

New data on the ecological peculiarities and the distribution in Bulgaria of the vulnerable habitat F3.1d Balkan-Anatolian submontane genistoid scrub from the European Red List of Habitats

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Key words: endemic vegetation, vulnerable habitat, *Genista lydia* complex, Balkan peninsula.

Ključne besede: endemična vegetacija, ogroženi habitati, kompleks *Genista lydia*, Balkanski polotok.

Abstract

The study presents new data on the habitat dominated by the species complex of *Genista lydia*/*G. rumelica* in Bulgaria. It is based on 129 phytocoenological relevés and provides information on the chorology, ecology and floristic structure of these communities. This habitat type occupies substrates composed by different volcanic rocks. The floristic structure is very rich in species. The phytogeographical relationships with the East Mediterranean region are considerable, which is proved by the high occurrence of floristic elements with Mediterranean or sub-Mediterranean origin. The plant life-forms analysis demonstrates that the therophytes, geophytes and chamephytes prevail in their floristic structure, which is also typical for the shrub communities in this region. During the field study this vegetation type has been mapped and its total area of occupancy has been calculated. For a first time it is proposed this habitat to be divided into three habitat sub-types due to the established differences in the environmental factors. Some recommendations have been proposed on the conservation management and also complements on the habitat's descriptions in EUNIS habitat classification.

Izvleček

V članku predstavljamo nove podatke o habitatnih tipih, v katerih prevladuje kompleks vrst *Genista lydia*/*G. rumelica* v Bolgariji. Na osnovi 129 fitocenoloških popisov predstavljamo informacije o horologiji, ekologiji in floristični sestavi teh združb. Habitatni tip najdemo na matični podlagi, ki jo sestavljajo različne vulkanske kamnine. Floristična sestava je vrstno bogata. Povezava z vzhodno mediteransko regijo je očitna, kar dokazuje velik delež vrst mediteranskega in submediteranskega flornega elementa. Analiza življenskih oblik je pokazala, da v floristični sestavi prevladujejo terofiti, geofiti in hamefiti, kar je značilno za grmiščne združbe tega območja. Ta vegetacijski tip smo kartirali na terenu in izračunali skupno območje razširjenosti. Na osnovi ugotovljenih razlik v okoljskih dejavnikih predlagamo razdelitev habitatnega tipa v tri podtipa. Predlagamo tudi nekatere ukrepe za naravovarstveno gospodarjenje in dopolnitve k opisom habitatnega tipa v EUNIS habitatni klasifikaciji.

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Introduction

The communities dominated by the species complex of *Genista lydia* Boiss/*G. rumelica* Velen. have been a subject of continuous scientific interest due to the indigenous origin of the one of the dominant species and their restricted geographical range. However, there is no sufficient information in the scientific literature about their floristic structure, ecological features and distribution. Despite that both taxa are broadly accepted as synonyms, there are still opposing opinions considering the variability within this group of species still not fully known.

Genista lydia was published as new species by Boissier (1843) based on materials collected for Flora Orientalis from the hillsides of Bozdağ Mt. (Turkey). The range of this species is known to include the Balkan Peninsula, parts of Turkey and Syria (ILDIS World Database of Legumes 2010). An alternative taxonomic scheme for *G. lydia* was proposed by Zieliński et al. (2004), treating it as the easternmost subspecies of *G. januensis* Viv. The authors considers *G. rumelica* as an extreme morphotype of *G. januensis* ssp. *lydia* (Boiss.) Kit Tan & Zieliński.

Genista rumelica was described for a first time by the Czech botanist Josef Velenovský during his work for Flora Bulgaria (see Velenovský 1890), on the basis of herbarium materials collected at Džendem Tepe locality (locus classicus), Plovdiv town, Bulgaria. Since then many authors have proposed different conceptions about the taxonomic position of this taxon. However, most of them have placed it in the *G. lydia* s. l., or accept it as only synonym (Turril 1957, Gibbs 1968, Ponert 1973, ILDIS World Database of Legumes 2010). For the Flora of P.R. Bulgaria, Kuzmanov (1976) have accepted *G. rumelica* as a different species. Stoyanov (2014) distinguished *G. lydia* from *G. rumelica* by differences in their morphology, physical appearance and habitat's preferences. The research of Evstatieva et al. (2004), based on a chaemotaxonomical study of the genus *Genista* in Bulgaria, have concluded that *G. rumelica* distinctly differs from *G. lydia* by its alkaloid composition and both taxa should not be referred to one species. Therefore, these studies have confirmed *G. rumelica* as an endemic taxon for the territory of Bulgaria and Northern Greece, which conception was already accepted by Kuzmanov (1976).

Morphologically, both taxa are low 30–70 (100) cm shrubs (heaths), with procumbent to erect branches, whose leaves fall soon after the flowering period (Figure 1).

Their communities were firstly mentioned by Vasilev (1983) as a part of the Bulgarian endemic vegetation. After that, Velčev & Bondev (1984a) have reported those



Figure 1: *Genista rumelica* in the natural habitat – Western Rhodope Mts.
Slika 1: *Genista rumelica* na naravnem rastišču – zahodni Rodopi.

heathlands as an important part of the Bulgarian vegetation. They have also defined these communities as endangered due to their restricted distribution and have noted that this vegetation is maintained mainly as pastures. The same authors have reported 5 associations (determined using criteria of Russian-Scandinavian school) dominated by *G. rumelica*, and provided also information on their distribution. However, the collected field materials from their study have never been published (see Velčev & Bondev 1984b). Additional data on the distribution of the studied communities in Bulgaria has been presented by Bondev (1991) in the map of vegetation (1:600 000) with an explanatory text. Also brief descriptions of their phytocoenoses have been given and some of co-dominants have been mentioned. Such species are *Stipa capillata*, *Melica ciliata*, *Diplachne serotina*, *Dichanthium ischaemum*, *Koeleria* spp., *Poa bulbosa* and *Satureja montana*. Bondev has entitled this vegetation type as “124 Shrubs of Rumelian green weed (*Genisteta rumelicae*) (r) and of Lydian green weed (*Genisteta lydiae*) (l)”.

The most comprehensive study concerning on these communities was published by Tzonev & Gushev (2015) in the Red Data Book of Bulgaria (vol. 3). In this book they have been entitled under the name “21F3 Mediterranean fields of Rumelian green weed (*Genista rumelica*) and Lydian green weed (*Genista lydia*)”. The authors have described the habitat as a complex of shrub, herbaceous and chasmophytic plant species, occupying areas with shallow soils or bare rocks. The floristic composition is qualified as diverse and with many annuals and species of southern origin with limited distribution in Bulgaria. The relict and endemic origin on one of the dominant species, but also some other species from the floristic structure of the habitat, determined the conservation significance and threatened status of the studied communities. Data on their distribution in Bulgaria, ecological preferences and characteristic species as well as some conservation measures are also pointed in this entry.

The European Red List of Habitats (Janssen et al. 2016) was released as a first attempt to assess the current status of all terrestrial, freshwater and marine habitats in the continent and surrounding offshore areas. The communities of *Genista lydia* complex were also assessed under the name “F3.1d Balkan-Anatolian submontane genistoid scrub”. According to the Red List criteria, the status of this habitat type is Vulnerable (see Janssen et al. 2016). The main reasons are the ongoing minor negative trends in its quality and quantity and the limited range of distribution, restricted to the southeast part of the Balkan Peninsula and West Anatolia. Information on the geographic occurrence, threats and restoration potential as well as the relationships with different classification systems have been also summarized in this survey. According to the available data, the current area of the habitat on the territory of Bulgaria is assumed to be about 60 km², area of occupancy (AOO) – 32 (3200 km²), extent of occurrence (EOO) but for Bulgaria and Greece – 56000 km² (Janssen et al. 2016).

EUNIS habitat classification (version 2017), revised for the forest, heathland, scrub and tundra vegetation (<https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification>) adopted the same habitat name from the European Red List of Habitats – S3-4. “Balkan-Anatolian submontane genistoid scrub” and list of some diagnostic and characteristic species has also been provided. It includes *Genista lydia*, *Minuartia hirsuta*, *Allium guttatum*, *Centaurea grisebachii*, *Hypericum olympicum*, *Thymus sibthorpii*, *Koeleria lobata*, *Micropyrum tenellum*, *Asperula aristata* and *Rumex acetosella*.

The present study expands the level of knowledge carried out by the previous authors regarding this rare on a European level habitat type. It provides also data on the

floristic composition and ecological preferences, as well as new information on its geographical range and area of occupancy, especially for Bulgaria. Furthermore, the factors determining its occurrence are pointed out and some remarks for its conservation are also proposed.

