ANNALI DI BOTANICA
Ann. Bot. (Roma), 2010

LOCAL OCCURRENCE OF *ARTEMISIA CHAMAEMELIFOLIA* VILL. IN BULGARIA

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ABSTRACT - The current study revealed new data about the rare and relict species *Artemisia chamaemelifolia* in the country. The data comprise 36 relevés collected in 2008 following the floristic-ecological approach. *A. chamaemelifolia* communities in Bulgaria have not been studied so far. A new association *Galio lovcense-Artemisietum chamaemelifoliae* referred to the *Cirsio-Brachypodion pinnati* alliance is described. The association is distributed locally in the western part of the Balkan Range. Information about different syntaxa including *A. chamaemelifolia* from the whole range of the species is gathered as well as their ecological characteristics.

KEY WORDS - BALKAN, DRY GRASSLANDS, NEW ASSOCIATION, VEGETATION SURVEY

INTRODUCTION

According to different authors, *Artemisisa* L. comprises between 200 and 500 taxa and it is one of the largest genera of the family *Asteraceae* (McArthur, 1979; Mabberley, 1990; Ling, 1982, 1994; Bremer & Humphries, 1993; Torrell & Vallès, 2000; Vallès & McArthur, 2001; Wang, 2004). It has a wide distribution in the northern hemisphere, whereas few species are representative of South America and Africa (Ling, 1994). *Artemisia chamaemelifolia* Vill. is a perennial herb, which is currently forming disjunct ranges distributed in Eurasian mountains: Spanish Sierra Nevada, Cantabrian chain, Pyrenees, the Alps (Italy and France), the Balkan range (Bulgaria), Caucasus (Russia and Georgia), northeast and east Anatolia (Turkey), Armenia, Azerbaijan and the mountains of northern Iran (Vallès, 1985; Meusel & Jäger, 1992b) (Fig. 1). European populations are much smaller as compared to these in Georgia, Armenia and Iran and in most cases they occur in very small areas. In Spain *A. chamaemelifolia* is represented by two subspecies: subsp. *cantabrica* M. Laínz and subsp. *chamaemelifolia* Vill., whereas in all other ranges of the species it is represented by subsp. *chamaemelifolia* only (Vallès, 1985).

According to Kuzmanov (1991) pollen of *Artemisia* genus in pollen diagrams from Bulgaria has been widely presented for the last 50 000 years. Nowadays there are 13 *Artemisia* species in Bulgaria two of which occur in the mountainous areas only. The other 11 species are spread in the lowlands. Kuzmanov (1991) suggests different origin of these two groups: the lowland species come from their initial origin area in Central Asia whereas the other group descends from the secondary origin area connected with the mountains of Eurasia (Caucasus, north

Received September 03, 2009
Accepted November 16, 2009

Fig. 1. Geographical range of *Artemisia chamaemelifolia* Vill. (by Vallés, 1985; Meusel & Jäger, 1992b). Small populations are marked with squares and bigger populations are marked with polygons.

Iran, East Asia Minor and also the Carpathians, the Alps and the Pyrenees). Kuzmanov (1991) refers *A. chamaemelifolia* and *A. eriantha* Ten. to the mountainous group of calcicole and chasmophilous species. The earliest pollen records of these two species from the Balkan Range are dated to the Late Glacial period (Kuzmanov, 1991).

Jordanoff (1923) was the first who reported *A. chamaemelifolia* for the Bulgarian flora. The author assigns this taxon to the interglacial or postglacial relict species. The same is stated by Meusel & Jäger (1992a) who characterized Bulgarian locality of the species as glacial. Nowadays the species is known with a single population located in Ponor mountain - part of the Balkan Range. In this paper we present the most recent data about the species distribution and its communities in the country, which have not been studied before.

