum flavescens, Trifolium montanum, Tephroseris longifolia, Poa pratensis agg.*

Succession stages evolved from alliance *Arrhenatherion elatioris* in concequence of abandonment. This type of vegetation grows on the moderately humid soils prefer north, north west-facing clifs at altitudes ranging from 550 – 1000 m with typical occurence of mezophilous species. Tall-growing stands dominated by grasses (*Agrostis capillaris, Avenula preusta, A. pubescens, Trisetum flavescens, Poa pratensis* agg., *Festuca rubra* agg., *Bromus erectus, Arrhenatherum elatius, Dactylis glomerata*, and *Anthoxanthum odoratum*). The expansive grasses and forbs (*Calamagrostis arundinacea, C. epigeios, Brachypodium pinnatum, Bromus erectus*) spread into the grassland and create early stages of succession. *Tephroseris longifolia* ssp. *moravica* grows in the mezophilous stands and *T. intergifolia* in the poor mezophilous pastures at the higher altitudes.

Cluster 2 – *Brachypodio pinnati-Molinietum arundinaceae* Klika 1939 (13 relevés, SK)

Diagnostic species: *Valeriana stolonifera, Campanula glomerata, Carex montana, Fragaria vesca, Thymus pulegioides, Tephroseris longifolia, Arrhenatherum elatius, Cirsium pannonicum, Trommsdorffia maculata, Carlina acaulis, Dianthus carthusianorum agg., Crepis praemorsa, Trisetum flavescens, Ranunculus polyanthemos*

Constant species: *Veronica chamaedrys agg., Tephroseris longifolia, Arrhenatherum elatius, Dactylis glomerata, Carlina acaulis, Briza media, Achillea millefolium agg., Acetosa pratensis, Vicia cracca, Primula veris, Luzula luzuloides, Galium mollugo agg., Dianthus carthusianorum agg., Valeriana stolonifera, Ranunculus polyanthemos, Potentilla erecta*

Dominant species: *Arrhenatherum elatius, Rhytidiadelphus triquetrus, Laserpitium latifolium, Galium mollugo agg.*

These species-rich semi-dry grasslands inhabit the calcareous bedrocks on deeper soils. Characteristic feature is occurence of mesophilous species of the *Molinion caeruleae* (*Betonica officinalis, Serratula tinctoria*) and thermophilous species of the *Festuco-Brometea* (*Dianthus carthusianorum, Helianthemum numularium* agg.) *Thephroseris longifolia* ssp. *moravica* has constant occurence. Locality: Lysá, Čavoj, Radobica, Veľké pole.

Cluster 3 – fringe vegetation with *Tephroseris longifolia* ssp. *moravica* (12 relevés, CZ)

Diagnostic species: *Dentaria bulbifera, Geranium pratense, Aegopodium podagraria, Quercus robur, Sanguisorba officinalis, Alliaria petiolata, Anthriscus sylvestris, Taraxacum spec. div., Heracleum sphondylium, Myosotis arvensis, Astrantia major, Tephroseris longifolia, Polygonatum multiflorum, Vicia sepium, Avenula preusta, Crepis biennis, Primula elatior*

Constant species: *Veronica chamaedrys agg., Tephroseris longifolia, Symphytum tuberosum* agg., *Ranunculus acris, Primula elatior, Heracleum sphondylium, Cruciata glabra, Alchemilla spec. div., Ajuga reptans, Vicia sepium, Taraxacum spec. div., Dentaria bulbifera, Sanguisorba officinalis, Hypericum maculatum, Dactylis glomerata, Astrantia major,*

Dominant species: *Poa trivialis, Festuca rubra agg., Fraxinus excelsior, Quercus robur*

These succession, species-rich grassland vegetation invaded by shurbs is located on north-facing clifs at the edge of the belts of decidous trees, mainly on the locality Hodňov. Species composition is a mixture of meadows species, forest fringe herbs and shrubs. Majority of stands is abandoned.