Material and methods

The plant communities of species complex *Genista lydia*/*G. rumelica* were investigated during the vegetation seasons of 2016–2017. The principles and methods of this study follow the Braun-Blanquet’s phytosociological school (Braun-Blanquet 1964, Mueller-Dombois & Ellenberg 1974). At each sampling plot the complete list of the present species (vascular plants) was recorded together with their cover-abundance values according to the 9-degree Braun-Blanquet scale, based on Barkman et al. (1964) (see Westhoff & van der Maarel 1980). The complete checklist of species and the study of ecological features are based on these sample plots. The taxonomic nomenclature of the vascular plants generally follows Delipavlov & Chesmedzhiev (2003). However, in the case of absence of sufficient information, misapplied names or different taxonomic combinations referred to a certain taxon, some additional literature was used, mostly from other Bulgarian floristic works (Jordanov 1963–1979, Velčev 1982, 1989, Kožuharov 1992, 1995, Assyov et al. 2012, Peev 2013) as well as and occasionally online databases (ILDIS World Database of Legumes 2010, The Plant List 2013, Euro+Med PlantBase 2018). The floristic elements (or geoelements) are indicated in accordance with Assyov et al. (2012) and are subsequently united in 10 larger categories for better understanding of some general trends in their distribution (see Tzonev 2002). The plant life-forms of the species are presented using the classification of Raunkiaer (1934). The soil types and composition of the bedrock outcrops are presented in accordance with the map of the soils of Bulgaria (Ninov 2002) and also the geological map (Cheshitev & Kânčev 1989). The map of habitat’s distribution was produced using the Quantum GIS application (<http://www.qgis.org/>) and Google Earth Pro (<https://www.google.com/earth/download/gep/agree.html>). The conservation status of the taxa from the floristic composition of studied habitat is according to Petrova & Vladimirov (2009). Their protected status is indicated in accordance with the Appendix 3 of the Bulgarian Biological Diversity Act (2002). The enlisted endemic taxa are presented according to Petrova & Vladimirov (2010) and Assyov et al. (2012), Euro+Med PlantBase (2018).

Results and Discussion

Distribution

The communities dominated by *Genista lydia*/*G. rumelica* have limited distribution on the territory of Bulgaria. The most significant areas occupied by this habitat type are the slopes of Pirin, Rila and Western Rhodope Mts. as well as the neighboring valley of Mesta River (close to the towns of Gotse Delchev and Dobrinishte) and the Eastern Rhodope Mts., along the valleys of Vurbitsa and Arda Rivers (near the villages of Podkova and Sedlovina). In Central Rhodope Mts., (between the towns of Devin and Chepelare), the habitat type occurs with less coverage of the plant communities. The northernmost spread of the communities on the territory of Bulgaria occupy the southern slopes of the Eastern Balkan Range (above the town of Sliven) (see Figure 2). The habitat's localities on the southern slopes of the Central Balkan Range (Kazanlak town), Sredna Gora Mts. (Pazardzhik region), Slavyanka (Orvilos) Mts. (South-western Bulgaria) and

Strandzha Mts. published on the map in the Red Data Book of Bulgaria, vol. 3 (Gussev & Tzonev 2015) were not confirmed during the field work. The localities at Durbash region of the Rhodope Mts. (Bondev 2002) are also unconfirmed.

Floristic composition

About 500 taxa belonging to 238 genera and 56 plant families were found to participate in the habitat's floristic structure (see the Appendix). The richest families are *Fabaceae* (65 taxa), followed by *Asteraceae* (59), *Poaceae* (54), *Caryophyllaceae* (42) etc. *Trifolium* is the genus with the highest number of species and subspecies (25), followed by *Vicia* and *Silene* (13), *Sedum* (11), *Potentilla* (8), etc. The studied plant communities are relatively rich in species: from 16 to 79 per plot (mean 43).

The flowering period for *Genista lydia*/*G. rumelica* starts at the end of April in the Eastern Rhodopean stands, which are located at the lowest altitude and ends in mid-June for those from the Central Rhodopes.



Figure 2: Map of distribution of communities of *Genista lydia*/*G. rumelica* in Bulgaria (10×10 km UTM grid scale). The presence of the habitat in the grid cells is marked in grey color.

Slika 2: Karta razširjenosti združb vrst *Genista lydia*/*G. rumelica* v Bolgariji (kvadranti 10×10 km UTM). Prisotnost habitata v kvadrantu je prikazana s sivo barvo.

During the flowering season the communities are easily identifiable due to the yellow aspect of the areas occupied by them. Therefore, it is the most suitable period for their mapping. The stands of the *Genista lydia* complex include species characteristic to different types of dry grasslands: *Koeleria nitidula*, *Anthoxanthum odoratum*, *Chrysopogon gryllus*, *Festuca valesiaca*, *Melica ciliata*, *Dichanthium ischaemum* as well as the annuals *Poa bulbosa*, *Vulpia ciliata*, *Vulpia myurus*, *Aira elegantissima*, *Aegilops triuncialis*, *Galium divaricatum*, *Bromus squarrosus*, *Trifolium arvense*, etc. At higher altitudes and under more mesophilic conditions other common species could be also *Arrhenatherum elatius*, *Cynosurus cristatus*, *Agrostis capillaris*, *Holcus lanatus*, etc. Other species with a high constancy are *Achillea coarctata*, *Asperula tenella*, *Cruciata pedemontana*, *Eryngium campestre*, *Euphorbia cyparissias*, *Galium verum*, *Hieracium hoppeanum*, *Hypericum perforatum*, *Luzula campestris*, *Moenchia mantica*, *Myosotis ramosissima*, *Cerastium glomeratum*, *Plantago lanceolata*, *Potentilla argentea*, *Rumex acetosella*, *Sanguisorba minor*, *Trifolium campestre*, *Thymus* spp., *Viola tricolor*. Various Balkan endemics species like *Dianthus pinifolius* ssp. *pinifolius*, *Silene frivaldszkyana*, *Anthemis macedonica*, *Verbascum humile*, *Viola aetolica*, *Trifolium trichopterum*, *Sesleria latifolia*, *Achillea coarctata*, *Sedum grisebachii*, *Sempervivum leucanthum*, *Digitalis viridiflora*, *Cerastium petricola* could be also found in the floristic composition of these communities. However, they are not so common. Some of them have also protected status according to the Bulgarian Biodiversity Act (enlisted in the Annex 3) – *Anthemis virescens*, *Campanula jordanovii*, *Sedum stefco*, *Romulea linaresii* ssp. *graeca*, etc. In Western Rhodopes and Pirin Mts., the dominant species are established to participate in mixed communities co-dominated from another Balkan endemic shrub – *Chamaecytisus absinthioides*. Other shrubs like *Juniperus communis*, *J. deltoides*, *Rosa* spp., *Genista carinalis*, *Cistus incanus*, *Paliurus spina-christi*, etc. also participate in their floristic structure. In more chasmophytic communities of the Eastern Balkan Mts., *Lembotropis nigricans* and *Syringa vulgaris* also could be found as co-dominants. In few plots, single individuals of some adventive species from the adjacent crop fields like the lavender (*Lavandula angustifolia*) were also observed. Some trees could occasionally participate in the floristic structure of these communities. In abandoned or occasionally grazed stands, some juvenile individuals from the surrounding forest vegetation could penetrate in the communities of *Genista* spp. Such species are *Quercus* spp., *Carpinus orientalis*, *Pinus nigra*, *P. sylvestris*, *Pyrus pyraeaster*, *Crataegus monogyna*, *Acer tataricum*, *Corylus avellana*, etc.

Ecological preferences and structure of the communities

Genista lydia and *G. rumelica*, generally prefer the more extreme conditions of the sheer rocks, rock crevices and stone terraces, therefore they could be described as chasmophytes. The secondary expansion of their communities is initiated mainly due to the habitat degradation as a result of deforestation, soil erosion or/and extensive livestock farming. These communities occupy mainly areas where there is some kind of disturbance of the primary dominant vegetation types. They could be found in territories actively used as pastures where, due to the overgrazing and trampling, the occurrence of grasses is suppressed. In the overgrazed areas the coverage of the dominant species is higher and vice versa. The communities of *G. lydia* complex could also occupy secondarily degraded areas: screes and eroded places which have replaced some destroyed or degraded oak (*Quercus frainetto*, *Q. pubescens*, *Q. delechampi*) and Black pine (*Pinus nigra*) forests. But at a higher elevation they could be also in places of European beech (*Fagus sylvatica*), Scot's pine (*Pinus sylvestris*) and Norway spruce (*Picea abies*) forests. These communities could also occupy mining deposits, open rocky slopes above the rivers, deep ravines and even eroded sides along the motorways as well as the sandy alluviums on the higher banks of rivers. They could even occasionally inhabit some recently abandoned crop fields formerly used for the cultivation of tobacco and lavender. This habitat type is also typical for steep, dry, stony and sunny localities with shallow soils, predominantly Lithic and Umbric Leptosols or Dystric Cambisols, and rarely on Eutric Fluvisols. The rocky outcrops are often composed from different magmatic rocks and minerals like volcanic tuffs, andesites, rhyolites and zeolites. However, this vegetation type also could be found on sandstones, schists, conglomerates and gneisses.