MATERIAL AND METHODS

The study area is located in the western part of the Balkan Range - Ponor Mt (Fig. 2). The average altitude of the mountain is about 1300 m (430 m – 1479 m). The base rock is limestone covered by Cambisols (CMd), eutric Cambisols (CMe) and lithic Leptosols (LPq) (Ninov, 2002). The mean annual temperature is 4.8^0C and the mean annual precipitation is 1164 mm (Koleva & Peneva, 1990). The potential natural vegetation in the area is constituted by broadleaved deciduous forests (Bohn *et al.* 2004). Our study covers about 73 % of the population of *A. chamaemelifolia* population which occupy an area of about 95 km^2.

The field sampling was carried out during the year 2008. The data comprises 36 relevés collected according to the floristic-ecological approach (Braun-Blanquet, 1965; Westhoff & van der Maarel, 1980). The sample plots were 4 m x 4 m (Chytrý & Otypková, 2003). We gathered our relevés with other 2400 relevés from the national database collected from grasslands and applied clustering aimed to find out the uniqueness of the observed group. Classification was performed by cluster analysis using TWINSPAN (Hill, 1979) within the JUICE software

(Tichý, 2002). The diagnostic species are determined by using phi-coefficient ≥ 30 (Sokal & Rohlf, 1995; Chytrý *et al.*, 2002). The definition of character species for the alliance and class level follows the literature data (Mucina, 1997; Chytrý & Tichý, 2003; Horvat *et al.*, 1974; Chytrý, 2007; Jarolimek & Šibik, 2008; Royer, 1991; Oberdorfer, 1993; Janišová, 2007). Our relevés are compared floristically with relevés from Caucasus area (Tzepkova, 1987, 2005) by means of Sorensen index.

The nomenclature of syntaxa is in accordance with International Code of Phytosociological Nomenclature (Weber *et al.*, 2000).The nomenclature of vascular plants follows Kozhuharov (1992, 1995), Delipavlov & Cheshmedzhiev (2003), Jordanov (1963, 1964, 1966, 1970, 1973, 1976, 1979), Lange (1995), Martynovský (1980), Velchev (1982, 1989). Floristic elements are recognized after Assyov & Petrova (2006).

RESULTS AND DISCUSSION

The locality of *A. chamaemelifolia* in Bulgaria appears as intermediate occurrence between these in Spain and the Alps on one hand and Russia, Turkey, Armenia, Azerbaijan, Georgia and Iran on the other hand (Fig. 1). In the eastern part of the distribution range it occurs in similar landscapes. At some places in Caucasus the base rock is granite-gneiss, whereas in the rest of the eastern locations it is limestone (Tzepkova, 1987, 2005) like in Bulgaria. The elevation of *A. chamaemelifolia* locations in Russia, Turkey and Iraq is much higher (1400-2200 m for Caucasus and 2200-4000 m for Iraq) than this in Bulgaria which reflects the differences in the latitude. Similarly, in the western part of the range *A. chamaemelifolia* could be found at 1000-2300 m in Italy and France but in Spain it reaches 2400-2600 m altitude. The base rock type is predominantly limestone besides the population in Sierra Nevada (south-east Spain) where the rock is mica-schist (Vallés, 1985).

As a result of cluster analysis 36 relevés including *A. chamaemelifolia* formed a separate group clearly distinguished among the other groups of herbaceous vegetation in the national database (not shown). This group is referred to a new association. This association is distributed in Ponor Mt. and it can be defined as mesoxerophilous vegetation. The horizontal structure of the vegetation is semi-closed up to closed with total projective cover between 80% and 100% (see Table 1, Fig 3). The average height of the above ground phytomas is 50 cm. *Brachypodium pinnatum*, *Briza media*, *Bromus riparius* and *Festuca rubra* are the dominant species. The overall species diversity encompasses 182 vascular plants. Species richness of the sample plots is high and reaches more than 50 species in some relevés.

The vegetation is dominated by hemicryptophytes (H) (83 %). Chamephytes (Ch) (6 %), terophytes (T) (7 %) and geophytes (G) (4 %) are considerably less. The geographical position and carbonate terrain of the studied area are the reasons why 27 % of the species have Euro-Mediterranean and sub-Mediterranean affiliation. Euro-Asiatic species occupy 23% followed by Boreal (11%), Pontic (11%) and Balkan (7 %) elements.

