HACQUETIA 7/1 • 2008, 21–32

DOI: 10.2478/v10028–008–0002–7

PHYTOSOCIOLOGICAL CHARACTERISTIC OF THE PLANT COMMUNITIES WITH THE OCCURRENCE OF ENDEMIC SPECIES *CYCLAMEN FATRENSE*

Róbert KANKA*, Peter TURIS**, Viktória CHILOVÁ***

Abstract

In this contribution we bring together the basic phytosociological characteristics of communities with the presence of species *Cyclamen fatrense* in the herb layer. The analysis was made on the basis of 30 original phytosociological relevés. The main criterion for the relevés recording was the selection of the broadest possible range of biotopes with presence and the highest possible abundance of species *Cyclamen fatrense* on the entire area of its occurrence, which is represented by the Veľká Fatra and Starohorské vrchy Mts. The forest phytocoenoses of the association *Carici albae-Fagetum* Moor 1952, and phytocoenoses of clearings of the association *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950, were classified by using Zürich-Montpellier School method. Additionally, 18 relevés with the presence of species *Cyclamen fatrense* were excerpted from already published works and detailed comparison was also made.

Key words: *Cyclamen fatrense*, endemic species, phytosociology, *Carici albae-Fagetum*, *Epilobio-Atropetum belladonnae*, Veľká Fatra Mts, Starohorské vrchy Mts

Izvleček

V članku so prikazane osnovne fitosociološke značilnosti združb z vrsto *Cyclamen fatrense*. Analizirali smo jih na podlagi 30 originalnih popisov. Glavno merilo pri izbiri popisnih ploskev je bil izbor čim širšega obsega rastišč s prisotno vrsto *Cyclamen fatrense,* na celotnem območju njenega pojavljanja, ki ga predstavljata gorovji Veľká Fatra in Starohorské vrchy. Rastišča smo izbirali tam, kjer ima vrsta največjo abundanco. S standardno srednjeevropsko metodo smo gozdne združbe uvrstili v asociacijo *Carici albae-Fagetum* Moor 1952 in združbe posek v asociacijo *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950. Dodatno smo zbrali 18 objavljenih popisov z vrsto *Cyclamen fatrense* in jih vključili v primerjave.

Ključne besede: *Cyclamen fatrense*, endemična vrsta, fitosociologija, *Carici albae-Fagetum*, *Epilobio-Atropetum belladonnae*, gorovje Veľká Fatra, gorovje Starohorské vrchy.

1. INTRODUCTION

Cyclamen fatrense is an important endemic species of the Slovak flora with the small area of occurrence covering parts of the Veľká Fatra and Starohorské vrchy Mts. It grows mainly in broadleaf and mixed forests of the montane altitudinal belt. It persists also in several different development stages created by the forest management activities in the past.

Phytosociological analysis of plant communities with the presence of *Cyclamen fatrense* has not yet been made, and this endemic species has been mentioned only sporadically in botanical and phytosociological literature. The first group of papers includes unspecified limestone beech forests (e.g. Halda & Soják 1971, Bernátová & Feráková 1999, Kliment 1999). Suza (1931) furnished evidence of species also in fir and beech-fir forests and their fringes, or in dense spruce monoculture. Phytosociological relevés with the presence of *Cyclamen fatrense* (named as *Cyclamen*, *Cyclamen europaeum* or *Cyclamen purpurascens*) were published by Klika (1926,

* Institute of Landscape Ecology of the Slovak Academy of Sciences, Štefánikova 3, P. O. Box 254, SK-81499 Bratislava, Slovak Republic; e-mail: robert.kanka@savba.sk

** The Low Tatras National Park, Zelená 5, SK-97401 Banská Bystrica, Slovak Republic; e-mail: turis@sopsr.sk

*** The Great Fatra National Park, Čachovský rad 7, SK-03861 Vrútky, Slovak Republic; e-mail: chilova@sopsr.sk

1927, 1936, 1949), in works dealing with forest communities of the Veľká Fatra Mts. The species was recorded within the frame of two relevés; in beech forest specified as „*Fagetum*, type *Oxalis-Maianthemum*“, and in spruce forest specified as „*Piceetum*“ (*Picetum* in original paper, Klika 1926). The next three relevés are from the mixed forests classified as „*Piceetum-Fagetum carpaticum typicum*“ (Klika 1927). The abundance of *Cyclamen fatrense* in the presented relevés ranges from „r“ to „+“. Klika (1936) included two relevés with the occurrence “+” of *C. fatrense* of the association *Fagetum carpaticum Fatrae caricetosum albae*. In his last work from Veľká Fatra Mts (1949), species *C. fatrense* is mentioned as significant species (constancy class I) for the association *Abieto-Fageto-Caricetum albae*. In the work of Kurzová-Urválková (1979) *Cyclamen fatrense* is recorded in 10 relevés of association *Carici humilis-Pinetum* Klika 1949 mainly with abundance “+”, rarely “r”.

Hendrych (1981) assumed the origin of the species *Cyclamen fatrense* Halda et Soják by the process of speciation from *Cyclamen purpurascens* Mill., which has been spread temporarily also to Slovakia. After worsening of climatic conditions, the original species *Cyclamen purpurascens* retreated from the territory of Slovakia and the phylogenesis headed towards a new taxon. The conditions and reasons leading to speciation of *C. fatrense* are not well known, however it is possible to take into account mainly climatic, geomorphologic, edaphic or other factors related to the biology of the taxon (e.g. pollinating, dissemination of seeds etc.). It is less relevant to consider the persistence of this taxon in the area of Veľká Fatra and Starohorské vrchy Mts, on account of different phytosociological conditions.

The main objective of this contribution is to present the phytosociological and ecological characteristics of plant communities with presence of the endemic species *Cyclamen fatrense*, in order to compare the described phytosociological units with identical ones from other mountain areas of the Slovak republic, to summarize existing information from published papers, and thus provide a basis for better knowledge of the species and its protection.

2. METHODS

Phytosociological relevés were made in compliance with the Zürich-Montpellier School methods (Braun-Blanquet 1964), in which we used mainly the methodical works of Moravec et al. (1994) and Kent & Coker (1994). The representative stands of the particular community were chosen in such a way as to record the highest possible variability of the community with respect to the homogeneity of the relevé area. The abundance was estimated by the new Braun-Blanquet scale for abundance and dominance (Barkmann et al. 1964).

Summarily, 30 relevés were made in the Veľká Fatra and Starohorské vrchy Mts, which represents the entire area of the *Cyclamen fatrense* occurrence. The data obtained from the field were stored in the database TURBOVEG (Hennekens & Schaminee 2001). The basic arrangement of the phytosociological table and tabular synthesis was made with the JUICE 6.2 software (Tichý 2002). The same software was also used for the calculation of Ellenberg’s indicator values. The methodical approach proposed by (Jurko 1990) was followed and Ellenberg indicator values were calculated as mean weighted values for each relevé. Relevés are lined up in the phytosociological tables on the basis of decreasing constancy.

The nomenclature of the vascular plants is according to Marhold et al. (1998), and of the bryophytes after the work of Kubinská & Janovicová (1998). Phytosociological units are in compliance with syntaxonomic nomenclature of the vegetation of Slovakia (Mucina & Maglocký 1985) and Jarolímek et al. (1997).

For the purpose of finding and visualizing mutual relations among the determined syntaxa the indirect gradient analysis and the model DCA – detrended correspondence analysis (Hill & Gauch1980) was chosen. The software CANOCO (ter Braak & Šmilauer 2002) was used for the calculation of this model.

3. RESULTS

Cyclamen fatrense as a species with a preference for semi-shadow and shadow light conditions in two basic types of biotope was recorded – in forest stands and glades. Its occurrence is primary in forest phytocenoses: in clearings and glades it is able to persist generally with the lower abundances over some period until formation of the new forest stand. Classification of the relevés into syntaxonomic units was based on works dealing with the phytosociology of submontane and montane limestone beech forests and glades. After analysis, the forest phytocoenoses were classified to the association *Carici albae-Fagetum* Moor 1952; glades to association *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950.

Analytical tables of the mentioned association have been published by Fajmonová (1972, 1973, 1978), Fajmonová & Šimeková (1973), Šimeková (1974), Miadok (1979), Jurko & Kubíček (1974) and Jurko & Kontriš (1982) from various mountains in Slovakia. The heterogeneity of the presented association is documented by the relatively high number of subassociations, variants and subvariants in these works. Fajmonová (1981, 1986) studied glade phytocoenoses of the *Atropion* alliance, mainly in the beech forest altitudinal zone. The final description and characteristics of the association respects the results of Jarolímek et al. (1997).