Cluster 4 – mezophilous grasslands (successional stages of *Arrhenatherion* Luquet 1926), semi-dry subcontinental and subatlantic broadleaved grasslands (*Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951, *Bromion erecti* Koch 1926) and panonian dry grasslands (*Bromo pannonici-Festucion pallentis* Zólyomi 1966) (48 relevés, 28 CZ, 20 SK)

Diagnostic species: *Thymus glabrescens, Onobrychis arenaria, Pulsatilla grandis, Polygala major*

Constant species: *Tephroseris integrifolia, Salvia pratensis, Arrhenatherum elatius, Dactylis glomerata, Achillea millefolium agg., Tithymalus cyparissias, Plantago media, Festuca rupicola, Colymbada scabiosa, Brachypodium pinnatum, Ranunculus polyanthemos, Briza media*

Dominant species: *Brachypodium pinnatum, Carex humilis, Arrhenatherum elatius, Inula ensifolia, Bromus erectus*

This cluster includes transitional and succession vegetation types between these four alliances. *Tephroseris longifolia* ssp. *moravica* occures in the successional stages of mezophilous grassland of *Arrhenatherion* and together with *T. integrifolia* in the semi-dry grasslands of *Bromion erecti*.

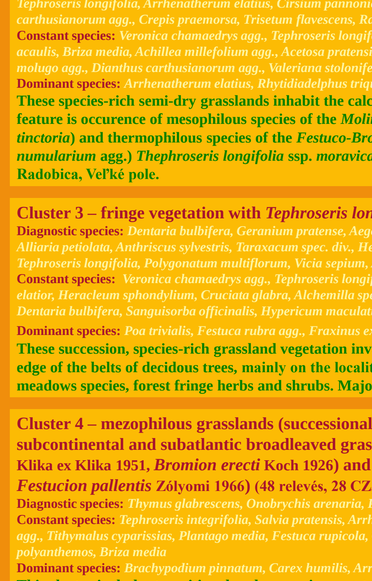
Cluster 5 – *Minuartio setaceae-Seslerietum calcariae* Klika 1931 (33 relevés, 25 CZ, 8 SK)

Diagnostic species: *Thymus praecox agg., Potentilla arenaria, Hypnum cupressiforme, Asplenium trichomanes, Sesleria albicans, Seseli osseum, Minuartia setacea, Dianthus praecox*

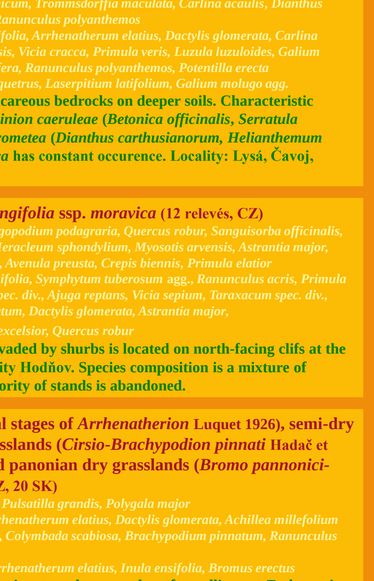
Constant species: *Tephroseris integrifolia, Sesleria albicans, Thymus praecox agg., Seseli osseum, Tithymalus cyparissias, Potentilla arenaria*

Dominant species: *Sesleria albicans, Hypnum cupressiforme, Geranium sanguineum, Pimpinella saxifraga agg., Genista pilosa*

Dry pericarpathian calcareous grasslands communities are dominated by *Sesleria albicans* at lower altitudes (altitude 250-600 m). These stands are located on cooler and moister (north-facing or inverse) slopes in the warm pericarpathian calcareous mountains. Typical is the presence of dealpine species (*Acinos alpinus, Biscutella laevigata, Leontodon incanus, Phyteuma orbiculare, Saxifraga paniculata*) and thermophilous *Festuco-Brometea* species (*Anthericum ramosum, Asperula cynanchica, Helianthemum ovatum, Jurinea mollis, Potentilla arenaria, Teucrium montanum, Thymus praecox, Sanguisorba minor*).