The exposition of the plots is mainly with southern and eastern component, on moderately steep slopes at altitudes between 1202 m to 1439 m. The soils are of medium depth, rich in gravel and stones and dry. The base rock is limestone with outcrops in some stands.

The full floristic composition of the new described association *Galio lovcense-Artemisietum chamaemelifoliae* is presented in Table 1. The relevé No 25 was selected as nomenclatural type of the association (holotipus).

We referred the new association *Galio lovcense-Artemisietum chamaemelifoliae* to alliance *Cirsio-Brachypodion pinnati* Hadac et Klika ex Klika 1951 and class *Festuco-Brometea* Br.-Bl. et R. Tx. in Br.-Bl. 1949 (Table 1). There are 8 diagnostic species for the alliance as *Asperula cynanchica*, *Veronica austriaca*, *Brachypodium pinnatum*, *Sanguisorba minor*, etc. and 14 diagnostis species for the class as *Thymus longicaulis*, *Filipendula vulgaris*, *Galum verum*, *Teucrium chamaedrys*,

Fig. 2. Map of the study area.

Briza media, etc. Characteristic species group for the association consists of *Galium lovcense*, *Inula salicina*, *Chamaecytisus calcareus*, *Artemisia chamaemelifolia*, *Viola hirta*, *Potentilla alba* and *Veratrum nigrum*.

Similar vegetation has been observed by Tzepkova (1987, 2005) for Caucasus area. She publishes *A. chamaemelifolia* as characteristic of *Artemisio chamaemelifoliae–Plantaginetum atratae* Tzepkova 2005 and *Artemisio chamaemelifoliae–Caricetum humilis* Tzepkova 1987 associations. The author includes both associations into the class *Festuco-Brometea*, and alliance *Festucion valesiacae*. Some similarity between Bulgarian and east European vegetation types exists but regarding the Soerensen index it ranges between 9% and 6%. There are only 11 common species between these three associations: *Artemisia chamaemelifolia*, *Festuca valesiaca*, *Carex humilis*, *Galium verum*, *Lotus corniculatus*, *Achillea milefolium*, *Rumex acetosella*, *Stachys recta*, *Anthylis vulneraria*, *Trilolum alpestre*, *Hypericum perforatum* and *Teucrium chamaedrys*. Several endemics for Caucasus area, as *Astragalus captiosus, A. oreades, Bromus variegates, Sempervivum caucasicum and Ziziphora puschkinii*, additionally emphasize the differences among the associations.

A. chamaemelifolia is diagnostic of various syntaxa in the different localities. The subspecies *cantabrica* and *chamaemelifolia* belong to two separate classes in Spain. Rivas-Martínez (2002) reports *A. chamaemelifolia* subsp. *cantabrica* as characteristic of alliance *Festucion burnatii* Rivas Goday & Rivas-Martínez ex Mayor, Andrés, Martínez, F. Navarro & T.E. Díaz 1973 (class *Festuco hystricis-Ononidetea striatae* Rivas-Martínez, T.E. Díaz, F. Prieto, Loidi & Penas 2002) whereas *A. chamaemelifolia* subsp. *chamaemelifolia* – of class *Asplenietea trichomanis* (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977. In France the same subspecies is given to be characteristic of alliance *Thlaspion rotundifolii* Br.-Bl. in Br.-Bl. et Jenny 1926 (class *Thlaspietea rotundifolii* Br.-Bl. in Br.-Bl. & Jenny 1926). According to Nazarian (2004) *A. chamaemelifolia* occurs in shrubby communities of *Juniperus communis* (class *Juniperetea*) as companion species in northern Iran.

Most of the grasslands in Ponor Mt. take place on former forests cleared in historical times, but the relict character and ecology of *A. chamaemelifolia* suppose that its population has been preserved in small patches of herbaceous communities remaining since the Late Glacial. Early Holocene pollen spectra taken in the periphery of the study area are dominated by *Artemisia, Chenopodiaceae, Asteraceae, Poaceae*, which proves broad distribution of herbaceous vegetation (Filipovitch *et al*., 1997) in this period. The palinological data confirm continuous presence of *Artemisia* in the region up to sub-Atlantic (Fil-


Fig. 3 *Galio lovcense-Artemisietum chamaemelifoliae,* picture of rel. 28, authors:HP&KV.

ipovitch, 1981). The forest clearance has enlarged the available habitats for distribution of the species.