Description of the plant communities with *Cyclamen fatrense*

A. Forest stands (Table 1)

Class: *Querco-Fagetea* Br.-Bl. et Vlieger in Vlieger 1937

Order: *Fagetalia* Pawłowski in Pawłowski et al. 1928

Alliance: *Fagion* Luquet 1926

Suballiance: *Cephalanthero-Fagenion* R. Tx. in R. Tx. et Oberd. 1958.

Association: *Carici albae-Fagetum* Moor 1952

Subassociation: *typicum* Fajmonová et Šimeková 1973

The evaluated forest phytocoenoses with presence of the species *Cyclamen fatrense* were classified into the association *Carici albae-Fagetum*, which represents the limestone beech forests of the submontane and montane belt. Relevés were made in forest stands at altitudes of 470–985 m a. s. l. in the beech and fir-beech forest altitudinal zone (sensu Zlatník 1959), and in the submontane (reaching marginally also to the upland) altitudinal zone on various stand expositions (range betwen SE and NE) with slopes of 15°–45°. The bedrock is formed by dolomites and limestones; the soil is modal rendzina.

Fagus sylvatica is dominant in three layer (abundance 40 %–95 %, on average 80 %), accompanied mostly by cultivated species *Picea abies*, which in some stands is subdominant or also dominant. The presence of species *Acer pseudoplatanus* is characteristic for scree habitats; *Abies alba*, *Larix decidua* and *Sorbus aria* agg. occur sporadically in several relevés. The shrub layer (abundance 1 %–20 %, average 7.5 %) is a compound of few species, *Fagus sylvatica* is prevalent here. The herb layer (abundance 5 %–98 %, average 47 %) is species rich, and the abundances markedly vary depending on the thickness of the litter on the soil surface. Constant and abundant species *Hieracium murorum*, *Mercurialis perennis* and *Prenanthes purpurea*, as well as the seedlings of *Acer pseudoplatanus* and *Fagus sylvatica*, comprise significant part of the herb layer. Bryophytes were determined in all relevés in which they occurred. The highest presences are those of *Dicranum scoparium* and *Hypnum cupressiforme*. The association *Carici albae-Fagetum* is a relatively heterogeneous syntaxon and therefore it is necessary to divide it into the lower syntaxonomical units. All classified phytocoenoses represent a mutually intersected mosaic of herbaceous and grassy limestone beech forests.

According to the NATURA 2000 scheme, the described forest stands are included in biotope of European importance 9150: Medio-European limestone beech forests.

Lower syntaxa:

a) typical variant

The phytocoenoses of a type rich in grasses, opposite the stands of the herbaceous type (included in variant inops *Carex alba*) occupy soils with a high content of carbonates in fine-grained proportion (Fajmonová 1973). The herb layer is composed mainly of *Carex alba* and *Calamagrostis varia*, which together with *Cirsium erisithales*, *Daphne mezereum*, *Fragaria vesca*, *Hieracium murorum*, *Lilium martagon*, *Senecio ovatus* and *Valeriana tripteris* differentiate the typical variant. The variant is can divided into the two subvariants:

aa) typical subvariant

The subvariant includes phytocoenoses of the more gentle slopes and its occurrence is bound to less extreme habitat conditions. It is differentiated by the species *Dentaria bulbifera* and *Polygonatum verticillatum*.

ab) subvariant with *Pinus sylvestris*

It includes the phytocoenoses of more extreme habitats, mostly steeper under-ridge slopes and small edges. The group of differential species is relatively large: *Pinus sylvestris* (E_3), *Anthericum ramosum*, *Berberis vulgaris*, *Cruciata glabra*, *Galium album*, *Melica nutans*, *Pimpinella major*, *Sesleria albicans*, *Tithymalus cyparissias*, *Viburnum lantana* and *Vincetoxicum hirundinaria*.

b) variant *inops*

To the variant belong the phytocoenoses, in which the taxon *Carex alba* was not recorded. Fajmonová (1973) characterized the mentioned phytocoenoses as a herbaceous type occurring mostly on clay limestones with an amount of skeleton in the

soil profile due to weathering of the bedrock. The main consequence is a slight increase of total acidity in upper soil horizons. The weaker aeration and lower mellowness are also characteristic for the soil conditions, which ecologically reflect on the species composition. There ia an absence of species *Carex alba* and *Calamagrostis varia*, which, together with species *Cirsium erisithales*, *Daphne mezereum*, *Fragaria vesca*, *Hieracium murorum*, *Lilium martagon*, *Senecio ovatus* and *Valeriana tripteris*, negatively differentiate the variant. Variant *inops* is considerably poorer in terms of the species richness (relevé nr. 25 represents a smooth transition to association *Dentario bulbiferae-Fagetum* (Zlatník 1935) Hartmann 1953), the species *Hedera helix* and *Pulmonaria officinalis* are differential within the frame of subassociation. Fajmonová (1973) designated these specific, poor phytocoenoses as the *Hedera helix-nudum* type.

B. Stands of clearings (Table 2)
Class: *Epilobietea angustifolii* R. Tx. et Preising R. Tx. ex von Rochow 1951

Alliance: *Atropion* Br.- Bl. ex Aichinger 1933

The alliance represents the first development stage of glades after cutting of forest communities of the alliances *Fagion* Luquet 1926 and *Carpinion* Issler 1931 on the nutritive substrates. It is optimally developed on base-rich soils, at altitudes up to 1000 m a. s. l. The spectrum of life forms is typified by the prevalence of hemicryptophytes.

Association: *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950
The described glade phytocoenoses with the presence of *Cyclamen fatrense* species occur in the beech and fir-beech forest altitudinal zone (650–995 m a. s. l.), slope gradient ranges from 15 % to 20 %, exposition ranges between WSW and NE. The species abundance declines by more than half of that in the forest stands as a consequence of increased light radiation. The geological bedrock is formed by dolomites and limestones; soil is modal rendzina. These heliophilous and nitrophilous short-living communities, whose formation was caused by the change of habitat conditions after removal of forest, represent various development stages of succession towards forest. As they are labile and quickly developed, their exact floristic delimitation has been difficult (Oberdorfer 1973, 1978).

The shrub layer (2 %–70 %) was developed in three relevés. It comprises the species *Acer pseudoplatanus*, *Fagus sylvatica*, *Larix decidua*, *Picea abies*, *Pinus sylvestris* and *Rosa canina* agg. In the herb layer (60 %–100 %) co-occur the typical glade species: *Atropa bella-donna*, *Cirsium arvense*, *Eupatorium cannabinum* and constant species of the community *Carici albae-Fagetum*:*Acer pseudoplatanus*, *Calamagrostis varia*, *Carex alba*, *Cyclamen fatrense* and *Fragaria vesca*. The bryophyte layer was recorded with small abundances (2 %–5 %) in two relevés.

Evaluation of Ellenberg's indicator values

The values for light, temperature, continentality, moisture, reaction and nutrients were calculated on the basis of the methodical approach of Ellenberg (1974) and Ellenberg et al. (1992). Software JUICE 6.2 (Tichý 2002) was used for this analysis, 91 % of all species included in the relevés corresponded to Ellenberg's indicator values in the database. The calculation was done for each particular relevé,

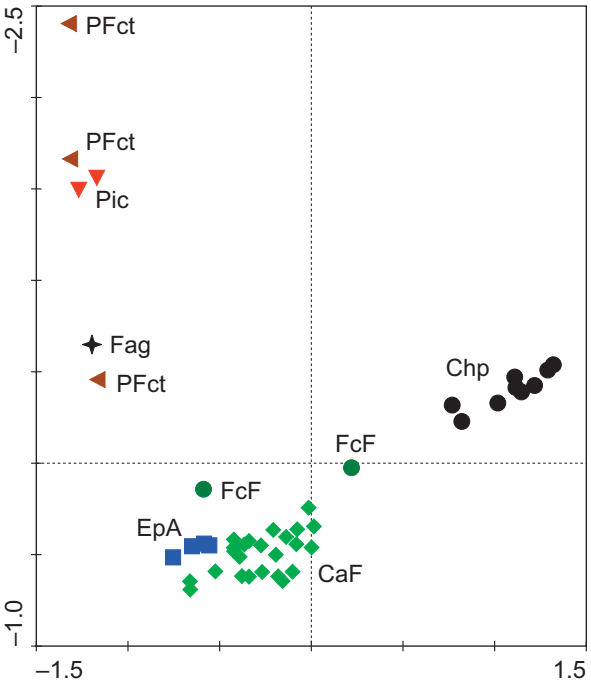

Figure 1: All recognised syntaxa with presence of the *Cyclamen fatrense*. Detrended correspondence analysis, each point represents one relevé. CaF – *Carici albae-Fagetum*, EpA – *Epilobio-Atropetum belladonnae*, FcF – *Fagetum carpaticum Fatrae caricetosum albae*, ChP – *Carici humilis-Pinetum*, PFct – *Piceetum-Fagetum carpaticum typicum*, Pic – *Piceetum*, Fag – *Fagetum*.