The present fieldwork did not confirm the preferences of the dominant species to the cretaceous substrates as it was presented in the published literature (Gushev & Tzonev 2015, Janssen et al. 2016, EUNIS habitat classification 2017). On the limestone terrains the species from the dominant complex, *Genista lydia* or *G. rumelica*, were observed only as solitary individuals or small groups with a scattered occurrence. Jakucs (1960) have described forests of *Quercus pubescens* from the calcareous slopes of Golo Burdo Mts., Western Bulgaria, where *G. lydia* was found to dominate in the shrub layer. This is probably a case of misidentification with *G. januensis* (syn.: *G. triangularis* Willd) which is a common species on limestone substrates in the western part of the country (see Apostolova-Stoyanova & Stoyanov 2009). According to our experience, closed and homogeneous

communities of the studied habitat type are established exclusively on volcanic rocks. It is especially wherever a certain amount of deposits accumulates as dust, sand and fine dried plant litter. Also they could be found at places composed by shallow soils with sandy structure. Contrary, the bare calcareous terrains with a high level of erosion normally are presented by larger stones and deposits which consist from gravel or larger particles. Such types of substrates are probably inappropriate for the spread of the communities discussed here.

The studied communities are mostly with open or semi-open and rarely almost closed coverage. Their structure is rather mosaic, consisting of patches with a different size (20 – 200 m²). In some places their coverage is closed and homogenous, overgrowing entire hillsides. The total vegetation cover varies in the range between 50% and 98% per plot (mean 80.5%). However, the cover of cryptograms is abundant in many of the studied stands. The areas with southern exposition (65.9%), predominate to those with northern (26.4%). The inclination varies between 1°–60°, (mean 10.4°). The altitudinal range is between 150 and 1500 m (see Table 1). Most of the habitat's areas fall into the climatic zone of Continental-Mediterranean region. Only the Eastern Balkan stands falls into the Transitional-Continental region (Velev 2002). According to Bondev (2002) the territories occupied by the studied communities belong to the Illyrian (Balkan) and Macedonian-Thracian provinces of the European deciduous forest region.

Table 1: Parameter values for the vegetation cover, exposition, inclination and altitude of the studied habitat type. The plot numbers are bolded.

Tabela 1: Vrednosti za pokrovnost vegetacije, smer neba, naklon in nadmorsko višino za obravnavani habitatni tip. Število ploskev je prikazano krepko.

Following the regional differences, the habitat could be split into three main habitat sub-types – A) Chas-

mophytic (Balkan), B) East Rhodopean (Thracian) and C) Rilo-Rhodopean. This separation is based on the variations in the communities depending from their features like the distribution, altitude, inclination of the terrains, soil types, basic rocks and floristic composition.

A) The Chasmophytic habitat sub-type (Figure 3) is represented mostly by chasmophytic communities occurring on acidic rocks (andesites, diorites, conglomerates) at the slopes of the East Balkan Range (Sliven).



Figure 3: Appearance of the Chasmophytic habitat sub-type, Sliven district, East Balkan range.

Slika 3: Hazmoftski habitatni podtip, Sliven, gorovje Vzhodni Balkan.

These communities inhabit mostly rock cliffs and terraces with a predominantly southern exposition, and occupied areas between 15–50 m². The soils are shallow Umbric Leptosols. The mean number of species per plot (29) is the lowest among the identified habitat sub-types due to the extreme ecological conditions. The mean value of the total vegetation cover is also the lowest one: 63% per plot. Species with high constancy are *Anthemis cretica*, *Semprevivum marmoreum*, *Galium flavescens*, *Hypericum montbretii*, *Festuca dalmatica*, *Bellardiocloa violacea*, *Potentilla rupestris*, *Seseli rigidum*, *Viscaria vulgaris* ssp. *atropurpurea*, etc (see Table 2).

Number of plots (in bold)	Vegetation cover (%)				Mean vegetation cover (80.5%)
	50–60 %	61–75%	76–90%	>91%	
	20 (15.5%)	19 (14.7%)	68 (52.7%)	22 (17.1%)	
	Exposition				Mean inclination value (10.4°)
	S, SW,SE	N,NW,NE	W	E	
	85 (65.9%)	34 (26.4%)	8 (6.2%)	2 (1.6%)	
	Inclination (degrees°)				Average altitude (698.9 m)
	1° –10°	11° – 20°	20°–30°	>31°	
	99 (76.7%)	9 (7%)	10 (7.8%)	11 (8.5%)	
	Altitude (meters)				
0–400	400–800	800–1200	>1200		
47 (36.4%)	32 (24.8%)	37 (28.7%)	13 (10.1%)		

Table 2: Synoptic table of the studied habitat sub-types with constancy displayed in classes and as percentage. Only species in constancy classes III or higher (>40%), at least for one of the sub-habitat types are shown in the table.

Tabela 2: Sinoptična tabela obravnavanih habitatnih podtipov s prikazano stalnostjo v razredih in z odstotki. Prikazane so samo vrste z razredom stalnosti III ali večjo stalnostjo (>40%) v vsaj enem od habitatnih podtipov.

Habitat subtype	S3-43. Rilo-Rhodopean submontane genistoid scrub (Rilo-Rhodopean)		S3-42. Thracian submontane genistoid scrub (Eastern Rhodopean)		S3-41. Balkan-Range submontane genistoid scrub (Chasmophytic)		All Habitat subtypes	
	class	%	class	%	class	%	class	%
<i>Genista lydia</i> / <i>G. rumelica</i>	V	100	V	100	V	100	V	100
<i>Eryngium campestre</i>	IV	61	V	83	II	25	IV	64
<i>Poa bulbosa</i>	III	46	IV	79	II	31	III	55
<i>Festuca valesiaca</i>	IV	77	II	36	I	0	III	54
<i>Sanguisorba minor</i>	III	48	IV	74	I	13	III	52
<i>Asperula tenella</i>	IV	69	II	36	II	6	III	50
<i>Cruciata pedemontana</i>	III	55	III	45	I	0	III	45
<i>Rumex acetosella</i>	II	32	IV	67	III	44	III	45
<i>Teucrium chamaedrys</i>	III	56	II	38	I	0	III	43
<i>Anthoxanthum odoratum</i>	II	28	IV	74	II	31	III	43
<i>Plantago lanceolata</i>	III	46	III	50	I	0	III	42
<i>Trifolium campestre</i>	IV	61	II	24	I	6	III	42
<i>Hieracium hoppeanum</i>	III	48	II	31	II	38	III	41
<i>Trifolium arvense</i>	III	45	II	29	II	38	II	39
<i>Centaurea cuneifolia</i>	III	41	III	43	I	13	II	38
<i>Bromus squarrosus</i>	III	52	I	19	I	13	II	36
<i>Euphorbia cyparissias</i>	III	41	II	24	III	50	II	36
<i>Agrostis capillaris</i>	III	59	I	0	I	19	II	35
<i>Dichanthium ischaemum</i>	III	38	II	38	I	6	II	34
<i>Galium verum</i>	III	35	III	45	I	0	II	34
<i>Chrysopogon gryllus</i>	I	20	IV	67	I	13	II	34
<i>Thymus glabrescens</i>	II	31	III	43	I	0	II	31
<i>Orlaya grandiflora</i>	I	20	I	19	III	56	II	24
<i>Thymus longicaulis</i>	III	52	I	2	II	38	II	34
<i>Achillea coarctata</i>	III	48	I	2	III	44	II	33
<i>Scabiosa triniifolia</i>	III	41	I	19	II	25	II	32
<i>Potentilla argentea</i>	III	41	II	26	I	0	II	31
<i>Koeleria macrantha</i>	III	52	I	0	I	13	II	30
<i>Plantago subulata</i>	III	41	I	0	IV	63	II	30
<i>Potentilla neglecta</i>	III	46	I	10	I	6	II	29
<i>Dianthus pinifolius</i> ssp. <i>pinifolius</i>	III	45	I	5	I	6	II	27
<i>Phleum montanum</i>	III	41	I	0	II	31	II	26
<i>Aira elegantissima</i>	II	25	IV	62	I	0	II	34
<i>Moenchia mantica</i>	I	11	III	52	I	0	II	23
<i>Euphorbia seguieriana</i>	I	0	III	55	I	19	I	20
<i>Carlina vulgaris</i>	I	4	III	48	I	0	I	18
<i>Geranium molle</i>	I	8	III	40	I	0	I	18
<i>Sherardia arvensis</i>	I	4	III	45	I	0	I	17
<i>Crepis setosa</i>	I	3	III	43	I	13	I	17
<i>Oenanthe pimpinelloides</i>	I	0	III	48	I	0	I	16
<i>Ranunculus millefoliatus</i>	I	0	III	45	I	0	I	15
<i>Daucus guttatus</i> ssp. <i>zahariadii</i>	I	3	III	41	I	0	I	15
<i>Linaria genistifolia</i> ssp. <i>genistifolia</i>	I	8	I	12	III	50	I	15
<i>Koeleria nitidula</i>	I	0	II	21	III	44	I	12
<i>Ornithogalum kochii</i>	I	6	I	7	III	44	I	11
<i>Festuca dalmatica</i>	I	4	I	0	III	56	I	9
<i>Anthemis cretica</i>	I	0	I	0	IV	63	I	8
<i>Sempervivum marmoreum</i>	I	0	I	0	III	44	I	5
<i>Viola kitaibeliana</i>	I	0	I	0	III	44	I	5

These communities are also rich in Balkan endemics like *Sesleria latifolia*, *Sempervivum erythraeum*, *Verbascum humile*, *Chamaecytisus calcareus*, *Scabiosa triniifolia*, *Silene lerchenfeldiana*. On the other hand, the therophytes are less in numbers comparing to the following two sub-

types (see Figures 4 and 5). Two species from the floristic composition have conservation significance – the local endemic *Campanula jordanovii* (VU) and *Tulipa australis* (NT). They are also protected under the Annex 3 of Bulgarian Biodiversity Act.