The stands have been used for grazing in the past but nowadays most of them are abandoned or the grazing is at very low intensity. Isolated population and human influence consisted in land use changes in the recent time are considered as the major factors for the species vulnerability. *A. chamaemelifolia* is included in the Red List of Bulgarian vascular plants (Petrova & Vladimirov, 2009) as critically endangered [CR B1ab(i,ii,iii)+2a(i,ii); C2b(i)] using IUCN criteria and categories (IUCN 2001, 2003). The species is legally protected under the Biodiversity Act.

ACKNOWLEDGEMENTS

This study is financially supported by the project "Conservation of globally important biodiversity in high nature value semi-natural grasslands through support for the traditional local economy"; Host Organization: Bulgarian Society for the Protection of Birds; funded by UNDP & GEF. Authors are grateful to the anonymous reviewer for the useful comments and critical notes.

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Life form	Flor. elem.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Constancy
		Elevation (m)	1266	1311	1268	1312	1303	1294	1303	1202	1245	1271	1297	1288	1344	1364	1353	1260	1397	1342	1390	1417	1418	1407	1427	1375	1354	1281	1260	1261	1359	1417	1374	1439	1347	1251	1298	1321	
		Exposition	E	SE	S	W	W	S	E	SW	NE	W	S	NE	E	E	N	0	NE	S	NE	S	W	NW	NE	S	S	E	0	S	SE	S	0	S	W	S	NW	NW	
		Slope (º)	8	10	10	7	10	10	35	10	15	10	8	12	8	7	10	0	8	12	3	10	20	20	12	10	8	6	0	8	10	8		15	12	12	8	12	
		Cover (%)	100	100	100	100	90	95	90	100	100	100	80	100	100	95	100	95	95	100	100	100	100	100	100	100	100	100	95	100	100	100	95	100	100	100	100	100	
		Number of relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
		Number of species in relevé	35	30	31	36	33	32	32	40	40	38	38	51	32	28	35	39	34	29	37	41	41	40	38	42	47	44	37	39	37	37	37	33	33	42	59	46	
		Area (m²)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Life form	Flor. elem.	***Galio lovcense-Artemisietum chamaemelifoliae* ass. nova**																																					
H	Bal-Anat	*Galium lovcense*	1	+	+	2	+	+	+		+			+	+		1		+			+	1	1	1	+	+	+			+	+	+	+	1	+	+	+	IV
Ch	Bal	*Chamaecytisus calcareus*	+		+	+	+	+	1	+	+	+				+	+		+	+	+	+	+		+		+	+			+			+		+		+	IV
H	Eur-As	*Inula salicina*	+	+	+	+		+		+	+	+	+				+		+	+	1	+	1	1	1	1	+			+		+	1	1	1	+			IV
Ch	Alp-Cauc	*Artemisia chamaemelifolia*							2		+		1	1	+	+	+	+	+	2	1	2	+		+	+	3	+	+	4	2	1	2	+	+				IV
H	Eur-As	*Viola hirta*		+			+			+	+	+					+	+		+	+		+	+	+	+	+	+	+				+					+	III
H	Pann-Pont	*Potentilla alba*										+					+	+		+	+		+		+	+	+	2	+				1		+	+	+		III
H	Eur-As	*Veratrum nigrum*				+		+								+	+					+	+	1	+	+	+				+			+			+	+	II
		***Cirsio-Brachypodion* Hadač et Klika ex Klika 1951**																																					
H	Eur-Med	*Asperula cynanchica*	+	+	+	+	+	+		+	+	+	+	+		+	+	+			+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	V
H	Eur-Med	*Veronica austriaca*	+	+	+	+	+		+	+		+	+	+		+	+		+	+	+	+			+	+	+	+		+	+	+	+		+	+	+	+	IV
H	SSib	*Brachypodium pinnatum*	2	4	2	2		3		3	+	1	1	3	1			1		2			2	3		3	2	2	1		1		2	2	2	4	1		IV
H	subBoreal	*Sanguisorba minor*		+		+	+	+	+	+	+	+			+	+	+	+	+			+							+	+	+	+	+			+	+	+	IV
H	Eur-Sib	*Polygala major*	+	+		+	+		+	+	+			+		+						+	+		+	+	+						+	+		+			III
H	Eur	*Euphorbia cyparissias*							+	+	+	+		+		+	+		+			+	+	+		+	+				+		+	+					III
H	Boreal	*Plantago media*				+	+	+	+				+					+	+		+						+		+	+		+				+	+	+	III
H	Pont	*Festuca valesiaca*							2	1	1	3	2	2				1								1	1	1		1	+		2						II
		***Festuco-Brometea* Br.-Bl. Et R. Tx. In Br.-Bl. 1949**																																					
H	Med	*Thymus longicaulis*	1	+	+	+	1	2	1	+	+	1	1	1	+		+	+	1	+	+	+	+	+	+			+	+	+		+	+	1		+	+	+	V
H	Eur-Med	*Filipendula vulgaris*	+	1	+	2	+	+	+	2		+		+			+	1		+	1	+	+	+	+	+	2	1	+		+	1	+	+	+	2	+	+	V
H	Eur-As	*Galium verum*	+	+	1	+	+	+		+		+		+	+	+		+	1	1	1	+	+	+		+	+	1	+	+	+	+	+	+	+	1	+		V
H	subMed	*Teucrium chamaedrys*	+	+	+	+	+	+	+	+	+		1	+		+		+	+	+	+	+	+		+	+	+		+	+	+	+		+	+	+		+	V
H	Eur	*Briza media*	1	1	2	2		1		1		1	1		2		2	3	1	1	1		2	1	1	2	1	3	3	2		1	2		1	2	1		IV
H	Kos	*Hypericum perforatum*	+	+	+	+				+		+	+	+	+			+	+	+	+	+		+	+			+	+	+	+	+	+	+	+	+			IV
H	Eur	*Koeleria macrantha*					1	+		1	+	1	1		1	1	+	+	1	+		+					1		+		+	1			+		+		III
H	Eur-Med	*Scabiosa columbaria*			+		+	+						+				+			+	+	+	+	+				+	+	+			+	+	+	1	+	III
H	SPont	*Trifolium montanum*	+	+	1	1	+			+	+		+	+	+			+				+			+	+	+	+			+						+		III