Slika 1: Analiza DCA, vsaka točka predstavlja popis. CaF – *Carici albae-Fagetum*, EpA – *Epilobio-Atropetum belladonnae*, FcF – *Fagetum carpaticum Fatrae caricetosum albae*, ChP – *Carici humilis-Pinetum*, PFct – *Piceetum-Fagetum carpaticum typicum*, Pic – *Piceetum*, Fag – *Fagetum*.

summarily 48 relevés: *Carici albae-Fagetum* – 26, *Epilobio-Atropetum bella-donnae* – 4, Klika (1926) – 3, Klika (1927) – 3, Klika (1936) – 2, Kurzová-Urválková (1979) – 10. Analysis showed relatively significant differences between particular syntaxa. Stands of association *Carici albae-Fagetum*, where *Cyclamen fatrense* survives with the highest abundances are characterized by the half shade, weak warm and sub-oceanic conditions; soils are fresh, weak acid – weak alkaline and moderate for soil nutrients. The range of calculated values for all considered syntaxa is large (Tab. 3, 4, Fig. 1). The largest amplitude is observed in relation to the values of light (shadow-half shadow – half light), soil moisture (dry-fresh – fresh-moist) and soil nutrients (poor soils – soils rich in nutrients). It is possible to state that the *Cyclamen fatrense* persists with lower abundances in relatively broad spectrum of ecological conditions.

Table 3: Range of Ellenberg's indicator values calculated for particular relevés.
Tabela 3: Razpon Ellenbergovih indikacijskih vrednosti, izračunanih za posamezni popis.

	Lowest	Descriptive characteristic	Highest	Descriptive characteristic
Light	3.6	Shadow-half shadow	6.6	Half light
Temperature	4.4	Cool-intermediate	5.3	Intermediate
Continentality	3.4	Oceanic-suboceanic	4.4	Suboceanic
Moisture	3.8	Dry-fresh	5.6	Fresh-moist
Soil reaction	5.8	Weakly acid-neutral	7.5	Neutral-basic
Nutrients	2.9	Poor	5.9	Rich

Table 4: Average numbers of Ellenberg's indicator values for particular syntaxa
Tabela 4: Povprečje Ellenbergovih indikacijskih vrednosti za posamezni sintakson.

	All	Forests	Glades	Klika (1926)	Klika (1927)	Klika (1936)	Kurz.-Urv. (1979)
Light	5.16	4.83	5.65	5.27	4.4	4.90	6.36
Temperature	4.83	4.83	4.95	4.90	4.63	5.05	4.75
Continentality	3.87	3.73	3.93	3.77	3.93	3.95	4.22
Moisture	4.80	4.92	4.90	5.23	5.23	4.90	4.18
Soil reaction	6.83	6.79	6.75	6.23	6.13	7.05	7.33
Nutrients	4.56	4.79	5.13	5.33	5.30	4.95	3.22

Indirect gradient analysis

Detrended correspondence analysis (Fig. 2) confirmed the assumed differences among particular syntaxa. Stands of both associations *Carici albae-Fagetum* and *Epilobio-Atropetum bella-donnae*, where the species *Cyclamen fatrense* occurs with the highest abundances, are unambiguously ecologically defined. On the other hand, comparison of the association *Carici albae-Fagetum* within the frame of the

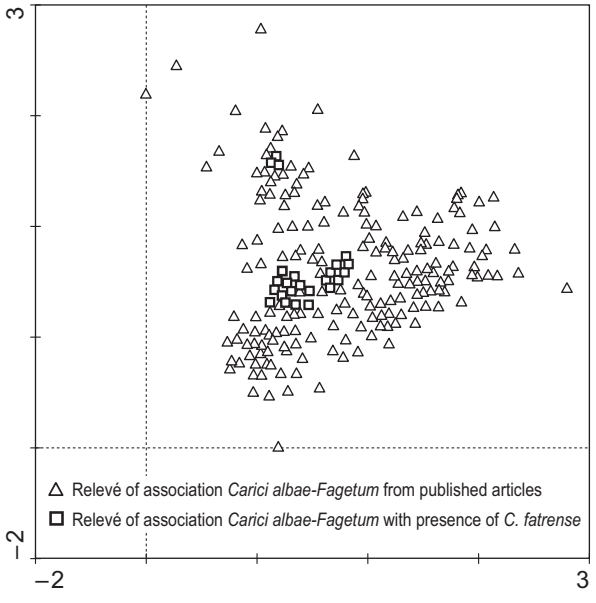

Figure 2: Association *Carici albae-Fagetum,* 185 selected relevés from already published articles, 26 relevés with presence of the *Cyclamen fatrense*. Detrended correspondence analysis, each point represents one relevé.

Slika 2: Asociacija *Carici albae-Fagetum,* 185 izbranih popisov iz objavljenih člankov, 26 popisov s prisotno *Cyclamen fatrense*. Analiza DCA, vsaka točka predstavlja popis.

whole area of Slovakia has not shown any important and clear differences. The comparison was done on the basis of works by Fajmonová & Šimeková (1973), Šimeková (1974), Fajmonová (1978), Jurko & Kontriš (1982), Jurko & Kubíček (1974), Miadok (1979). Summarily, 185 relevés were analyzed, and the results are presented in Fig. 3.

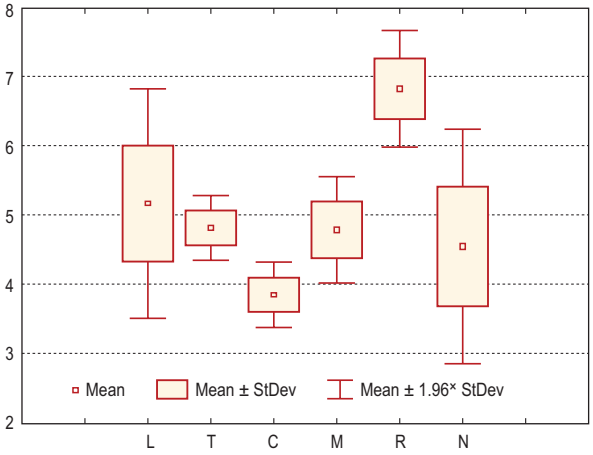

Figure 3: Box and whisker plot of Ellenberg's indicator values. All 48 relevés are included. L – light, T – temperature, C – continentality, M – moisture, R – soil reaction, N – soil nutrients.

Slika 3: Okvir z ročaji Ellenbergovih indikacijskih vrednosti. Vključenih je vseh 48 popisov. L – svetloba, T – temperatura, C – celinskost, M – vlažnost, R – reakcija tal, N – hranila.

4. DISCUSSION

The knowledge obtained of the ecological requirements of the taxon and of the appropriate biotopes necessary for its successful occurrence and living might contribute to conservation of this unique endemic taxon. The primary effort, aimed at describing as much as possible of the biotopes with the presence of species *Cyclamen fatrense*, resulted in one forest and glade association. Association *Carici albae-Fagetum* is a very heterogeneous syntaxon, which includes several lower syntaxonomic units – subassocations, variants and subvariants which reflect on the relatively high variability of habitat conditions. Stands of clearings also offer appropriate conditions for occurrence of this rare species, although with lower abundance than in forests.

Overall, it is interesting, that although there are various species compositions in the tree layer, species *Cyclamen fatrense* prefer primarily the phytocoenoses of only one association, *Carici albae-Fagetum*. To summarize: the phytosociological centre of occurrence of the endemic species *Cyclamen fatrense* can be considered to be the phytocoenoses of the association *Carici albae-Fagetum*, where the highest abundances have been reached ("1" and "2" of the Braun-Blanquet scale).