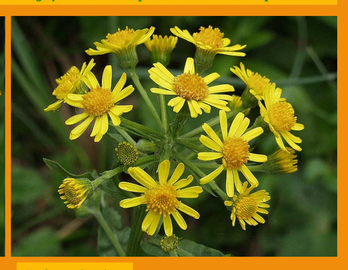
Čavoj, *Tephroseris longifolia* ssp. *moravica* © K. Hegedüšová



Belianske Tatry, Bielovodská dolina valley, *Tephroseris crispa* © K. Hegedüšová

Distribution of *Tephroseris longifolia* ssp. *moravica*, *T. integrifolia* and *T. crispa* in the Western Carpathians

Tephroseris integrifolia



Tephroseris crispa

Cluster 6 – *Festuco pallentis-Seslerietum calcariae* Futák 1947 (16 relevés, SK)

Diagnostic species: *Erysimum witmannii, Pulsatilla slavica, Platanthera bifolia, Hieracium bifidum, Primula auricula, Teucrium montanum, Acinos alpinus, Thesium alpinum, Inula ensifolia, Carduus glaucinus, Anthericum ramosum, Kernera saxatilis, Phyteuma orbiculare, Dianthus carthusianorum agg., Senecio umbrosus, Leontodon incanus, Bellidiastrum michelii, Polygala amara, Galium pumilum agg., Sesleria albicans, Carex humilis, Seseli osseum*

Constant species: *Tephroseris integrifolia, Sesleria albicans, Galium pumilum agg., Dianthus carthusianorum agg., Carex humilis, Anthericum ramosum, Phyteuma orbiculare, Leontodon incanus, Teucrium chamaedrys, Pulsatilla slavica, Platanthera bifolia, Leucanthemum vulgare agg., Inula ensifolia, Erysimum witmannii, Carlina acaulis, Acinos alpinus*

Dominant species: *Carex humilis, Sesleria albicans, Inula ensifolia*

Transitional grasslands between the colline *Minuartio setaceae-Seslerietum calcariae* and the montane grasslands of the *Pulsatillo slavicae-Caricetum humilis* with occurence of dealpine and prealpine species and sporadically *Bellidiastrum michelii*, without strict thermophilous species and true montane species. They prefered cool north-facing slopes on limestones at the altitude 800 – 930 m. Locality: Strážovské vrchy Mts. From study species only *Tephroseris integrifolia* is occured.

Cluster 7 – *Corno-Quercetum* Jakucs et Zólyomi ex Máthé et Kovács 1962 (6 relevés, SK)

Diagnostic species: *Quercus pubescens agg., Melittis melissophyllum, Crataegus monogyna, Cornus mas, Sorbus aria, S. torminalis, Viburnum lantana, Potentilla heptaphylla, Convallaria majalis, Thlaspi montanum, Dorycnium herbaceum, Thalictrum minus, Asperula tinctoria, Arabis hirsuta agg., Genista pilosa, Brachypodium sylvaticum*

Constant species: *Vincetoxicum hirundinaria, Teucrium chamaedrys, Tephroseris integrifolia, Symphytum tuberosum agg., Sesleria albicans, Quercus pubescens agg., Primula veris, Potentilla heptaphylla, Pimpinella saxifraga agg., Leontodon incanus, Genista pilosa, Carex humilis, Asperula tinctoria, Thalictrum minus*

Dominant species: *Quercus pubescens agg., Vincetoxicum hirundinaria, Sesleria albicans, Festuca rupicola*

Open termophilous forests vegetation with dominance of *Qrercus pubescens* and species penetrating from the nieghbouring associations of dry and mezophilous grasslands. The stands are located on the west slope with shallow soils developed over carbonate bedrocks.

Radobica, *Tephroseris longifolia* ssp. *moravica* © K. Hegedüšová

Radobica, *Tephroseris longifolia* ssp. *moravica* © M. Janišová

Cluster 8 – transitional stands of *Festucion carpaticae* Bělohlávková et Fišerová 1989, *Seslerion tatrae* Pawlowski 1935 corr. Klika 1955 and *Oxytropido-Elynion* Br.-Bl. 1949 (10 relevés, SK)

Diagnostic species: *Sesleria tatrae, Myosotis alpestris, Anemone narcissiflora, Soldanella carpatica, Poa alpina, Cardaminopsis halleri, Potentilla aurea, Rhodiola rosea, Salix reticulata, Ranunculus breyninus, Hedysarum hedysaroides, Carex atrata, Androsace chamaejasme, Ligusticum mutellina, Bistorta vivipara, Pedicularis oederi*

Constant species: *Tephroseris crispa, Sesleria tatrae, Soldanella carpatica, Bistorta major, Swertia perennis, Potentilla aurea, Poa alpina, Myosotis alpestris, Cardaminopsis halleri, Bistorta vivipara, Rhodiola rosea, Ligusticum mutellina, Geranium sylvaticum, Galium pumilum agg., Anemone narcissiflora, Alchemilla spec. div.*

Dominant species: *Hylocomium splendens, Festuca carpatica, Sesleria tatrae, Calamagrostis villosa, Valeriana tripteris, Silene acaulis, Salix retusa, Salix reticulata, Rhytidiadelphus squarrosus, Parnassia palustris*

Species composition is mixture of alpine and subalpine chinophilous tall and blue-grass swards on windswept ridges and summit edges on moderately basic soil. Locality: Belianske Tatry Mts., Západné Tatry Mts., Vysoké Tatry Mts.