Number of relevé			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
H	Eur	*Potentilla cinerea*	+			+	+		1		+	+	1	+				+							+		+		+	+					+	+	+	III
H	Pont-subMed	*Pimpinella tragium*								+	+		+	+						+	+		+	+				+		+		+			+	+	+	II
H	Eur-Sib	*Fragaria viridis*				+				+		+		+	+	+		+		+								+	+			+			1	1		II
H	subMed	*Festuca dalmatica*					3	1								1				3		2		2	1	1			1			2						II
H	SPont	*Onobrychis arenaria*						1		+		+		1		+										1	+				+					+	2		II
		Other																																				
Ch	Eur	*Chamaespartium sagittale*	1		1	1	1	1		+	+	1	+			+	1		+	+	2	+	+	+	+	+	+	2		1	+	+	1	+	+	+	+		V
H	Eur-Sib	*Trifolium alpestre*	+			+	1	1	+	1	+		+	1	+	+	1		+	+	+	1	1	+		+				+	+	2	+		1	+	+	+	IV
H	Pont	*Bromus riparius*	1	1		+	3	2		1	1	2		1		3	1	1		2		2	2	1		1	1		1		+	+	+		1		+	1	IV
H	Eur-Med	*Primula veris*	+			+	+		+		+	+		+		+	+				+	+	+	+	+	+	+	+		+	+			+		+	+	IV
H	Kos	*Plantago lanceolata*	+			+	+	+			+	+		+			+	+	+		+	+	+	+	+	+		+	+	+	+			+	+			IV
H	Pont-Med	*Hypericum linarioides*	+					+	+	+	+	+	1	1		1	+		+		+		1		+		+	+		1	1		+	+				+	III
H	Boreal	*Festuca rubra*	2	1	2	2			1						2	1	3	1	2		3		2				1	1	1	2		4		2	3	1	2		III
H	Eur-As	*Anthoxanthum odoratum*		+	1	1				+			1		+		1	1	1		1		1	1	1	1	2	1	1	1			1		+			+	III
H	Med-OT	*Seseli peucedanoides*	+													+				+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	III
H	SMed-CAs	*Cruciata glabra*		+	+	+						+					+			+	+		+	+	+	+		+				+	+	+		+	+	III
H	subMed	*Cerastium banaticum*	+				+		+		+						+	+			+				+		+		+	+	+		+			+	1	III
H	Eur-Sib	*Achillea millefolium*		+	+			+	+					+	+			1	+		+								+	1		+			+	+			III
H	subMed	*Stachys officinalis*	+	+	1	+														1		+	+	1	+	+		+					+		1		+		II
H	Boreal	*Agrostis capillaris*			2	1						2					1	2		+		+		2			1	1	2	+		1			1				II
H	SSib	*Avenula pubescens*	1				1	1			+	1		+	+				1					1			+								3		1	+	II
H	Eur	*Carlina acanthifolia*			+			+		+	+	+	+	+				+								+		+	+	+							+	II
H	Eur-Med	*Lotus corniculatus*		+	+				+				+				+					+					+	+		+		+	+	+					II
H	Eur-Med	*Coronilla varia*						+						+	1			+		+				1			+		+		1	+	+		1				II
T	Eur-CAs	*Vicia villosa*	+											+	+		+			+	+	+	1	+												+	+	II
T	Eur	*Rhinanthus angustifolius*				+								+	+	+			1					+	+							+	3		+		+		II
H	Bal	*Sesleria latifolia*							1	+	4	1		+			1						1		3									+			2	3	II
Ch	Eur-Sib	*Genista tinctoria*																			+	+	+		+	+	+	+		+		+			+	1			II
T	Eur-Med	*Alyssum minus*			+									+					+			+			+	+	+				+		+			+			II
H	Med	*Potentilla pedata*	+	+		+	+							+	+				+												1				+			II
H	Eur-As	*Veronica chamaedrys*													+			+	+					+				+	+	+		+				+		II
H	Eur	*Geranium sanguineum*	2	+																			+			1						+			+	+	+	II
H	subBoreal	*Luzula campestris*																+	+		+		+				+	+	+	+								II
		Hieracium sp.			+														+	+				+			+					+						I
H	subMed	*Asperula purpurea*							+	1	+		+																		+		+		+			I
T	Eur-Med	*Minuartia viscosa*									+		+	+					+		+							+	+									I
H	Eur-As	*Bromus barcensis*													+					2			+				2				+	2	2						I
H	Eur-As	*Dactylis glomerata*	1							+				+	2																	+					1		I
H	Eur-Sib	*Thalictrum minus*	+	+	1																													1		+	+		I
H	Eur-Sib	*Leucanthemum vulgare*				+	+										+						+	+													+		I
H	Boreal	*Carex caryophyllea*					+		+				1											+			+											+		I
		Centaurea sp.					+														+	+												+			+	+	I
H	Eur	*Stipa pennata*														3						4			3						3		3	+				I