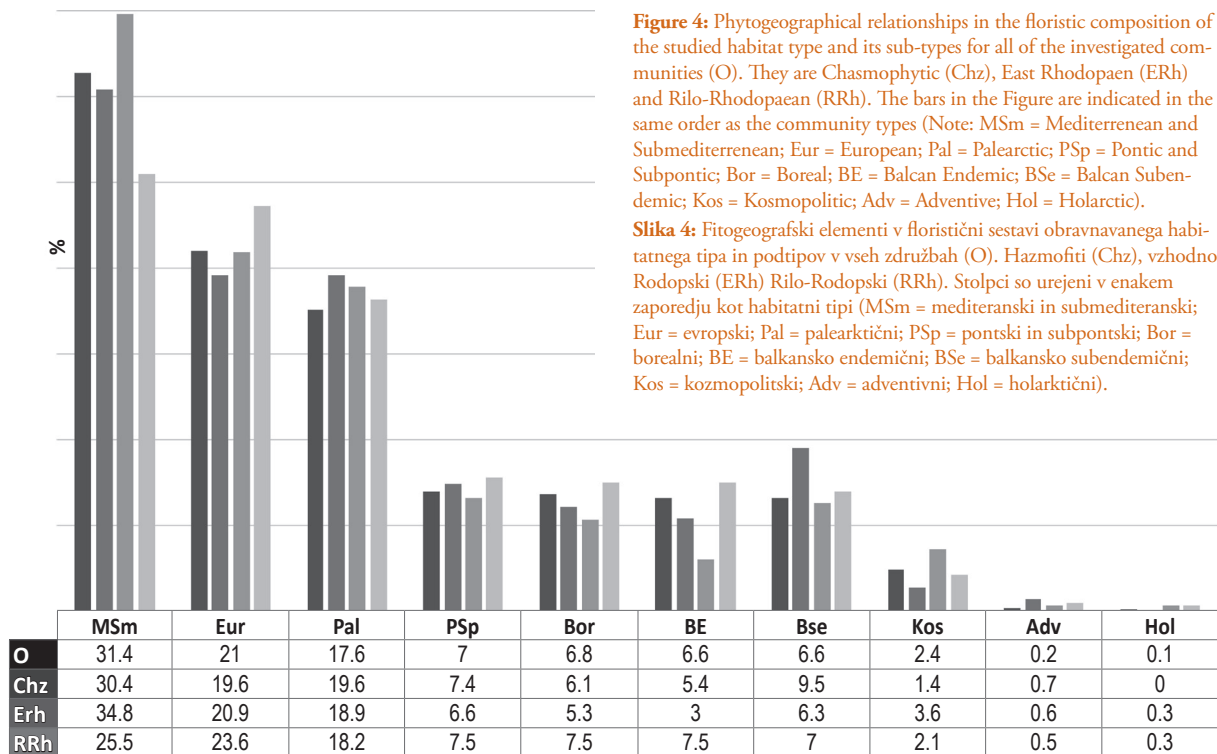


Figure 4: Phytogeographical relationships in the floristic composition of the studied habitat type and its sub-types for all of the investigated communities (O). They are Chasmophytic (Chz), East Rhodopaean (ERh) and Rilo-Rhodopaean (RRh). The bars in the Figure are indicated in the same order as the community types (Note: Msm = Mediterranean and Submediterranean; Eur = European; Pal = Palearctic; PSp = Pontic and Subpontic; Bor = Boreal; BE = Balkan Endemic; Bse = Balkan Subendemic; Kos = Kosmopolitic; Adv = Adventive; Hol = Holarctic).

Slika 4: Fitogeografski elementi v floristični sestavi obravnavanega habitatnega tipa in podtipov v vseh združbah (O). Hazmofiti (Chz), vzhodno Rodopski (ERh) Rilo-Rodopski (RRh). Stolpci so urejeni v enakem zaporedju kot habitatni tipi (Msm = mediteranski in submediteranski; Eur = evropski; Pal = palearktični; PSp = pontski in subpontski; Bor = borealni; BE = balkansko endemični; Bse = balkansko subendemični; Kos = kozmopolitski; Adv = adventivni; Hol = holarktični).

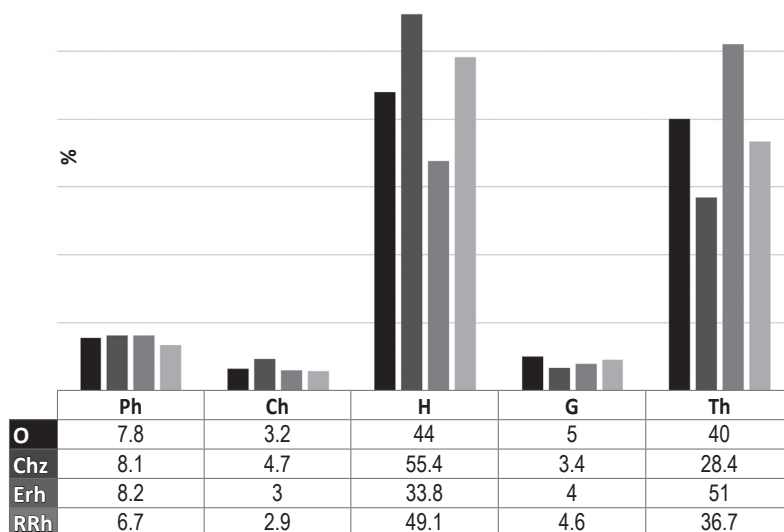


Figure 5: Spectrum of plant life-forms (Ph – phanerophytes, Ch – chamaephytes, H – hemicryptophytes, G – geophytes, Th – therophytes) amongst the researched habitat sub-types for all investigated sub-types (O); Chasmophytic (Chz), East Rhodopaean (ERh) and Rilo-Rhodopaean (RRh). The bars in the Figure are ordered in the same way as in the legend.

Slika 5: Spekter življenskih oblik (Ph – fanerofiti, Ch – hamefiti, H – hemikriptofiti, G – geofiti, Th – terofiti) v obravnavanih habitatnih podtipih (O); hazmofitski (Chz), vzhodno rodopski (ERh) in Rilo-rodopski (RRh). Stolpci so v enakem zaporedju kot poimenovanja v legendi.



Figure 6: East Rhodopean stands of the studied communities.

Slika 6: Sestoji obravnavanih združb v Vzhodnih Rodopih.

B) The Eastern Rhodopean (Thracian) habitat sub-type (Figure 6) is spread on schist, sandstones, tuffs or sand alluviums in the basin of Arda River between 160–390 m alt. Around the village of Sedlovina these communities have their own specificity. They could occupy substrates comprising almost entirely of white zeolites and mining deposits, which remained after their processing. In the vicinity of the village of Podkova, this habitat sub-type covers significant areas. The soil types are Lithic and Umbric Leptosols, but along the rivers, these communities also occupy the Eutric Fluvisols. Here the sub-Mediterranean climatic influence is considerable, promoting the richest floristic structure amongst the studied communities, where the therophytes with a typical Mediterranean origin dominate (see Figures 4 and 5). In early spring the herbaceous layer is dominated by geophytes like *Romulea linaresii* ssp. *graeca*, *Ornithogalum* spp., *Crocus chrysanthus*, reaching significant cover at some of the plots. The late spring aspect is rich in therophytes like many annual clovers. From mid-June, the aspect is dominated by grasses like *Chrysopogon gryllus*, *Dichanthium ischaemum* and some yellow flowering composites like *Crepis setosa*, *Hypochaeris glabra*, etc. The slopes with lower inclination are most prominent. Characteristic species are *Euphorbia seguieriana*, *Oenanthe pimpinelloides*, *Trifolium tenuifolium*. Other constant species are *Poa bulbosa*, *Chrysopogon gryllus*, *Anthoxanthum odoratum*, *Aira elegantissima*, *Carlina vulgaris*,

Crepis setosa, *Ranunculus millefoliatus*, *Tuberaria guttata* (see Table 2). The endemics are not as well presented as in the other two habitat sub-types. Balkan endemics are *Armeria rumelica*, *Chamaecytisus jankae*, *Daucus guttatus* ssp. *zahariadii*, *Dianthus corymbosus*, *Anthemis virescens*, *Romulea linaresii* ssp. *graeca*. The last two taxa are also included in the Red List of Bulgarian vascular plants (Petrova & Vladimirov 2009) and Annex 3 of the Bulgarian Biodiversity Act as respectively Endangered (EN) and Vulnerable (VU).