Klika (1936, 1949) recorded *C. fatrense* in old synonyms of this association, namely *Fagetum carpaticum Fatrae caricetosum albae* and *Abieto-Fagetocaricetum albae* with lower abundance "+". After deforestation, the species persists also in glade phytocoenoses of the association *Epilobio-Atropetum bella-donnae* ("+" and "1"). Marginally it was recognized in associations *Carici humilis-Pinetum, Piceetum, Fagetum* and *Piceetum-Fagetum carpaticum typicum* ("+" and "r"). Comparison between the association *Carici albae-Fagetum* with the presence of *Cyclamen fatrense,* and fundamental works dealing with this syntaxon from the area of Slovakia, did not prove differences in phytosociological character. It is necessary to note that fuller analysis of limestone beech forests is not a purpose of our article, thus the comparison was done in simplified manner. This confirms the theory of Hendrych (1981), who considered climatic, geomorphologic, edaphic or other factors relative to the biology of taxon as being essential.

5. ACKNOWLEDGEMENTS

For the determination of bryophytes we thank RNDr. A. Kubinská, CSc., and for help with the determination of some vascular plants we are grateful to Mgr. J. Kollár, PhD. The contribution was prepared within the grant project of the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences No. 2/6081/26.

6. REFERENCES

Barkman, J. J., Doing, H. & Segal, S. 1964: Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationanalyse. Acta Botanica Neerlandica, Amsterdam, 13: 394–419.

Bernátová, D. & Feráková, V. 1999: *Cyclamen fatrense* Halda et Soják. In: Čeřovský, J., Feráková, V., Holub, J., Maglocký, Š. & Procházka, F.: Červená kniha ohrozených a vzácnych druhov rastlín a živočíchov SR a ČR. Vol. 5. Vyššie rastliny. Príroda, Bratislava, p. 121.

Braun-Blanquet, J. 1964: Pflanzensoziologie. Grund-

züge der Vegetationskunde. Edition 3. Springer, Wien, New York, 865 pp.

Ellenberg, H. 1974: Zeigenwerte der Gefässpflanzen Mitteleuropas. Scripta Geobotanica, 9, Göttingen, 97 pp.

Ellenberg, G, H., Weber, H. E., Düll, R., Wirth, W., Werner, W. & Paulissen,

D. 1992: Zeigenwerte von Pflanzen in Mitteleuropa. Edition 2. Scripta Geobotanica, 18, Göttingen, 258 pp.

Fajmonová, E. 1972: Príspevok k fytocenológii vápencových bučín Stredného Považia [*Carici albae-*(*Abieti-*)*Fagetum* Klika (1936) 1949]. Biológia (Bratislava), 27: 31–42.

Fajmonová, E. 1973: Prehľad sutinových lesov Stredného Považia. Biológia (Bratislava), 28: 547–561.

Fajmonová, E. 1978: Waldgesellschaften der Strážov – Berggruppe (Nordteil des Gebirges Strážovská hornatina). Acta Facultatis Rerum Naturalis Universitas Comeniae, Botanica, 26, Bratislava, p. 87–105.

Fajmonová, E. 1981: Rúbaniskové spoločenstvá v Javorníkoch. Biológia (Bratislava), 36: 289–295.

Fajmonová, E. 1986: K fytocenológii trávnatých rúbaniskových spoločenstiev v niektorých oblastiach Slovenska. Biológia (Bratislava), 41: 13–20.

Fajmonová, E. & Šimeková, J. 1973: Beitrag zur Phytosociologischen Klassifikation der Kalkstein Buchenwälder in den Westkarpaten. Acta Facultatis Rerum Naturalis Universitas Comeniae, Botanica, 21: 31–52.

Halda, J. & Soják, J. 1971: *Cyclamen fatrense* sp. n., nový druh západokarpatské květeny. Časopis Národního Musea, Oddělení Přírodovědné, Praha, 140, 1/2: 63–65.

Hendrych, R. 1981: Bemerkungen zum Endemismus in der Flora der Tschechoslowakei. Preslia, 53: 97–120.

Hennekens, S. M. & Schaminée, J. H. J. 2001: Turboveg, a comprehensive database management system for vegetation data. Journal of Vegetation Science 12: 589–591.

Hill, M. O. & Gauch, H. G. 1980: Detrended correspondence analysis: An improved ordination technique. Plant Ecology 42 (1–3): 47–58. (DOI 10.1007/BF00048870)

Jarolímek, I., Zaliberová, M., Mucina, L. & Mochnacký, S. 1997: Rastlinné spoločenstvá Slovenska. 2. Synantropná vegetácia. Veda, Bratislava, 420 pp.

Jurko, A. 1990: Ekologické a socioekonomické hodnotenie vegetácie. Príroda, Bratislava, 200 pp.

Jurko, A. & Kontriš, J. 1982: Vápencové bučiny Malých Karpát. Biológia (Bratislava), 37: 487–493.

Jurko, A. & Kubíček, F. 1974. Bučiny v centrálnej časti Kremnických vrchov. Biológia (Bratislava), 29: 13–19.

Kent, M. & Coker, O. 1994: Vegetation description and analysis – a practical approach. John Wiley & Sons, Chichester, England, 340 pp.

Klika, J. 1926: Poznámky ke geobotanickému výzkumu Veľké Fatry. Sborník Přírodovědecké společnosti v Moravské Ostravě, 3: 38–85.

Klika, J. 1927: Příspěvek ke geobotanickému výzkumu Veľké Fatry. Preslia, Praha, 5: 6–35.

Klika, J., 1936: Das Klimax-Gebiet der Buchenwilder in den Westkarpathen. Beihefte zum Botanischen Centralblatt, Dresden, 55/B: 373–418.

Klika, J., 1949: Lesy Veľké Fatry. Prírodovedný sborník (Turčiansky Sv. Martin), 4: 7–36.

Kliment, J. 1999: Komentovaný prehľad vyšších rastlín flóry Slovenska, uvádzaných v literatúre ako endemické taxóny. Bulletin Slovenskej Botanickej Spoločnosti, Bratislava, 21, Supplement 4, Slovenská botanická spoločnosť pri SAV, Botanická záhrada UK, 434 pp.

Kubinská, A. & Janovicová, K. 1998: Machorasty – Bryophytes, 297–331 pp. In: Marhold, K. & Hindák, F. (eds), Zoznam nižších a vyšších rastlín Slovenska, Veda, Bratislava.

Kurzová-Urválková, O. 1979: Asociácia *Carici humilis-Pinetum* Klika 1949 v západnej časti Veľkej Fatry. Kmetianum, Martin, 5: 135–151.

Marhold, K., Goliašová, K., Hegedüšová, Z., Hodálová, I., Jurkovičová, V., Kmeťová, E., Letz, R., Michalková, E., Mráz, P., Peniašteková, M., Šípošová, H. & Ťavoda, O. 1998: Papraďorasty a semenné rastliny – Ferns and Flowering Plants. In: Marhold, K. & Hindák, F. (eds), Zoznam nižších a vyšších rastlín Slovenska, Veda, Bratislava 333–687 pp.

Miadok, D. 1979: Kalkbuchenwälder im Karstgebiet von Tisovec. Acta Facultatis Rerum Naturalis Universitas Comeniae, Botanica, 27: 77–85.

Moravec, J., Blažková, D., Husová, M., Kolbek, J., Krahulec, F., Neuhäusl, R., Neuhäuslová-Novotná, Z., Hejný, S., Kropáč, Z., Jeník, J., Květ, J., Samek, V., Krečmer, V., Rybníček, K., Rybníčková, E. & Štěpán, J. 1994: Fytocenologie. Academia, Praha, 404 pp.

Mucina, L. & Maglocký, Š. (eds) 1985: A list of vegetation units of Slovakia. Documents Phytosociologiques, Camerino, 9: 175–220.

Oberdorfer, E. 1973: Die Gliederung der *Epilobietea*

angustifolii-Gesellschaften am Beispiel süddeutscher Vegetationsaufnahmen. Acta Botanica Academiae Scientiarum Hungaricae, 19: 235–253.

Oberdorfer, E. 1978: Süddeutsche Pflanzengesellschaften. Teil 2. Gustav Fischer, Stuttgart, 355 pp.

Suza, J. 1931: Poznámky k rozšíření bramboříku (*Cyclamen europaeum* L.) ve Veľké Fatre (Slovensko). Věda Přírodní, 12: 153–154.

Šimeková, J. 1974: Vápencové bučiny Slovenského raja. Biológia (Bratislava), 29: 263–280.

ter Braak, J. F. C. & Šmilauer, P. 2002: CANOCO Reference Manual and CanoDraw for Windows User's Guide to Canoco for Windows: Software for Canonical Community Ordination (version 4.5). Microcomputer Power (Ithaca, NY, USA), Ithaca, NY, USA, 500 pp.

Tichý, L. 2002: JUICE, software for vegetation classification. Journal of Vegetation Science 13: 451–453.