Number of relevé			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Ch	Eur-Med	*Corothamnus procumbens*		+					1																								+	+			+	I
H	Eur-Sib	*Ferulago campestris*			+	+	+																													+	+	I
G	Pont-Med	*Hyacintella leucophaea*			+			+					+														+			+									I
H	Eur-Med	*Anthylis vulneraria*				+								+		+							+														+	I
H	subMed	*Trinia glauca*					+			+												+								+							+	I
H	Boreal	*Elymus repens*					+		+						+	1																				1		I
H	subMed	*Thesium linophyllon*						+			+														+	+							+					I
H	Eur-As	*Carex humilis*							+			2					+																			+	+	I
H	Eur-Med	*Dorycnium herbaceum*								1	+			+														+		2								I
H	Eur	*Danthonia alpina*								+								+								+		1	+									I
H	subMed	*Inula germanica*									+		+							+																+	+	I
H	Eur-OT	*Campanula glomerata*										r											+	+												+	+	I
H	Eur-Med	*Hieracium pilosella*											2					2										+	2	+								I
H	Kos	*Poa pratensis*											+	1							1									1						1		I
		Euphrasia sp.											+					+										+			+						+	I
H	Eur-Med	*Stachys recta*													+				+			+									+					+		I
H	subMed	*Prunella grandiflora*																						+		1							1		+		+	I
H	subMed	*Centaurea triumfetti*	+	+		1																													+			I
H	subMed	*Thesium bavarum*		+																			+	+								+						I
H	Eur-Sib	*Scorzonera austriaca*						+		+	+										+																	I
H	Kos	*Convolvulus arvensis*						+						+	+																+							I
H	Eur	*Globularia aphyllanthes*							+	+	+		1																										I
T	Med-CAs	*Acinos rotundifolius*							+				+	+																						+			I
H	Eur-Sib	*Carex montana*								+		+														+					1								I
H	Eur-Sib	*Knautia arvensis*									+					+			+																	+		I
H	Boreal	*Festuca pratensis*										2		1	1																					+			I
H	Pont-Med	*Leontodon crispus*											+	+																						+	+		I
H	Pont-Sib	*Centaurea pannonica*												+				+							+				+									I
H	subMed	*Thlaspi praecox*												+																	+		+			+		I
G	Med-OT	*Muscari neglectum*															+					+			+		+											I
H	Kos	*Ranunculus acris*																+			+				+				+									I
H	Eur-subMed	*Achillea collina*																	+		+		+					+										I
H	Med	*Scorzonera cana*		+																						+	+											I
H	Eur-As	*Rumex thyrsiflorus*			+																															+	+		I
Ch	Alp-Med	*Helianthemum nummularium*						+			+																											+	I
H	Boreal	*Arabis hirsuta*											+		+																	+						I
H	Ap-Bal	*Verbascum lychnitis*													+															+					+			I
H	Bal	*Pastinaca hirsuta*														+						+		+														I
H	Boreal	*Stellaria alsine*															+							+				+										I
G	Med	*Allium flavum*																	+			+										+						I
H	SPont	*Ajuga genevensis*																								+		+				+						I
H	Eur-As	*Nepeta nuda*	+												+																								I
		Orobanche sp.	+																							+													I
H	Pont	*Alchemilla erythropoda*					+										+																						I