Cluster 9 – montane, supramontane and rarely subalpine tall herb broad-leaved natural riparian communities and forest shady spring areas (fragments of alliances *Caricion remotae* Kästner 1941, *Petasition officinalis* Sillinger 1933, *Trisetion fusci* Krajina 1933 and *Alnion incanae* Pawłowski in Pawłowski et al. 1928) (40 relevés, 5 CZ, 35 SK)

Diagnostic species: *Dentaria glandulosa, Aconitum variegatum, Stellaria nemorum agg., Roegneria canina, Mycelis muralis, Calliergon cordifolium, Valeriana excelsa subsp. sambucifolia, Stachys sylvatica, Ranunculus lanuginosus, Petasites kablikianus, Galeobdolon luteum agg., Daphne mezereum, Alnus incana, Viola biflora*

Constant species: *Tephroseris crispa, Caltha palustris, Myosotis scorpioides agg., Crepis paludosa, Chaerophyllum hirsutum*

Dominant species: *Petasites kablikianus, Petasites hybridus, Petasites albus, Alnus incana, Filipendula ulmaria, Conocephalum conicum, Cardamine amara, Trisetum fuscum, Stachys sylvatica, Sphagnum squarrosum*

The occurence of these communities is on the nutrient-rich soils in forest spring areas, banks and alluviums of mountain brooks, streams and torrents at the higher altitudes. Typical is prevalence of the vascular plants over the mooses.

Cluster 10 – *Cardamino-Chrysosplenietum alternifolii* Maas 1959 (20 relevés, 3 CZ, 17 SK)

Diagnostic species: *Brachythecium rivulare, Chrysosplenium alternifolium, Chaerophyllum hirsutum, Stellaria alsine, Stellaria nemorum agg., Cardamine amara, Rhizomnium punctatum agg., Caltha palustris*

Constant species: *Tephroseris crispa, Chaerophyllum hirsutum, Caltha palustris, Myosotis scorpioides agg., Crepis paludosa, Chrysosplenium alternifolium, Cardamine amara, Deschampsia cespitosa, Plagiomnium affine agg.*

Dominant species: *Caltha palustris, Chaerophyllum hirsutum, Plagiomnium affine agg., Brachythecium rivulare, Rhizomnium punctatum agg., Cardamine amara, Viola palustris, Petasites hybridus*

This cluster encompasses communities of forest crenal lime-poor habitats. Typical is presence of broad-leaved forbs *Caltha palustris* ssp. *laeta, Chaerophyllum hirsutum* and *Chrysosplenium alternifolium*. The stands are formed on the less shadow forest spring areas at the altitude 600 – 1300 m on a deep, wet, fenny and slightly acid soils with unprocessed humus and leaves.

Cluster 11 - *Carici elongatae-Alnetum glutinosae* Schwickerath 1933 (3 relevés, SK)

Diagnostic species: *Sorbus aucuparia, Salix cinerea, Lycopodium annotinum, Calamagrostis canescens, Frangula alnus, Solanum dulcamara, Lonicera nigra, Alnus glutinosa, Valeriana dioica, Gymnocarpium dryopteris, Plagiothecium denticulatum, Picea abies, Salix cinerea, Dryopteris carthusiana agg., Sphagnum palustre*

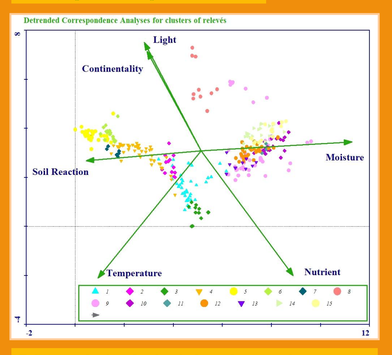
Constant species: *Valeriana officinalis, Valeriana dioica, Vaccinium myrtillus, Tephroseris crispa, Sphagnum palustre, Sorbus aucuparia, Solanum dulcamara, Salix cinerea, Salix cinerea, Ranunculus repens,*