Zlatník, A. 1959: Přehled slovenských lesů podle skupin lesních typů. Vědecké laboratoře biogeocenologie a typologie lesa, LF-VŠZ Brno, č. 3, 178 pp.

Recieved 9. 5. 2006
Revision recieved 29. 8. 2006
Accepted 16. 4. 2008

Table 1: Association *Carici albae-Fagetum*, phytosociological table, V.w. *C.a.* – variant without *Carex alba*. Csv – constancy of subvariant, Cv – constancy of variant, Ct – total constancy, Pv – presence of subvariant.

Tabela 1: Asociacija *Carici albae-Fagetum*, fitocenološka tabela, V.w. *C.a.* – varianta brez vrste *Carex alba*. Csv – stalnost subvariante, Cv – stalnost variante, Ct – skupna stalnost, Pv – prisotnost subvariante.

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	Csv	14	15	16	17	18	19	20	21	22	23	Csv	Cv	24	25	26	Pv	Ct
														Subassociation *typicum*																	
														Typical variant																	
E_3														**Typical subvariant**																	
Fagus sylvatica	2	4	4	3	4	4	4	4	5	3	4	4	4	V	2	3	3	3	3	1	3	4	.	2	V	V	4	3	5	3	V
Picea abies	2	2	2	.	1	2	2	2	1	2	1	2	2	V	4	1	2	3	2	2	2	1	3	3	V	V	1	2	.	2	V
Acer pseudoplatanus	2	.	.	3	2	.	2	2	.	.	1	.	1	III	2	1	.	.	.	.	.	1	3	2	III	III	.	.	1	1	III
Abies alba	.	.	.	1	2	1	.	.	1	.	1	1	.	III	.	.	.	1	.	.	.	.	.	1	I	II	1	.	.	1	II
Larix decidua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	.	I	I	.	.	.	.	I
Sorbus aria agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	1	II	I	.	.	.	.	I
Ulmus glabra	.	.	.	2	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	I	I	.	.	1	1	I
E_2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		I					
Fagus sylvatica	.	.	1	+	2	1	1	2	2	2	.	.	2	IV	.	.	2	1	1	.	1	1	1	1	IV	IV	1	1	2	3	IV
Picea abies	r	.	.	.	.	.	.	.	.	.	.	.	1	I	1	1	1	1	.	.	.	.	.	1	III	II	.	.	.	.	II
Abies alba	.	.	.	+	1	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	I	I	.	.	.	.	I
Acer pseudoplatanus	.	.	.	1	.	.	.	.	.	.	.	.	.	I	1	.	.	.	.	.	.	1	.	.	I	I	.	.	.	.	I
Sorbus aria agg.	.	.	.	.	1	.	.	.	.	.	.	.	1	I	.	.	.	.	.	.	.	1	+	.	I	I	.	.	.	.	I
Differential species of variant without *Carex alba*																															
Hedera helix	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	3	I
Pulmonaria officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	3	I
Differential species of typical variant																															
Carex alba	+	1	+	2	+	1	1	+	2	2	2	2	2	V	+	3	3	2	2	4	3	2	1	3	V	V	.	.	.	.	V
Calamagrostis varia	+	+	.	+	1	+	2	2	1	4	2	1	1	V	.	2	2	+	3	2	2	2	1	3	V	V	.	.	.	.	V
Daphne mezereum	.	.	.	+	+	+	+	+	r	.	+	+	.	IV	.	+	+	+	+	.	+	+	+	+	IV	IV	.	.	.	.	IV
Lilium martagon	+	+	r	+	+	.	.	+	.	.	+	r	+	IV	+	+	r	.	.	.	r	.	.	+	III	IV	.	r	.	.	III
Valeriana tripteris	.	.	.	.	+	+	2	.	1	2	.	+	2	III	.	+	r	+	1	.	1	1	1	+	IV	IV	.	.	.	.	III
Cirsium erisithales	.	.	.	+	+	+	+	+	+	+	+	+	+	IV	.	.	.	+	+	.	+	.	.	+	II	IV	.	.	.	.	III
Hieracium murorum	r	r	r	.	+	.	+	.	+	.	1	1	1	IV	+	1	+	1	+	+	1	+	.	+	V	IV	.	.	.	.	IV
Senecio ovatus	r	.	.	+	+	+	2	+	1	+	+	r	+	V	.	+	+	r	+	+	+	.	.	+	IV	IV	.	.	.	.	IV
Fragaria vesca	.	.	.	+	.	+	.	+	+	1	+	+	+	IV	+	+	+	+	+	+	r	+	.	+	V	IV	.	.	.	.	IV