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G	Eur-subMed	*Ornithogalum kochii*					+																				+												I
H	Bal	*Silene roemeri*																										+					+						I
H	subBoreal	*Lathyrus pratensis*																		+				+															I
H	Eur-subMed	*Phleum pratense*																			+			+															I
H	Med	*Euphorbia niciciana*						+			+																												I
T	subMed	*Crupina vulgaris*							+	+																													I
T	Eur-Med	*Sedum hispanicum*							1				+																										I
H	Pont-Med	*Eryngium campestre*								+	+																												I
H	Pont-Med	*Centaurea orientalis*								+		+																											I
H	Eur-Med	*Hypochaeris glabra*										+											+																I
T	subMed	*Helianthemum salicifolium*										1										+																	I
G	Eur-subMed	*Orchis tridentata*											+																	+									I
H	Eur-subMed	*Poa compressa*												+																		+							I
H	Eur-Med	*Cirsium vulgare*																+											+										I
H	SPont	*Potentilla argentea*																+												+									I
H	subMed-Anat	*Bellardiochloa violacea*																	+									+											I
H	subMed	*Achillea setacea*																									+										+		I
H	Eur-Sib	*Hypochaeris maculata*																									+											1	I
H	Pont-Med	*Viola dacica*																									+						+						I
H	Eur-As	*Cirsium arvense*																										+		+									I
H	Med	*Scorzonera hispanica*																																+		+			I
H	Pont-Bal	*Asyneuma canescens*																																		+		+	I
H	subMed	*Anthericum liliago*																																			+	3	I
H	Med-CAs	*Thesium arvense*																																			+	+	I