C) Amongst the three habitat sub-types, The Rilo-Rhodopean habitat sub-type covers the largest territories (Figure 7). They are found in the Mesta River valley and with more limited distribution in the Central Rhodope Mts. The bedrock varies but mostly there are rhyolites, volcanic schists, gneisses, sandstones, conglomerates. The soil types are represented by Umbric Leptosols and Dystric Cambisols. The altitudinal range is between 600 and 1500 m alt. The slopes are mostly facing south with an average inclination of 15%, which is the highest among the habitat sub-types. The floristic elements with Mediterranean origin are the most widespread and the geoelements of European and Boreal origins are more prominent than those in the previously described community sub-types (see Figure 4). This could be explained with the higher altitudes and the influence of the montane climate. Species with high constancy are *Thymus longicaulis*, *Achillea coarctata*, *Agrostis capillaris*,



Figure 7: The Rilo-Rhodopean habitat sub-type, vicinities of Dobrinishte town, West Rhodopes Mts.

Slika 7: Rilo-rodopski habitatni podtip iz okolice mesta Dobrinishte, gorovje Zahodni Rodopi.

Dianthus pinifolius ssp. *pinifolius*, *Scabiosa triniifolia*, *Sedum grisebachii*, *Hypericum rumeliacum*. Other common species are *Festuca valesiaca*, *Trifolium campestre*, *Bromus squarrosus*, *Koeleria macrantha*, *Plantago subulata*, *Hieracium hoppeanum*, *Potentilla neglecta*, *Phleum montanum*, *Minuartia hirsuta* ssp. *falcata* (see Table 2). The floristic composition of the Rilo-Rhodopean communities is the richest in Balkan endemic species comparing with the other identified habitat sub-types. Typical endemic and sub-endemic species are *Digitalis viridiflora*, *Viola aetolica*, *Chamaecytisus absinthioides*, *Verbascum humile*, *Dianthus moesiacus* ssp. *moesiacus*, *Cerastium petricola*, *Trifolium trichopterum*, *Silene velenovskiyana*, *S. frivaldszkijana*, *Asyneuma anthericoides*, *Sempervivum erythraeum*, *S. leucanthum*, *Campanula sparsa*, *C. scutellata*, *Anthemis macedonica*, etc. According to Petrova & Vladimirov (2009), two taxa – *Sedum stefco* and *Orchis papilionacea* are evaluated as Vulnerable (VU) and are protected under Annex 3 of the Bulgarian Biodiversity Act.

Area of coverage and sort of impact

The total area of 5.2 km² covered by the studied habitat type was mapped during the field work. AOO is 26 (2600 km²) (Figure 2), EOO is about 9670 km². The estimated coverage is far below the established values in the European Red List of Habitats (Janssen et al. 2016).

The areas occupied by the habitat are close to the settlements. They are under continuous human impact related to the traditional practices of extensive livestock farming. Most of these territories are primarily used as pastures where the overgrazing, over-trampling, deforestation and the erosion seem to favor the expansion of these plant communities. There was not observed the direct effect of grazing on the dominants in the examined plots. However, the spread and sowing of *Genista* seeds is probably assisted by livestock movement and trampling. The established effects of recent fires were assessed as a positive for the expansion of *Genista* populations in two of the localities, due to the elimination of the strong competition of grasses and forbs as well as the slow-growing shrubs. According to our experience, the main factor leading to decline of the habitat's area is abandonment of grazing. The communities are more closed and homogeneous covering larger areas in the places with active grazing, while in the areas with occasional or without grazing, they have lower density and are represented by small stands with a mosaic distribution. In habitat's sites, overgrown by perennial grasses, thorny shrubs or low trees, many individuals from the dominant complex were found morbid and significantly infected by *Cuscuta* spp. Therefore it could be conclude that *G. lydia* and *G. rumelica* are poor competitors and their communities are depending from the grazing or other types of disturbances. Although

some areas occupied by these communities are located on continuously abandoned agricultural lands used as pastures at the present, now these lands are ploughed again due to the subsidies for farming coming from the European Agricultural Policy.

Conservation measures

Some of the stands of the studied vegetation type are located in the protected sites of the Natura 2000 ecological network (“Mesta River”, “Rhodopes-Eastern”, “Rhodopes –Western”). They also could be part of the vegetation cover of protected areas designated according to the Bulgarian Protected Areas Act. Such territories are “Sinite Kamani” Nature Park, “Yumruk skala” Protected Area and “Pashovi Skali” Natural Monument. However, this vegetation type is not subject to special protection measures because it is not included in Annex I of the Habitats Directive and in the Bulgarian Biodiversity Act. Some proposed measures for its conservation are to be undertaken at national and European level. One of these measures should be their enlisting in Annex I of the Habitats Directive and Bulgarian Biodiversity Act. The designation of some most representative localities as protected areas is also necessary. This measure should be combined with regular monitoring and some kind of appropriate management, e.g. special grazing regime. It is in order to prevent the successional changes and decline of the habitat’s areas.

The preferences of the dominant species to limestone substrates is not confirmed during this study. This should be reflected in the further revisions/editions of the “Red Data Book of Bulgaria, vol. 3 Natural habitats” and also of the European Red List of Habitats and EUNIS habitat classification. The establishment of habitat sub-types should also be indicated in the above-mentioned sources. We propose the following subdivision of the habitat S3-4. “Balkan-Anatolian submontane genistoid scrub:

- S3-41. Balkan-Range submontane genistoid scrub
- S3-42. Thracian submontane genistoid scrub
- S3-43. Rilo-Rhodopean submontane genistoid scrub

Despite its limited area of occurrence it should be pointed that the habitat has a natural ability to expand its distribution to some secondary eroded terrains. The copious seed production and the fast growth of the dominant *Genista* species are the reasons for their rapid spread and overgrowth on many disturbed and pioneer sites like mining deposits, sand alluviums, abandoned crop fields, roadsides, etc. The preference of the dominant species to unstable substrates with a high level of

erosion make these communities suitable for planting as anti-erosion vegetation, especially in the area of the eastern Mediterranean region.

Conclusion

The present study is the first one focused on the vegetation dominated by the species complex of *G. lydia*/*G. rumelica* in Bulgaria at the habitat level. It has confirmed some inference, done by previous authors and also contributes to the data on the diversity of floristic composition, ecological features and distribution on the national level of this vegetation type. The collected data emphasizes the typical Sub-Mediterranean origin and distribution of studied communities which are proven by the high occurrence of species with such origin (31.4%) and also the significant number of therophytes, geophytes and chamaephytes (48.2% in total). The various altitudinal range of occurrence, the transitional climatic influences and the differences of the management of these areas are among the main reasons for their great floristic diversity – about 500 species participate in their floristic composition. The habitat has a large number of endemic species (33 Balkan endemics and the same number of Balkan subendemics), some of them also protected. It is together with the less territories occupied by these communities compared to the data from the European Red List, which emphasizes their conservation significance and level of vulnerability. The major threat to this habitat is the abandonment of traditional practices in the pastureland management and the changes in the land use. Such are also the transformation of pasturelands into crop fields or artificial forest plantations. After the abandonment of grazing, some rapid successional changes lead to the complete replacement of these heatlands by grassland and tall scrubland or even tree communities. Therefore some measures and specific maintenance should be applied in order to prevent habitat’s decline.

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Appendix

Checklist of the species from the floristic composition of the habitat F3.1d Balkan-Anatolian submontane genistoid scrub from Bulgaria (Note: The abbreviations in bold are explained under Figure 4 and 5).

Equisetopsida

Equisetaceae: *Equisetum ramosissimum* Desf. **Bor,Cr,RRh**

Polypodiopsida

Aspleniaceae: *Asplenium adiantum-nigrum* L.