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	Csv	14	15	16	17	18	19	20	21	22	23	Csv	Cv	24	25	26	Pv	Ct
Differential species of typical subvariant																															
Dentaria bulbifera	+	.	+	+	+	+	+	+	.	.	+	+	+	IV	.	.	.	.	+	.	.	.	.	.	I	III	+	+	r	3	III
Polygonatum verticillatum	+	.	.	+	+	+	+	+	1	.	.	+	+	IV	.	.	.	.	.	.	+	r	.	.	I	III	.	.	.	.	III
Differential species of subvariant with *Pinus sylvestris*																															
Pinus sylvestris (E_3)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	2	2	1	2	1	.	IV	II	.	.	.	.	II
Viburnum lantana	.	.	.	.	.	.	.	.	.	.	.	r	.	I	.	+	+	+	+	+	r	.	r	+	IV	II	.	.	.	.	II
Melica nutans	.	.	.	.	.	.	.	.	.	.	.	.	+	I	.	+	1	+	+	+	+	.	+	+	IV	II	+	.	+	2	III
Pimpinella major	.	.	.	.	.	.	.	.	.	.	.	r	.	I	r	.	.	.	+	r	+	+	+	+	IV	II	.	.	.	.	II
Vincetoxicum hirundinaria	.	.	.	.	.	.	.	.	.	.	r	.	.	I	+	+	+	.	.	+	.	r	2	+	IV	II	.	.	.	.	II
Anthericum ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	+	.	.	.	+	III	II	.	.	.	.	I
Galium album s.str.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+	.	.	.	.	III	II	.	.	.	.	I
Berberis vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	+	II	I	.	.	.	.	I
Cruciata glabra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	+	II	I	.	.	.	.	I
Tithymalus cyparissias	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	r	.	II	I	.	.	.	1	I
Sesleria albicans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	1	2	.	II	I	.	.	.	.	I
Other species in E_1																															
Cyclamen fatrense	1	1	1	1	+	1	1	1	1	1	1	2	2	V	+	1	1	1	1	1	2	1	2	1	V	V	1	1	+	3	V
Acer pseudoplatanus	+	+	+	.	+	+	+	+	1	+	1	+	1	V	+	+	1	+	+	+	+	+	1	+	V	V	+	.	r	2	V
Fagus sylvatica	+	+	+	.	1	+	+	1	1	2	1	1	1	V	+	+	.	+	1	+	+	+	.	+	IV	V	+	1	1	3	V
Epipactis helleborine agg.	+	+	r	+	+	+	+	+	r	.	+	.	+	V	+	r	.	+	r	+	+	+	+	+	V	V	.	+	+	2	V
Mercurialis perennis	1	.	+	1	2	1	2	1	2	.	+	1	2	V	+	2	2	+	2	+	1	+	+	2	V	V	.	.	+	1	V
Prenanthes purpurea	+	.	+	1	2	+	+	1	1	1	+	1	1	V	+	+	+	+	1	.	1	+	.	1	IV	V	+	.	+	2	V
Abies alba	+	r	r	.	+	+	+	.	r	.	+	r	.	IV	r	.	.	+	r	+	+	.	+	+	IV	IV	r	.	.	1	IV
Campanula rapunculoides	+	.	.	+	+	.	+	+	.	+	+	.	.	III	+	+	+	+	+	+	.	+	.	+	IV	IV	.	.	+	1	IV
Mycelis muralis	+	.	+	+	.	+	+	+	1	.	.	+	+	IV	.	+	+	+	+	r	.	.	.	r	III	IV	+	.	.	1	IV
Sorbus aria agg.	.	.	.	.	+	r	+	+	+	1	+	+	+	IV	.	+	+	+	+	.	+	+	.	r	IV	IV	r	.	.	1	IV
Sorbus aucuparia	.	.	.	.	+	.	+	+	+	+	+	+	+	IV	r	+	+	.	+	r	+	+	.	.	IV	IV	.	.	.	.	III
Viola reichenbachiana	.	.	+	+	+	1	.	r	1	.	.	+	1	IV	.	r	r	+	.	+	.	.	.	+	III	III	+	.	+	2	III
Ajuga genevensis	.	.	.	+	+	+	.	+	1	.	.	+	+	III	+	+	.	+	+	+	.	.	.	+	III	III	.	.	+	1	III
Tithymalus amygdaloides	.	.	.	.	+	+	+	.	1	+	1	+	2	IV	.	1	.	r	+	+	1	.	.	+	III	IV	.	.	r	1	III
Asarum europaeum	+	.	+	+	.	+	.	+	.	.	.	.	+	III	.	.	+	1	.	1	.	.	.	+	II	III	+	1	+	3	III
Astrantia major	+	+	.	.	+	.	+	+	r	.	.	.	1	III	.	+	+	+	.	.	+	.	r	+	III	III	r.	.	.	1	III
Melittis melissophyllum	.	+	.	.	+	.	r	+	.	.	+	.	.	II	+	+	.	r	+	+	.	.	+	+	IV	III	.	.	+	1	III
Viola riviniana	+	.	.	1	1	+	+	+	+	.	.	.	.	III	.	+	+	.	+	+	.	.	.	+	III	III	.	.	+	1	III
Campanula trachelium	.	.	.	+	r	+	+	+	.	.	.	.	+	III	+	.	.	.	+	.	.	.	r	r	II	III	r	.	+	2	III
Convallaria majalis	.	.	.	.	+	.	+	+	+	+	.	+	.	III	+	+	+	.	.	.	+	+	.	.	III	III	.	.	+	1	III
Galium schultesii	.	.	.	.	.	.	2	+	.	.	+	.	+	II	.	.	.	+	+	+	1	1	+	+	IV	III	.	.	+	1	III
Orthilia secunda	.	.	.	.	+	+	+	.	r	.	.	+	+	III	.	+	+	+	+	+	.	+	.	.	III	III	.	.	.	.	III
Picea abies	+	.	.	.	.	.	+	.	+	.	r	.	+	II	.	+	r	+	1	.	r	.	+	+	IV	III	.	.	.	.	III
Corylus avellana	.	r	r	.	.	.	.	.	.	.	.	.	r	II	.	.	.	r	r	+	r	.	+	+	III	II	.	r	r	2	III
Lathyrus vernus	+	+	r	.	+	+	.	+	.	.	+	.	.	III	.	.	+	.	.	.	.	.	+	+	II	III	.	.	+	1	III
Carex digitata	r	.	r	.	.	r	+	.	r	.	.	.	+	III	.	.	.	.	.	.	+	.	+	.	I	II	r	.	r	2	II
Maianthemum bifolium	+	.	.	.	.	+	.	.	+	.	.	+	.	II	.	+	+	.	.	+	+	+	.	+	III	III	.	.	.	.	II
Rosa pendulina	+	.	.	.	+	.	+	+	+	+	.	.	.	III	.	.	.	+	+	.	.	+	+	.	II	III	.	.	.	.	II
Rubus saxatilis	.	.	.	.	+	.	r	.	.	+	.	.	.	II	.	r	+	.	r	.	+	+	+	+	IV	III	.	.	.	.	II
Fraxinus excelsior	.	.	.	+	1	r	+	+	.	.	+	.	.	III	.	.	.	.	r	.	.	.	.	r	I	II	+	.	.	1	II
Heracleum sphondylium	.	.	.	+	+	.	.	+	.	.	.	+	+	II	.	.	.	.	.	+	+	.	+	.	II	II	.	.	+	1	II
Ranunculus nemorosus	.	.	.	.	.	.	.	.	.	.	.	+	+	I	.	+	.	r	+	+	+	+	.	+	IV	II	.	.	.	.	II
Monotropa hypophegea	r	r	+	.	.	.	.	.	.	.	r	.	+	II	.	.	.	+	.	+	.	.	.	.	I	II	.	r	.	1	II
Platanthera bifolia	.	.	.	.	.	r	+	+	.	+	.	.	r	II	.	.	.	.	+	+	+	.	.	.	II	II	.	.	.	.	II
Salvia glutinosa	.	.	.	+	+	+	.	r	r	.	.	.	+	III	.	.	.	+	.	.	.	.	.	+	I	II	.	.	.	.	II
Solidago virgaurea	.	.	.	.	.	.	+	.	.	.	+	+	r	II	.	.	.	r	+	.	.	+	+	.	II	II	.	.	.	.	II
Campanula rotundifolia agg.	.	.	.	.	.	.	.	.	.	.	.	+	+	I	.	+	+	.	.	+	.	.	+	+	III	II	.	.	.	.	II
Carduus glaucinus	.	.	.	.	.	.	.	.	.	1	r	.	.	I	r	.	.	.	1	.	+	+	.	+	III	II	.	.	.	.	II
Gentiana asclepiadea	.	.	.	.	.	+	+	.	+	.	.	+	+	II	.	.	.	.	.	.	+	+	.	.	I	II	.	.	.	.	II

Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	Csv	14	15	16	17	18	19	20	21	22	23	Csv	Cv	24	25	26	Pv	Ct
Neottia nidus-avis	r	.	.	.	.	r	.	r	.	.	r	r	.	II	.	.	.	r	.	.	.	.	.	+	I	II	.	.	.	.	II
Oxalis acetosella	.	.	1	.	.	+	.	.	.	.	.	+	+	II	.	.	.	+	.	.	+	.	.	.	I	II	+	.	.	1	II
Pulmonaria obscura	.	.	.	+	+	+	.	+	.	.	.	.	.	II	.	.	.	+	.	.	.	.	.	+	I	II	.	.	+	1	II
Actaea spicata	+	.	+	.	.	+	.	.	r	.	.	.	.	II	.	r	.	.	.	.	.	.	.	.	I	II	.	.	+	1	II
Ajuga reptans	.	.	.	.	r	.	.	.	+	.	.	.	.	I	.	+	+	.	.	+	.	.	.	+	II	II	.	.	.	.	II
Dryopteris filix-mas	.	.	+	+	.	+	+	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	+	I	II	+	.	.	1	II
Eupatorium cannabinum	.	.	.	+	.	r	.	.	.	.	.	.	.	I	.	.	r	.	.	+	r	.	.	+	II	II	.	.	.	.	II
Gymnocarpium robertianum	.	.	.	.	.	+	+	.	.	.	.	.	+	II	.	.	.	.	.	.	+	.	+	+	II	II	.	.	.	.	II
Melampyrum sylvaticum	.	.	.	.	.	+	.	.	.	.	.	+	.	I	.	.	.	.	2	.	+	+	.	+	II	II	.	.	.	.	II
Paris quadrifolia	.	.	.	+	.	.	r	.	r	.	.	+	.	II	.	.	.	.	.	+	.	.	.	.	I	II	.	+	.	1	II
Sanicula europaea	.	.	.	.	.	+	.	.	+	.	.	.	+	II	.	+	+	.	.	+	.	.	.	.	II	II	.	.	.	.	II
Vaccinium myrtillus	.	.	.	.	.	.	1	.	+	+	.	1	.	II	.	.	.	.	.	.	+	1	.	.	I	II	.	.	.	.	II
Cotoneaster integerrimus	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	+	+	.	.	.	r	+	.	.	II	II	.	.	.	.	I
Knautia maxima	.	.	.	.	+	.	.	.	.	.	.	.	+	I	.	.	.	+	.	+	+	.	.	.	II	II	.	.	.	.	I
Poa stiriaca	.	.	.	.	.	.	.	.	.	.	1	.	.	I	.	1	+	.	.	.	.	.	+	+	II	II	.	.	.	.	I
Primula acaulis	+	.	.	.	.	.	.	.	.	.	.	.	.	I	+	.	.	+	.	+	.	.	.	r	II	II	.	.	.	.	I
Soldanella carpatica	.	.	.	.	.	.	.	.	.	.	.	+	+	I	.	.	.	.	.	.	+	+	r	.	II	II	.	.	.	.	I
Taraxacum sect. *Ruderalia*	.	.	.	.	.	.	.	r	r	.	+	.	.	II	.	r	.	.	.	+	.	.	.	.	I	II	.	.	.	.	I
Acer platanoides	.	+	+	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	I	I	r	r	.	2	I
Aegopodium podagraria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	+	II	I	+	.	.	1	I
Cephalanthera damasonium	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.	.	.	.	.	r	+	.	.	I	I	r	.	.	1	I
Cephalanthera longifolia	.	r	.	.	.	.	.	.	.	.	+	.	+	II	.	.	.	.	.	.	r	.	.	.	I	I	.	.	.	.	I
Galium odoratum	.	.	.	.	.	.	+	+	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	+	I	I	+	.	.	1	I
Laserpitium latifolium	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.	.	.	.	.	.	+	.	+	I	I	.	+	r	1	I
Rubus idaeus	r	.	.	.	.	+	+	+	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	I
Pyrethrum clusii	.	.	.	.	+	.	.	.	.	r	.	.	+	II	.	.	.	.	r	.	.	.	.	.	I	I	.	.	.	.	I
Allium ochroleucum	.	.	.	.	.	.	.	.	.	.	r	.	.	I	.	.	.	.	.	+	.	+	.	.	I	I	.	.	.	.	I
Bellidiastrum michelii	.	.	.	.	.	.	.	.	.	.	.	.	r	I	.	.	.	.	.	.	+	+	.	.	I	I	.	.	.	.	I
Brachypodium sylvaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	1	.	.	.	.	II	I	.	.	.	.	I
Bromus benekenii	.	.	.	+	.	.	.	+	.	.	.	.	.	I	.	.	+	.	.	.	.	.	.	.	I	I	.	.	.	.	I
Buphthalmum salicifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	+	.	.	.	+	+	II	I	.	.	.	.	I
Cardaminopsis arenosa agg.	+	.	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	.	+	.	.	.	.	I	I	+	.	.	1	I
Carex flacca	.	.	.	.	.	.	.	.	.	.	.	+	1	I	.	.	.	.	.	.	.	.	.	+	I	I	.	.	.	.	I
Carlina acaulis	.	.	.	.	r	.	.	.	.	.	.	.	.	I	.	.	.	.	+	r	.	.	.	.	I	I	.	.	.	.	I
Cotoneaster tomentosus	.	.	.	.	+	.	.	.	.	.	.	.	.	I	r	.	.	.	+	.	.	.	.	.	I	I	.	.	.	.	I
Dentaria enneaphyllos	.	.	.	+	.	+	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	.	.	.	I	.	+	.	1	I
Galeobdolon montanum	.	.	+	.	.	+	.	.	.	.	.	.	.	I	.	.	.	.	.	.	.	.	+	.	I	I	.	.	.	.	I
Hordelymus europaeus	.	.	.	+	+	.	+	.	.	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	I
Lonicera xylosteum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	.	.	.	.	.	.	.	II	I	.	.	.	.	I
Phyteuma spicatum	.	.	.	.	.	+	.	.	.	.	.	+	.	I	.	.	.	.	.	.	+	.	.	.	I	I	.	.	.	.	I
Padus avium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	r	.	.	.	.	.	.	II	I	.	.	.	.	I
Rosa canina agg.	.	.	.	.	.	.	.	.	.	.	+	.	r	I	.	.	.	.	.	+	.	.	.	.	I	I	.	.	.	.	I
Rosa sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	r	.	.	.	.	.	.	II	I	.	.	.	.	I
Teucrium chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	II	I	.	.	.	.	I
Tussilago farfara	.	.	.	.	.	+	.	+	1	.	.	.	.	II	.	.	.	.	.	.	.	.	.	.	.	I	.	.	.	.	I
Ulmus glabra	.	.	.	.	.	.	.	+	.	.	.	.	.	I	.	.	.	r	.	+	.	.	.	.	I	I	.	.	.	.	I
E_0																															
Bryum capillare	.	.	.	.	.	.	.	.	.	.	.	+	.	I	.	.	.	.	.	.	+	.	+	.	I	I	.	.	.	.	I
Dicranum scoparium	.	.	.	.	.	.	.	.	1	.	+	+	.	II	.	.	.	.	.	.	+	.	.	.	I	I	.	.	.	.	I
Hypnum cupressiforme	.	.	.	.	.	.	.	.	.	.	+	.	.	I	.	.	.	.	.	.	+	+	+	1	II	II	.	.	.	.	I
Tortella tortuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	+	II	I	.	.	.	.	I