Dominant species: *Sphagnum palustre, Cardamine amara, Valeriana dioica, Picea abies, Lonicera nigra, Caltha palustris, Salix cinerea, Ranunculus repens, Picea abies, Lycopodium annotinum, Filipendula ulmaria*

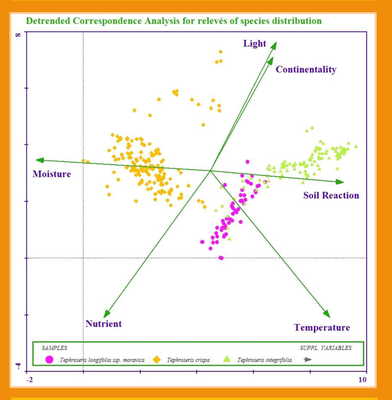
Boggy spruce-alder forest occures in the terrain depresion with the dominance *Sphagnum palustre* in moss layer and presence of *Tephroseris crispa* and some montane species. Only one locality: Bacúšska jelšina (Bacúch alder forest).

Tephroseris longifolia ssp. *moravica* © K. Hegedüšová

Inovec, *Tephroseris crispa* © J. Smatanová



DCA analysis of relevés has showen that moisture gradient exhibited the strongest positive correlation with first DCA axis. First axis also strongly negatively correlated with soil reaction. Second axis positivly correlated with light and negatively with temperature and nutient.



DCA analysis of relevés of three study species has showen the strongest positive correlation of soil reaction and the strongest negative correlation of moisture with first DCA axis.

The results of the both DCA analysis demonstrated that the most strong effect on the data set variability was predominantly produced by moisture and soil reaction. The most basiphilous and dry soils occupy communities with *Tephroseris integrifolia*, communities with *T. crispa* are ocurred on the wet and slightly acidic soils. The stands with *T. longifolia* ssp. *moravica* have intermediate character betweet other communities.

Beljanske Tatry, *Tephroseris crispa* © K. Hegedüšová

Cluster 12 – *Caricion fuscae* Koch 1926 em. Klika 1934 a transitional to *Calthion palustris* Tüxen 1937 (36 relevés, 4 CZ, 32 SK)

Diagnostic species: *Carex echinata, Scirpus sylvaticus, Eriophorum angustifolium, Trifolium spadiceum, Carex canescens agg., , Carex nigra, Epilobium palustre, Lychnis flos-cuculi, Viola palustris*

Constant species: *Tephroseris crispa, Carex nigra, Myosotis scorpioides agg., Eriophorum angustifolium, Scirpus sylvaticus, Caltha palustris, Potentilla erecta, Crepis paludosa, Carex echinata, Ranunculus acris, Geum rivale, Filipendula ulmaria, Carex panicea, Anthoxanthum odoratum agg., Lychnis flos-cuculi*

Dominant species: *Climacium dendroides, Carex nigra, Eriophorum angustifolium, Crepis paludosa, Sphagnum recurvum agg., Scirpus sylvaticus, Caltha palustris*

Mesotrophic dwarf-sedge mirers and fens on shallow peaty soils occures on nutrient-poor substretes derived from sands and granites at the altitudes 700 – 1200 m. Decrease of ground water table, increasing of nitrogen and phosphorus and accumulation of oranic matter fosters the transformation of the *Caricion fuscae* communities into the wet meadows of the *Calthion*.

Cluster 13 – *Cirsietum rivularis* Nowiński 1927 (10 relevés, 4 CZ, 6 SK)

Diagnostic species: *Cirsium rivulare, Brachythecium rutabulum, Poa trivialis, Deschampsia cespitosa, Cirriphyllum piliferum, Ranunculus auricomus agg.*

Constant species: *Tephroseris crispa, Poa trivialis, Plagiomnium affine agg., Myosotis scorpioides agg., Festuca rubra agg., Deschampsia cespitosa, Crepis paludosa, Cirsium rivulare, Acetosa pratensis, Ranunculus auricomus agg., Ranunculus acris, Caltha palustris, Lathyrus pratensis*

Dominant species: *Cirsium rivulare, Chaerophyllum hirsutum, Trollius altissimus, Rhytidiadelphus squarrosus, Nardus stricta, Geranium sylvaticum, Crepis paludosa, Crepis mollis, Caltha palustris*

The species-rich wet meadows on mineral-rich soils influenced by groundwater with dominance of *Cirsium palustre*. As a codominance are small sedges (*Carex nigra, C. panicea*), broad-leaved forbs (*Caltha palustris*) and grasses. Moss layer is well developed.