Bor,H,RRh, Hypolepidaceae: *Pteridium aquilinum* (L.) Kuhn **Kos,H,ERh,RRh**

Pinopsida

Cupressaceae: *Juniperus communis* L. **Bor,Ph,O, Juniperus deltooides** R.P. Adams **Msm,Ph,ERh,RRh**

Pinaceae: *Picea abies* (L.) Karst. **Bor,Ph,RRh, Pinus nigra** Arnold ssp. *pallasiana* (Lamb.) Holmboe **Msm,Ph,ERh,RRh, Pinus sylvestris L. **Bor,Ph,RRh****

Magnoliopsida

Aceraceae: *Acer tataricum* L. **Msm,Ph,RRh, Anacardiaceae:** *Pistacia terebinthus* L. **Psp,Ph,RRh**

Apiaceae: *Anthriscus sylvestris* (L.) Hoffm. **Eur,H,RRh, Daucus carota L. **Pal,Th,ERh,RRh, Daucus guttatus** Sm. ssp. *zahariadii* Heywood **BE,Th,ERh,RRh, Ferulago campestris** (Besser) Grecescu **Eur, H,RRh, Ferulago sylvatica** (Besser) Rchb. **Msm,H,O, Oenanthe pimpinelloides L. **Eur,H,ERh, Orlaya daucooides** (L.) Greuter **Msm,Th,ERh,RRh, Orlaya grandiflora** (L.) Hoffm. **BSe,Th,O, Peucedanum arenarium** Waldst. & Kit. ssp. *neumayeri* (Vis.) Stoj. & Stef. **BSe,H,RRh, Pimpinella saxifraga L. **Pal, H,RRh, Scandix pecten-veneris** L. ssp. *macrorhyncha* (C.A.Mey.) Rouy & E.G.Camus **Msm,Th,Chz, Seseli pallasii** Besser **Eur,H,RRh, Seseli rigidum** Waldst. & Kit. ssp. *rigidum* **Msm,H,Chz,RRh,********

Tordylium maximum L. **Msm,Th,ERh, Torilis leptophylla (L.) Rchb. f. **Psp,Th,ERh****

Asclepiadaceae: *Cionura erecta* (L.) Griseb. **Msm,Ph, ERh, Vincetoxicum hirundinaria Medik. ssp. *hirundinaria* **Pal,H,Chz****

Asteraceae: *Achillea coarctata* Poir. **BSe,H,O, Achillea crithmifolia Waldst. & Kit. **BSe,H,O, Achillea millefolium L. **Pal,H,O, Achillea pannonica** Scheele **Eur,H,Chz,RRh, Anthemis auriculata** Boiss. **BSe, Th,ERh, Anthemis cotula L. **Pal,Th,RRh, Anthemis cretica L. **Msm,H,Chz, Anthemis macedonica** Boiss. & Orph. ssp. *macedonica* **BE,Th,RRh, Anthemis macedonica** Boiss. & Orph. ssp. *orbelica* (Pančić) Oberpr. **BE,Th,RRh, Anthemis ruthenica M. Bieb. **Pal,Th,RRh, Anthemis tenuiloba** (DC.) R. Fern. **BSe,H,RRh, Anthemis tinctoria L. **Pal,H,O, Anthemis virescens** Velen. **BE,Th,ERh, Artemisia vulgaris L. **Bor,H,RRh, Bellis perennis L. **Pal,H,ERh, Carduus candicans** Waldst. & Kit. ssp. *globifer* (Velen.) Kazmi **BSe,H,RRh, Carlina acanthifolia All. **Eur,H,RRh, Carlina vulgaris L. **Eur,Th,ERh, RRh, Carthamus lanatus L. **Msm,Th,ERh, Centaurea cuneifolia** Sm. **BE,H,ERh,RRh, Centaurea diffusa** Lam. **Psp,Th,Chz, Centaurea rhenana** Boreau ssp. *rhenana* **Msm,H,Chz,RRh, Centaurea salonitana** Vis. ssp. *salonitana* **Psp,H,RRh, Chondrilla juncea L. **Pal,H,ERh, Cichorium inthybus L. **Pal,H,O, Cirsium ligulare** Boiss. **Msm,H,RRh, Cirsium vulgare** (Savi) Ten. **Eur,H,RRh, Cnicus benedictus L. **Msm,Th,ERh, Crepis sancta (L.) Babc. **Msm,Th,ERh,RRh, Crepis setosa** Haller f. **Eur,Th,ERh,RRh, Crepis zacintha (L.) Babcock **Msm,Th,ERh, Crupina vulgaris** Cass. **Msm,Th,O, Doronicum hungaricum** Rchb. **Psp,H,ERh,RRh, Echinops sphaerocephalus L. ssp. *albidus* (Boiss. & Spruner) Kožuharov **BSe,H,RRh, Erigeron acer L. **Bor,Th,RRh, Erigeron annuus (L.) Pers. **Bor,Th, RRh, Eryngium campestre** L. **Psp,H,O, Filago vulgaris Lam. **Pal,Th,O, Hieracium baubini** Besser **Pal,H,O, Hieracium cymosum L. **Pal,H,RRh, Hieracium hoppeanum** Schult. **Eur,H,O, Hieracium piloselloides** Vill. ssp. *piloselloides***