Species with occurrence in one or two relevés:
E_3: *Acer platanoides* 23: 2; *Carpinus betulus* 26: 1; *Corylus avellana* 14: 1; *Fraxinus excelsior* 4: 2; *Pinus nigra* 19: 1; *Sorbus aucuparia* 12: 1; *Swida australis* 26: 1; *Salix caprea* 4: 1; *Tilia platyphyllos* 22: 1; *Ulmus glabra* 4: 2, 26: 1; **E_2:** *Abies alba* 4: +, 5: 1; *Corylus avellana* 22: 1; *Crataegus monogyna* 14: 1; *Rosa pendulina* 22: +; *Taxus baccata* 3: +; *Ulmus glabra* 4: +; **E_1:** *Acinos alpinus* 18: +, 22: +; *Achilea distans* 18: +, 21: r; *Aconitum vulparia* 22: +; *Anemone nemorosa* 23: +; *Arabis sagittata* 7: +; *Asperula tinctoria* 23: +; *Asplenium trichomanes* 1: r; *Asplenium viride* 6: r, 20: +; *Campanula cochlearifolia* 20: +, 21: +; *Campanula persicifolia* 23: +; *Cardamine impatiens* 24: +; *Carex diandra* 12: +, 21: +; *Carex montana* 16: +; *Clematis alpina* 20: +, 23: +; *Clinopodium vulgare* 23: +; *Cortusa matthioli* 13: 1; *Crataegus laevigata* 16: +; *Crataegus monogyna* 19: r; *Crepis biennis* 19: r; *Cyanus mollis* 11: +, 23:r; *Digitalis grandiflora* 18: +; *Epilobium montanum* 24: r; *Epipactis atrorubens* 18: +; *Epipactis microphylla* 24: r; *Euonymus europaeus* 26: r; *Frangula alnus* 18: +, 19: 1; *Galeobdolon luteum* 9: +; *Galeobdolon* sp. 2: r; *Galeopsis tetrahit* 24: r; *Galium anisophyllon* 18: +, 21: +; *Genista pilosa* 19: r; *Geranium robertianum* 4: +; *Goodyera repens* 19: +; *Hacquetia epipactis* 3: +, 14: +; *Hieracium lachenalii* 10: +, 19: +; *Hypericum perforatum* 18: r; *Jacea phrygia* agg. 19: +; *Knautia arvensis* 19: +; *Leontodon autumnalis* 18: +; *Leontodon hispidus* 19: +; *Leucanthemum margaritae* 18: +; *Ligustrum vulgare* 16: +; *Listera ovata* 4: r; *Lonicera nigra* 17: +; *Moneses uniflora* 21: +; *Petasites albus* 13: +; *Phyteuma orbiculare* 22: +; *Pimpinella saxifraga* s.str. 19: +; *Pinus sylvestris* 16: r, 19: r; *Pleurospermum austriacum* 20: +, 21: +; *Poa nemoralis* 13: r; *Polygala amara* 18: +, 19: +; *Polygonatum multiflorum* 3: +; *Polygonatum odoratum* 19: +; *Polystichum aculeatum* 6: +; *Potentilla heptaphylla* 19: +; *Primula elatior* 5: r; *Prunus spinosa* 19: +; *Pteridium aquilinum* 16:+, 19:+; *Pyrethrum corymbosum* 14: +; *Ranunculus lanuginosus* 1: r; *Ribes uva-crispa* 24: +; *Rubus fruticosus* agg. 4: +; *Scabiosa lucida* 22: +; *Secutigera varia* 18: +, 19: +; *Senecio germanicus* subsp. *germanicus* 23: +; *Senecio umbrosus* 22: +, 23: +; *Silene vulgaris* 22: +; *Spiraea media* 16: +; *Swida australis* 16: +; *Swida hungarica* 17: +, 19: +; *Swida sanguinea* 22: +; *Taraxacum* sp. 23: +; *Taxus baccata* 3: +, 14: r; *Thalictrum aquilegiifolium* 1: +, 21: +; *Tilia platyphyllos* 22: +; *Tofieldia calyculata* 20: r; *Urtica dioica* 6: +; *Vaccinium vitis-idaea* 12: +, 21: +; *Viburnum opulus* 17: +, 19: r; **E_0:** *Brachythecium salebrosum* 22: 1; *Brachythecium velutinum* 22: +; *Ctenidium molluscum* 8: +, 20: +; *Distichium inclinatum* 21: +; *Ditrichium flexicaule* 19: +; *Eurhynchium angustirete* 19: +, 23: +; *Fissidens dubius* 12: +; *Fissidens taxifolius* 22: +; *Hylocomium splendens* 23: +; *Lophocolea bidentata* 23: +; *Plagiochila porelloides* 20: +, 23: +; *Plagiomnium rostratum* 23: +; *Pleurozium schreberi* 19: 2; *Rhytidiadelphus triquetrus* 20: +, 23: +; *Scleropodium purum* 23: +.