Lysá, *Tephroseris longifolia* ssp. *moravica* © K. Hegedüšová

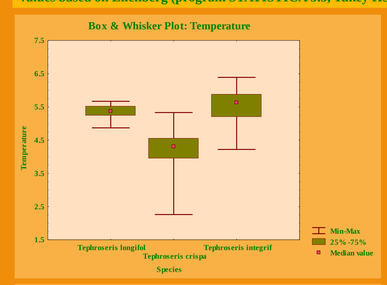
Aim

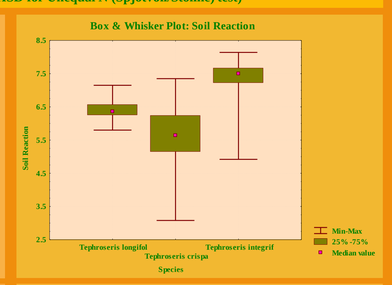
The main question was to determine plant communities inhabited by the studied taxa and the strength of their coenological specialization.

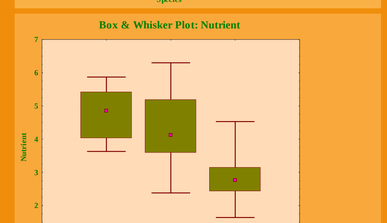
Methods

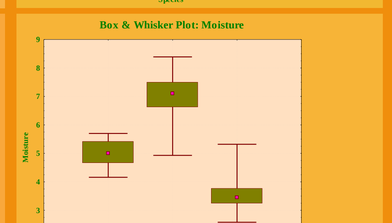
The base for the study and evaluation of data were the Central Phytosociological Database of Slovakia (CDF, http://www.ibot.sav.sk/cdf/index.html, Hegedüšová 2007) and the Czech National Phytosociological Database (http://www.sci.muni.cz/botany/chytry/links.htm). Phytocoenological material (321relevés) was analysed in program JUICE (Tichý 2002). Classification was performed by cluster analysis (PC-ORD 4), using relative Euclidean distance as a distance measure and the Ward's group linkage method with Square Root Transformation (p = 0.5). The optimal number of clusters was indicated according to the analysis of crispness of classification in program JUICE taking into account the possibility of interpretation. Diagnostic, constant and dominant species was calculated. Diagnostic species are ordered according to the value of *phi* coefficient, critical value of *phi* coefficient was set to 0.20. Constant species include those species present in more than 40 % relevés ordered according to frequency. Dominant species were calculated according to percentage of relevés in which they reach the cover over 25 %. Only the most importand diagnostic, constant and dominant species are included. Detrended correspondent analysis (DCA) defined major gradients in the spatial arrangement of species and clusters of the analysed data set. Average Ellenberg indication values for relevés were plotted onto a DCA ordination diagram as supplementary environmental data. At the comparison of relevés of the species *Tephroseris longifolia* ssp. *moravica*, *T. integrifolia* and *T. crispa* through the indicator values were used Box & Whisker Plots (STATISTICA 5.5, Break down & one-way ANOVA).

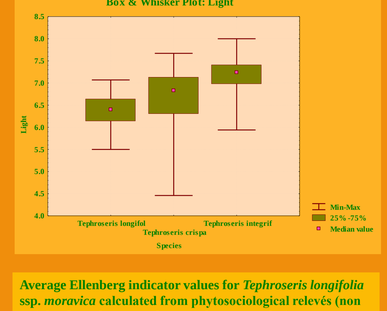
A comparison of relevés of the species *Tephroseris longifolia ssp. moravica*, *T. integrifolia* and *T. crispa* through the indicator values based on Ellenberg (program STATISTICA 5.5, Tukey HSD for Unequal N (Spjotvoll/Stoline) test)