- Msm,H,RRh**, *Hypochaeris glabra* L. **Eur,H,ERh,RRh**, *Hypochaeris radicata* L. **Eur,H,ERh,RRh**, *Inula hirta* L. **Pal,H,Chz**, *Inula oculus-christi* L. **Eur,H,Chz,RRh**, *Leontodon cichoraceus* (Ten.) Sanguin. **Msm,H,ERh**, *Leontodon crispus* Vill. **Psp,H,O**, *Leucanthemum vulgare* Lam. **Pal,H,RRh**, *Logfia arvensis* (L.) Holub **Eur,Th,O**, *Scorzonera hispanica* L. **Msm,H,RRh**, *Scorzonera laciniata* L. **Msm,H,ERh**, *Scorzonera mollis* M. Bieb. **Msm,H,RRh**, *Senecio vernalis* Waldst. & Kit. **Eur,Th,ERh,RRh**, *Senecio vulgaris* L. **Pal,Th,ERh,RRh**, *Taraxacum officinale* L. **Msm,Th,ERh,RRh**, *Tragopogon dubius* Scop. **Eur,Th,ERh,RRh**, *Tussilago farfara* L. **Pal,H,RRh**, *Xeranthemum annuum* L. **Msm,Th,O**
- Berberidaceae:** *Berberis vulgaris* L. **Eur,Ph,ERh**
- Boraginaceae:** *Anchusa officinalis* L. **Psp,H,RRh**, *Buglossoides arvensis* (L.) I. M. Johnst. **Pal,Th,O**, *Cynoglossum officinale* L. **Psp,H,ERh**, *Echium vulgare* L. **Pal,H,ERh,RRh**, *Myosotis arvensis* (L.) Hill **Pal,Th,ERh**, *Myosotis incassata* Guss. **Msm,Th,RRh**, *Myosotis ramosissima* Rochel **Msm,Th,ERh,RRh**, *Myosotis stricta* Link ex Roem. & Schult. **Pal,Th,ERh,RRh**, *Onosma heterophylla* Griseb. **Msm,H,RRh**
- Brassicaceae:** *Alyssum alyssoides* (L.) L. **Msm,Th,Chz,RRh**, *Alyssum minutum* Schltld. ex DC. **Msm,Th,ERh,RRh**, *Alyssum murale* Waldst. & Kit. **Msm,H,Chz,RRh**, *Arabis thaliana* (L.) Heynh. **Bor,Th,ERh,RRh**, *Aurinaria saxatilis* (L.) Desv. **Eur,H,Chz**, *Berteroa obliqua* (Sm.) DC. **Msm,H,ERh**, *Calepina irregularis* (Asso) Thell. **Msm,Th,ERh**, *Capsella bursa-pastoris* (L.) Medicus **Kos,Th,ERh**, *Capsella rubella* Reut. **Msm,Th,ERh**, *Cardamine hirsuta* L. **Pal,Th,ERh,RRh**, *Draba muralis* L. **Eur,Th,RRh**, *Erophila verna* (L.) Chevall. ssp. *verna* **Pal,Th,ERh,RRh**, *Erysimum diffusum* Ehrh. **Eur,Th,ERh**, *Rorippa thracica* (Griseb.) Fritsch **Msm,H,O**, *Teesdalia coronopifolia* (J. P. Bergeret) Thell. **Msm,Th,ERh,RRh**, *Thlaspi perfoliatum* L. **Eur,Th,ERh,RRh**
- Campanulaceae:** *Asyneuma anthericoides* (Janka) Bornm. **BE,H,RRh**, *Asyneuma limonifolium* (L.) Janch. **BSe,H,ERh**, *Campanula cervicaria* L. **Psp,H,RRh**, *Campanula jordanovii* Ančev & Kovanda **BE,H,Chz**, *Campanula lingulata* Waldst. & Kit. **BSe,H,RRh**, *Campanula phrygia* Jaub. & Spach **Msm,Th,ERh**, *Campanula rapuncululus* L. **Pal,H,ERh,RRh**, *Campanula scutellata* Griseb. **BE,Th,RRh**, *Campanula sparsa* Friv. **BE,Th,RRh**, *Jasione heldreichii* Boiss. & Orph. **Eur,H,ERh,RRh**
- Caryophyllaceae:** *Arenaria serpulifolia* L. **Pal,Th,O**, *Cerastium glomeratum* Thuill. **Kos,Th,ERh**, *Cerastium petricola* Pančić **BE,Th,RRh**, *Cerastium pumilum* Curtis **Eur,Th,O**, *Cerastium semidecandrum* L. **Eur,Th,ERh,RRh**, *Dianthus corymbosus* Sibth. & Sm. **BE,H,ERh,RRh**, *Dianthus deltoides* L. **Eur,H,RRh**, *Dianthus giganteus* d'Urv. ssp. *giganteus* **Msm,H,Chz,RRh**, *Dianthus moesiacus* Vis. & Pančić ssp. *moesiacus* **BE,H,RRh**, *Dianthus pallens* Sm. **BSe,H,RRh**, *Dianthus petraeus* Waldst. & Kit. **BSe,H,Chz**, *Dianthus pinifolius* Sm. ssp. *pinifolius* **BSe,H,O**, *Gypsophila muralis* L. **Pal,Th,ERh**, *Herniaria hirsuta* L. **Pal,Th,ERh**, *Holosteum umbellatum* L. **Pal,Th,ERh,RRh**, *Lychnis coronaria* (L.) Desr. **Msm,H,RRh**, *Minuartia hirsuta* (M. Bieb.) Hand.-Mazz. ssp. *falcata* (Griseb.) Mattif **Msm,H,Chz,RRh**, *Minuartia viscosa* (Schreb.) Schinz & Thell. **Eur,Th,RRh**, *Moenchia erecta* (L.) Gaertn., B. Meyer & Scherb. **Msm,Th,ERh**, *Moenchia mantica* (L.) Bartl. **Eur,Th,ERh,RRh**, *Petrorhagia illyrica* (Ard.) P. W. Ball & Heywood **Psp,H,RRh**, *Petrorhagia prolifera* (L.) P. W. Ball & Heywood **Psp,Th,O**, *Scleranthus dichotomus* Schur **Msm,H,Chz,ERh**, *Scleranthus perennis* L. **Eur,H,O**, *Scleranthus verticillatus* Tausch **Msm,Th,ERh**, *Silene armeria* L. **Eur,Th,RRh**, *Silene bupleuroides* Chater & Walters **Psp,H,RRh**, *Silene compacta* Fisch. **Msm,Th,ERh**, *Silene conica* L. ssp. *conica* **Msm,Th,ERh,RRh**, *Silene dichotoma* Ehrh. **Eur,Th,ERh**, *Silene flavescens* Waldst. & Kit. **BSe,H,ERh**, *Silene frivaldszkyana* Hampe **BE,H,RRh**, *Silene gallica* L. **Kos,Th,ERh**, *Silene gallinyi* Rchb. **Msm,Th,ERh**, *Silene larchenfeldiana* Baumg. **BSe,H,Chz,RRh**, *Silene oites* (L.) Wibel **Eur,H,ERh,RRh**, *Silene velenovskiyana* Jordanov & Panov **BE,H,RRh**, *Silene vulgaris* (Moench) Garcke **Pal,Th,RRh**, *Spergula pentandra* L. **Msm,Th,ERh,RRh**, *Stellaria graminea* L. **Pal,H,RRh**, *Stellaria media* (L.) Vill. **Kos,Th,RRh**, *Viscaria vulgaris* Röhl. ssp. *atropurpurea* (Griseb.) Stoj **Pal,H,Chz**
- Chenopodiaceae:** *Polycnemum arvense* L. **Pal,Th,RRh**
- Cistaceae:** *Cistus incanus* L. **Msm,Ph,ERh**, *Helianthemum nummularium* (L.) Mill. **Msm,H,Chz,RRh**, *Tuberaria guttata* (L.) Fourr. **Msm,Th,ERh**
- Convolvulaceae:** *Convolvulus arvensis* L. **Kos,H,ERh,RRh**, *Convolvulus cantabrica* L. **Psp,H,Chz,ERh,RRh**
- Corylaceae:** *Carpinus betulus* L. **Eur,Ph,Chz**, *Carpinus orientalis* Mill. **Msm,Ph,Chz,ERh**, *Corylus avellana* L. **Eur,Ph,RRh**
- Crassulaceae:** *Jovibarba heuffelii* (Schott) A. & D. Löve **BSe,H,RRh**, *Sedum acre* L. **Eur,H,ERh,RRh**, *Sedum album* L. **Msm,H,RRh**, *Sedum annuum* L. **Pal,Th,RRh**, *Sedum caespitosum* (Cav.) DC. **Msm,Th,RRh**, *Sedum grisebachii* Boiss. & Heldr. **BE,H,RRh**, *Sedum hispanicum* L. **Eur,Th,Chz,RRh**, *Sedum maximum* (L.) Suter **Bor,H,RRh**, *Sedum ochroleucum* Chaix **Msm,H,Chz,RRh**, *Sedum rubens* L. **Eur,Th,ERh,RRh**, *Sedum stefco* Stef. **BE,H,RRh**, *Sedum urvillei* DC. **Eur,H,Chz,RRh**, *Sempervivum leucanthum* Pančić **BE,H,RRh**, *Sempervivum erythraeum* Velen. **BE,H,Chz,RRh**, *Sempervivum marmoreum* Griseb. **Msm,H,Chz**
- Cuscutaceae:** *Cuscuta approximata* Bab. **Hol,Th,ERh,RRh**, *Cuscuta campestris* Yunck. **Adv,Th,O**
- Dipsacaceae:** *Knautia arvensis* (L.) Coult. **Pal,H,RRh**