Table 2: Association *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950, phytosociological table, P – presence.
Tabela 2: Asociacija *Epilobio-Atropetum bella-donnae* R. Tx. 1931 em. 1950, fitocenološka tabela, P – prisotnost.

Number of relevé	1	2	3	4	P
E_2					
Fagus sylvatica	+	.	+	.	2
Picea abies	.	1	4	.	2
Rosa canina agg.	+	1	.	.	2
E_1					
Acer pseudoplatanus	1	1	+	2	4
Astrantia major	1	+	+	+	4
Calamagrostis varia	+	2	1	5	4
Cirsium arvense	1	1	1	r	4
Cyclamen fatrense	+	1	1	1	4
Eupatorium cannabinum	2	2	2	2	4
Fragaria vesca	+	+	1	+	4
Galium schultesii	1	1	+	2	4
Rubus idaeus	2	1	1	1	4
Senecio ovatus	+	r	+	r	4
Asarum europaeum	2	+	+	.	3
Atropa bella-donna	+	+	+	.	3
Brachypodium sylvaticum	2	+	+	.	3
Campanula rapunculoides	+	+	.	1	3
Carex alba	+	1	2	.	3
Clinopodium vulgare	2	+	+	.	3
Tithymalus amygdaloides	+	+	+	.	3
Mercurialis perennis	.	+	+	1	3
Viola reichenbachiana	+	+	+	.	3
Aegopodium podagraria	+	.	+	.	2
Ajuga reptans	+	+	.	.	2
Calamagrostis epigejos	1	.	1	.	2
Campanula persicifolia	+	r	.	.	2
Campanula trachelium	+	+	.	.	2
Cirsium erisithales	.	+	.	+	2
Swida hungarica	.	+	+	.	2
Cruciata glabra	+	+	.	.	2
Dryopteris filix-mas	+	.	+	.	2
Epilobium montanum	+	+	.	.	2
Tithymalus epithymoides	.	r	+	.	2
Fagus sylvatica	.	.	+	1	2
Hypericum hirsutum	+	.	+	.	2
Maianthemum bifolium	.	+	+	.	2
Mycelis muralis	+	.	.	+	2
Picea abies	1	.	.	2	2
Primula acaulis	+	+	.	.	2
Rosa canina agg.	.	+	+	.	2
Salix caprea	.	r	+	.	2
Securigera varia	+	1	.	.	2
Sorbus aria agg.	.	+	+	.	2
Sorbus aucuparia	.	+	+	.	2
Stachys sylvatica	+	+	.	.	2
Urtica dioica	+	+	.	.	2
Veronica chamaedrys	+	.	+	.	2
Vicia cracca	+	.	+	.	2
Vincetoxicum hirundinaria	.	+	r	.	2
Viola riviniana	+	.	.	+	2

Headers of relevés presented in Table 1 and Table 2:
Orographic unit; name and short description of locality; altitude (m a.s.l.); slope (°); exposition; abundance E_3 (%); abundance E_2 (%); abundance E_1 (%); abundance E_0 (%); relevé area (m^2); date; author/authors of the particular relevé.

Association *Carici albae-Fagetum*:

1. Veľká Fatra Mts. (VF); village Rakša, dolina Mača valley, Drienok hill (1268 m); 970; 20; WSW; 95; 5; 10; 0; 400; 16.8.2001; Turis, Chilová.
2. VF; village Rakša, Rakšianska dolina valley, SE from elevation point Suché vrchy (664 m); 650; 25; SW; 95; 0; 10; 0; 400; 16.8.2001; Turis, Chilová.
3. VF; village Necpaly, Necpalská dolina valley, Priavna lateral small valley; 660; 30; NW; 90; 5; 10; 0; 400; 17.8.2001; Turis, Chilová.
4. Starohorské vrchy Mts. (SV); village Baláže, Krčahy hill (1129 m), J from elevation point; 970; 15; S; 85; 10; 30; 0; 400; 24.7.2001; Turis.
5. SV; village Baláže, Krčahy hill (1129 m), JZ from elevation point; 970; 30; SW; 75; 20; 35; 0; 400; 24.7.2001; Turis.
6. VF; village Liptovské Revúce, dolina Kutajova valley; 820; 30; SW; 90; 3; 15; 0; 400; 26.7.2001; Turis.
7. VF; Podšturec, dolina Chladná valley; 985; 25; W; 85; 3; 75; 0; 400; 26.7.2001; Turis.
8. VF; Podšturec, dolina Stará valley; 980; 20; S; 90; 20; 35; 1; 400; 26.7.2001; Turis.
9. VF; village Liptovské Revúce, dolina Kutajova valley, close to relevé nr. 14; 913; 20; NW; 90; 7; 40; 1; 400; 31.7.2002; Turis.
10. VF; Podšturec, dolina Stará valley, close to relevé nr. 16; 930; 40; SSE; 60; 10; 80; 0; 300; 31.7.2002; Turis.
11. VF; village Motyčky, Muráň; 835; 25; S; 80; 0; 70; 5; 375; 5.8.2002; Turis.
12. SV; village Motyčky, Bukovská dolina valley, Ťažalová lateral small valley; 885; 15; NW; 90; 0; 45; 2; 400; 5.8.2005; Turis.
13. SV; village Motyčky, Bukovská dolina valley, Poliakova lateral small valley; 800; 30; NNE; 90; 10; 70; 0; 400; 5.8.2002; Turis.
14. VF; village Rakša, dolina Mača valley, Jabloňská hill (751 m); 680; 45; S; 95; 5; 7; 0; 400; 16.8.2001; Turis, Chilová.
15. VF; village Necpaly, Necpalská dolina valley, Nosáková lateral small valley; 740; 45; NW; 70; 5; 80; 0; 400; 17.8.2001; Turis, Chilová.
16. VF; village Necpaly, Necpalská dolina valley, Nosáková lateral small valley, 300 m N from locality nr. 4; 700; 25; NW; 70; 10; 85; 0; 400; 17.8.2001; Turis, Chilová.
17. VF; village Belá, Belianska dolina valley, Šindolná lateral small valley; 660; 30; S; 80; 10; 25; 0; 400; 17.8.2001; Turis, Chilová.
18. VF; village Prášnica, NE from settlement; 860; 30; SW; 70; 1; 90; 0; 400; 26.7.2001; Turis.
19. VF; village Rakša, Rakšianska dolina valley, Suché vrchy hills (664 m); 600; 20; S; 40; 0; 98; 20; 400; 8.8.2002; Turis, Chilová.
20. VF; village Valentová, dolina Rybô valley; 735; 40; NE; 75; 1; 70; 2; 400; 3.9.2002; Turis.
21. VF; village Horný Jelenec, Pohorenisko hill (932 m); 850; 20; E; 80; 10; 65; 2; 400; 3.9.2002; Turis.
22. VF; village Necpaly, Necpalská dolina valley, Morávková; 600; 35; SW; 70; 5; 60; 10; 100; 16.9.2002; Turis, Chilová.
23. VF; village Necpaly, Necpalská dolina valley, Baničná lateral small valley; 700; 30; SE; 70; 3; 85; 5; 400; 16.9.2002; Turis, Chilová.

24. SV; village Priechod, dolina Ľupčica valley, Kopec hill (730 m); 470; 20; NE; 85; 2; 10; 0; 400; 20.7.2001; Turis.
25. SV; village Priechod, dolina Ľupčica valley, Igovo; 530; 20; NE; 70; 5; 5; 0; 400; 23.7.2001; Turis.
26. SV; village Priechod, dolina Ľupčica, Igovo, close to the locality nr. 9; 470; 30; N; 85; 15; 10; 0; 400; 23.7.2001; Turis.

Association *Epilobio-Atopetum belladonnae*

1. Veľká Fatra Mts. (VF); village Rakša, Rakšianska dolina valley, WNW from the Havrania skala elevation point (924 m); 650; 15; NW; 0; 2; 100; 5; 100; 8.8.2002; Turis, Chilová.
2. VF; village Rakša, Rakšianska dolina valley, NE from elevation point Suché vrchy (664 m); 680; 15; N; 0; 5; 95; 0; 100; 8.8.2002; Turis, Chilová.
3. VF; village Necpaly, Necpalská dolina valley, Tokáreň hill; 650; 15; NE; 0; 70; 60; 2; 100; 16.9.2002; Turis, Chilová.
4. VF; village Motyčky, dolina Chladná valley, close to relevé nr. 15; 995; 20; WSW; 0; 0; 100; 0; 25; 31.7.2002, Turis.