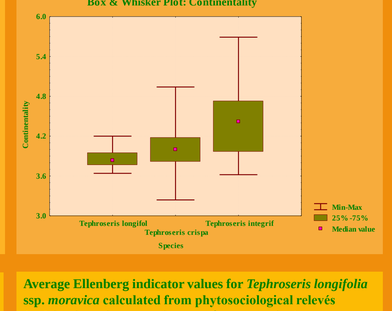












Average Ellenberg indicator values for *Tephroseris longifolia* ssp. *moravica* calculated from phytosociological relevés (non weighted, mode means the most frequent value)

	Mean	Median	Std.Dev.	Mode
Light	6.369815	6.4	0.3607	7
Temperature	5.366296	5.37	0.17828	6
Continentality	3.854444	3.835	0.12458	3
Moisture	4.996667	5	0.43068	5
Soil Reaction	6.409074	6.36	0.28757	7
Nutrient	4.757222	4.85	0.71275	5

Average Ellenberg indicator values for *Tephroseris longifolia* ssp. *moravica* calculated from phytosociological relevés (weighted, mode means the most frequent value)

	Mean	Median	Std.Dev.	Mode
Light	6.30019	6.285	0.39604	7
Temperature	5.39407	5.365	0.19064	6
Continentality	3.80074	3.795	0.14203	3
Moisture	5.09556	5.085	0.40783	5
Soil Reaction	6.56148	6.565	0.25226	7
Nutrient	5.39259	5.47	0.63517	5

Cluster 14 - *Caricion davallianae* Klika 1934 (22 relevés, SK)

Diagnostic species: *Diagnostic species: Primula farinosa, Carex davalliana, Succisa pratensis, Dactylorhiza maculata, Ligularia sibirica, Carex flava*

Constant species: *Tephroseris crispa, Filipendula ulmaria, Ranunculus acris, Potentilla erecta, Equisetum palustre, Carex panicea, Carex davalliana, Galium uliginosum, Cirsium rivulare, Carex flava, Bryum pseudotriquetrum, Briza media, Valeriana simplicifolia, Succisa pratensis, Primula farinosa, Festuca rubra agg., Crepis paludosa, Eriophorum latifolium, Geum rivale, Caltha palustris*

Dominant species: *Carex davalliana, Drepanocladus revolvens, Carex rostrata, Carex panicea, Plagiomnium affine agg.*

These two-layer communities included calcareous fens on organogenic and mineral-gleyc soils with neutral to slightly basic soil reaction. Typical is dominance of hygrophilous mosses (except *Sphagnum*) and sedges. The stands are found around water spring, seeps and edges of water bodies and damp alluvia.

Cluster 15 – *Sphagno warnstorfiani-Tomenthypnion* Dahl 1957 (14 relevés, SK)

Diagnostic species: *Carex dioica, Epipactis palustris, Menyanthes trifoliata, Tomenthypnum nitens, Carex lasiocarpa, Sphagnum warnstorfii, Eriophorum latifolium, Carex rostrata, Fissidens adianthoides, Valeriana simplicifolia, Galium uliginosum*

Constant species: *Tephroseris crispa, Carex panicea, Valeriana simplicifolia, Tomenthypnum nitens, Potentilla erecta, Galium uliginosum, Eriophorum latifolium, Eriophorum angustifolium, Crepis paludosa, Carex rostrata, Carex dioica, Equisetum palustre, Epipactis palustris, Cirsium palustre, Briza media, Menyanthes trifoliata, Geum rivale, Drepanocladus revolvens*

Dominant species: *Tomenthypnum nitens, Carex lasiocarpa, Drepanocladus revolvens, Sphagnum warnstorfii*

These sedge-moss dominated fen meadows usually are developed as higher successional stage of the *Caricion davallianae* and *Caricion fuscae* on deep fen peat layers. The stands are located on calcareous bedrocks of the submontane belt. Typical feature is a occurence calcitolerant peat mosses.

In summary, *Tephroseris longifolia* ssp. *moravica* has the narrowest coenological niche. The communities of *Bromion erecti* represent the habitat conditions of its potential common occurrence only with *T. integrifolia*.

There are no records of hybrids between *Tephroseris* taxa in the relevant literature overall the distribution area of the studied taxa. These three study taxa are polyploids with 2n = 48 and there are several possibilities of their occurrence in the same locality within the studied area. Thus the existence of hybrids cannot be ruled out.

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