Species occurring in one relevé only: *Comandra elegans*: +, 36; *Myosotis laxa*: +, 35; *Allium carinatum*: +, 35; *Helleborus odorus*: +, 35; *Polygala comosa*: +, 35; *Agrostis gigantea*: 2, 35; *Hypericum rumeliacum*: +, 35; *Cynoglossum hungaricum*: +, 35; *Tanacetum corymbosum*: +, 35; *Anthriscus sylvestris*: +, 35; *Arrenatherum elatius*: +, 34; *Scabiosa triniifolia*: +, 34; *Carduus nutans*: +, 34; *Festuca paniculata*: 2, 32; *Cuscuta approximata*: +, 31; *Iris reichenbachii*: +, 29; *Carex hirta*: +, 26; *Orchis morio*: +, 24; *Carex michelii*: +, 24; *Vincetoxicum hirundinaria*: r, 23; *Pedicularis grisebachii*: +, 22; *Campanula sparsa*: +, 22; *Juniperus communis*: r,19; *Nardus stricta*: 1, 18; *Viola tricolor*: +, 17; *Bromus squarrosus*: 1, 14; *Myosotis scorpioides*: +, 13; *Carduus candicans*: +, 13; *Medicago falcata*: +, 12; *Sanguisorba officinalis*: +, 12; *Mercurialis ovata*: +, 12; *Centaurea jacea*: +, 12; *Juniperus sibirica*: r, 12; *Poa badensis*: +, 11; *Medicago lupulina*: +, 11; *Tragopogon pterodes*: +, 11; *Tragapogon balcanicum*: +, 10; *Linum tauricum*: +, 10; *Carex* sp.: 1, 9; *Filipendula ulmaria*: 1, 9; *Mentha spicata*: +, 8; *Satureja montana*: 2, 7; *Cotoneaster nebrodensis*: +, 7; *Hypericum maculatum*: +, 25; *Poa trivialis*: +, 4; *Potentilla erecta*: +, 3; *Rumex acetosella*: +, 3; *Viola reichenbachiana*: +, 2; *Prunella vulgaris*: +, 1;

Carex sp.: 1, 9; Filipendula ulmaria: 1, 9; Mentha spicata: +, 8; Satureja montana: 2, 7; Cotoneaster nebrodensis: +, 7; Hypericum maculatum: +, 25; Poa trivialis: +, 4; Potentilla erecta: +, 3; Rumex acetosella: +, 3; Viola reichenbachiana: +, 2; Prunella vulgaris: +, 1;

Coordinates of stands: 1. N43.09730 E23.12607; 2. N43.09917 E23.12813; 3. N43.09784 E23.13198; 4. N43.09676 E23.13872; 5. N43.09267 E23.12220; 6. N43.08497 E23.12212; 7. N43.07611 E23.19072; 8. N43.05646 E23.24628; 9. N43.05635 E23.24172; 10. N43.05416 E23.22411; 11. N43.08648 E23.17901; 12. N43.07140 E23.18933; 13. N43.08017 E23.19597; 14. N43.07979 E23.19936; 15. N43.08393 E23.20358; 16. N43.07850 E23.21309; 17. N43.08439 E23.19567; 18. N43.08918 E23.18425; 19. N43.09226 E23.18225; 20. N43.08851 E23.20730; 21. N43.09205 E23.20390; 22. N43.09605 E23.20374; 23. N43.08946 E23.21773; 24. N43.08892 E23.22125; 25.N43.08834 E23.22453; 26. N43.08380 E23.22468; 27. N43.07850 E23.21309; 28. N43.07670 E23.20835; 29. N43.08059 E23.20518; 30. N43.08100 E23.21000; 31. N43.08392 E23.22047; 32. N43.08632 E23.21497; 33. N43.08862 E23.20363; 34. N43.06807 E23.23543; 35. N43.08379 E23.28529; 36. N43.08149 E23.28232

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