- Scabiosa argentea* L., **BSe,H,ERh,RRh**, *Scabiosa columbaria* L. **Eur,H,RRh**, *Scabiosa triniifolia* Friv. **BE,H,O**
- Euphorbiaceae:** *Euphorbia cyparissias* L. **Eur,H,O**, *Euphorbia helioscopia* L. **Pal,Th,ERh**, *Euphorbia myrsinites* L. **Msm,H,O**, *Euphorbia niciciana* Borbás ex Novák **Msm,H,RRh**, *Euphorbia seguieriana* Neck. **Pal,H,ERh**, *Euphorbia taurinensis* All. **Msm,Th,ERh,RRh**
- Fabaceae:** *Astragalus depressus* L. **Msm,H,RRh**, *Astragalus onobrychis* L. **Pal,H,RRh**, *Chamaecytisus absinthioides* (Janka) Kuzmanov **BE,Ph,RRh**, *Chamaecytisus albus* (Hack.) Rothm. **Eur,Ph,ERh**, *Chamaecytisus austriacus* (L.) Link **Eur,Ph,RRh**, *Chamaecytisus calcareus* (Velen.) Kuzmanov **BE,Ch,Chz,RRh**, *Chamaecytisus jankae* (Velen.) Rothm. **BE,Ch,ERh**, *Chamaespartium sagittale* (L.) Gibbs **Eur,Ch,RRh**, *Coronilla varia* L. **Eur,H,RRh**, *Dorycnium herbaceum* Vill. **Eur,H,RRh**, *Genista carinalis* Griseb. **BSe,Ch,ERh,RRh**, *Genista lydia* agg. **BSe,Ch,O**, *Lathyrus pratensis* L. **Bor,H,RRh**, *Lathyrus sativus* L. **Msm,Th,RRh**, *Lathyrus sphaericus* Retz., **Pal,Th,Chz,RRh**, *Lembotropis nigricans* (L.) Griseb. **Eur,Ch,Chz**, *Lotus angustissimus* L. **Msm,Th,Chz,ERh**, *Lotus corniculatus* L. **Pal,H,ERh,RRh**, *Medicago lupulina* L. **Pal,Th,ERh,RRh**, *Medicago minima* (L.) Bartal. **Pal,Th,O**, *Medicago rigidula* (L.) All. **Eur,Th,O**, *Melilotus neapolitana* Ten. **Msm,Th,ERh**, *Melilotus officinalis* (L.) Pall. **Msm,Th,Chz**, *Onobrychis caput-gali* (L.) Lam. **Msm,Th,ERh**, *Onobrychis gracilis* Besser **Psp,H,ERh,RRh**, *Ononis arvensis* L. **Pal,Ch,ERh,RRh**, *Ornithopus compressus* L. **Msm,Th,ERh**, *Trifolium alpestre* L. ssp. *alpestre* **Pal,H,Chz,RRh**, *Trifolium angustifolium* L. **Msm,Th,O**, *Trifolium arvense* L. **Pal,Th,O**, *Trifolium aureum* Pollich. **Pal,Th,RRh**, *Trifolium campestre* Schreb **Eur,Th,O**, *Trifolium cherleri* L. **Msm,Th,ERh,RRh**, *Trifolium dubium* Sibth. **Eur,Th,O**, *Trifolium glomeratum* L. **Msm,Th,ERh**, *Trifolium hirtum* All. **Msm,Th,O**, *Trifolium hybridum* L. ssp. *elegans* (Savi) Asch. & Graebn. **Eur,H,ERh,RRh**, *Trifolium incarnatum* L. ssp. *molinerii* (Hornem.) Syme **Msm,Th,ERh**, *Trifolium medium* L. ssp. *balkanicum* Velen. **BE,H,RRh**, *Trifolium nigrescens* Viv. **Psp,Th,ERh,RRh**, *Trifolium pallidum* Waldst. & Kit. **Msm,Th,ERh**, *Trifolium pannonicum* Jacq. **Msm,H,Chz,RRh**, *Trifolium purpureum* Loisel. **Msm,Th,ERh**, *Trifolium repens* L. **Pal,H,ERh,RRh**, *Trifolium scabrum* L. ssp. *scabrum* **Msm,Th,ERh**, *Trifolium setiferum* Boiss. **Msm,Th,ERh**, *Trifolium smyrnaeum* Boiss. **Msm,Th,RRh**, *Trifolium striatum* L. ssp. *striatum* **Eur,Th,ERh,RRh**, *Trifolium strictum* L. **Pal,Th,ERh,RRh**, *Trifolium subterraneum* L. **Msm,Th,ERh**, *Trifolium tenuifolium* Ten. **Msm,Th,ERh**, *Trifolium trichopterum* Pancic **BE,Th,RRh**, *Vicia angustifolia* Grufberg **Pal,Th,RRh**, *Vicia cordata* Wulfen **Msm,Th,ERh,RRh**, *Vicia cracca* L. **Pal,H,Chz,ERh**, *Vicia grandiflora* Scop. **Msm,Th,RRh**, *Vicia hirsuta* (L.) Gray **Eur,Th,ERh,RRh**, *Vicia incana* Gouan **Eur,H,RRh**, *Vicia lathyroides* L. **Eur,Th,ERh,RRh**, *Vicia lutea* L. **Msm,Th,RRh**, *Vicia onobrychioides* L. **Msm,H,RRh**, *Vicia sativa* L. **Eur,Th,ERh,RRh**, *Vicia tetrasperma* (L.) Schreb. **Eur,Th,RRh**, *Vicia varia* Host **Eur,Th,ERh,RRh**, *Vicia villosa* Roth **Pal,Th,ERh,RRh**
- Fagaceae:** *Quercus dalechampii* Ten. **Msm,Ph,Chz**, *Quercus frainetto* Ten. **Eur,Ph,ERh**, *Quercus pubescens* Willd. **Eur,Ph,O**
- Fumariaceae:** *Fumaria rostellata* Knaf **Eur,Th,Chz,RRh**
- Gentianaceae:** *Centaurium erythraea* Raf. ssp. *austriacum* (Ronninger ex Fritsch) Kozuharov & Petrova **Msm,Th,RRh**, *Gentiana cruciata* L. **Pal,H,RRh**
- Geraniaceae:** *Erodium ciconium* (L.) L'Hér. **Msm,Th,ERh**, *Erodium cicutarium* (L.) L'Hér. **Bor,Th,ERh,RRh**, *Geranium columbinum* L. **Msm,Th,O**, *Geranium dissectum* L. **Pal,Th,ERh**, *Geranium molle* L. **Eur,Th,ERh,RRh**, *Geranium purpureum* Vill. **Msm,Th,ERh**, *Geranium rotundifolium* L. **Pal,Th,O**, *Geranium sanguineum* L. **Eur,H,RRh**
- Hypericaceae:** *Hypericum cerastoides* (Spach) N. Robson **BSe,H,O**, *Hypericum montbretii* Spach **Msm,H,Chz,RRh**, *Hypericum olympicum* L. **Msm,H,O**, *Hypericum perforatum* L. **Kos,H,O**, *Hypericum rumelicum* Boiss. **BE,H,Chz,RRh**
- Lamiaceae:** *Acinos alpinus* (L.) Moench **BSeH,O**, *Acinos rotundifolius* Pers. **Msm,H,RRh**, *Acinos suaveolens* (Sm.) Don **Msm,H,Chz**, *Ajuga genevensis* L. **Psp,H,ERh,RRh**, *Clinopodium vulgare* L. **Bor,H,RRh**, *Lamium amplexicaule* L. **Pal,Th,ERh**, *Lamium garganicum* L. **Msm,H,Chz**, *Lamium purpureum* L. **Eur,Th,ERh,RRh**, *Lavandula angustifolia* Mill. **Adv,Ch,RRh**, *Mentha longifolia* (L.) Huds. **Pal,H,RRh**, *Nepeta nuda* L. ssp. *nuda* **Pal,H,RRh**, *Origanum vulgare* L. ssp. *vulgare* **Pal,H,RRh**, *Prunella laciniata* (L.) L. **Eur,H,O**, *Prunella vulgaris* L. **Kos,H,ERh,RRh**, *Salvia verticillata* L. **Msm,H,RRh**, *Satureja pilosa* Velen. **BE,Ch,ERh**, *Stachys angustifolia* M. Bieb. **Psp,H,O**, *Stachys germanica* L. ssp. *germanica* **Eur,H,ERh,RRh**, *Stachys recta* L. ssp. *recta* **Eur,H,Chz,RRh**, *Teucrium chamaedrys* L. **Msm,H,ERh,RRh**, *Teucrium polium* L. **Psp,Ch,RRh**, *Thymus callieri* Borbás ex Velen. ssp. *urumovii* Velen. **BE,Ch,O**, *Thymus glabrescens* Willd. **Eur,Ch,ERh,RRh**, *Thymus longicaulis* C. Presl **Msm,Ch,O**, *Thymus sibthorpii* Benth. **BSe,Ch,ERh,RRh**
- Linaceae:** *Linum bienne* Mill. **Msm,Th,ERh,RRh**, *Linum catharticum* L. **Bor,Th,RRh**, *Linum trigynum* L. **Msm,Th,ERh,RRh**
- Oleaceae:** *Fraxinus ornus* L. **Msm,Ph,Chz,RRh**, *Jasminum fruticans* L. **Msm,Ch,Chz**, *Syringa vulgaris* L. **BSe,Ph,Chz,ERh**
- Papaveraceae:** *Papaver dubium* L. **Msm,Th,RRh**, *Papaver rhoeas* L. **Pal,Th,ERh**

Plantaginaceae: *Plantago bellardii* All. MSm,Th,ERh,
Plantago coronopus L. Eur,Th,ERh,RRh, *Plan-*
tago lanceolata L. Kos,H,ERh,RRh, *Plantago*
media L. Bor,H,ERh,RRh, *Plantago scabra* Moe-
nch Pal,Th,ERh,RRh, *Plantago subulata* L.
MSm,H,Chz,RRh

Plumbaginaceae: *Armeria rumelica* Boiss. BE,H,ERh,RRh

Polygalaceae: *Polygala major* Jacq. Pal,H,Chz,RRh

Polygonaceae: *Fallopia convolvulus* (L.) Á.Löve
Pal,Th,ERh, *Polygonum rurivagum* Jord. ex Boreau
Bor,Th,RRh, *Rumex acetosa* L. Bor,H,ERh,RRh, *Rumex*
acetosella L. Eur,H,O, *Rumex pulcher* L. Pal,H,ERh

Primulaceae: *Anagallis arvensis* L. Kos,Th,O, *Primula veris*
L. ssp. *canescens* (Opiz) Hayek ex Ludi Eur,H,RRh

Ranunculaceae: *Clematis vitalba* L. Eur,Ph,ERh,RRh,
Ficaria verna Huds. ssp. *calthifolia* (Rchb.) Arcang.
Eur,H,ERh,RRh, *Nigella arvensis* L. MSm,Th,ERh,RRh,
Ranunculus gracilis E. D. Clarke MSm,H,ERh, *Ranun-*
culus illyricus L. Eur,H,O, *Ranunculus millefoliatus* Vahl
MSm,H,ERh, *Ranunculus polyanthemus* L. Eur,H,RRh,
Ranunculus rumelicus Griseb. MSm,H,O

Rhamnaceae: *Paliurus spina-christi* Mill. Pal,Ph,O

Rosaceae: *Agrimonia eupatoria* L. Eur,H,ERh,RRh,
Amelanchier ovalis Medicus PSp,Ph,Chz, *Aphanes*
arvensis L. Eur,Th,ERh,RRh, *Cerasus avium* (L.)
Moench MSm,Ph,ERh,RRh, *Cerasus mahaleb*
(L.) Mill. Eur,Ph,Chz, *Crataegus monogyna* Jacq.
Bor,Ph,ERh,RRh, *Filipendula vulgaris* Moench
Eur,H,Chz,ERh, *Fragaria vesca* L. Bor,H,RRh, *Fragaria*
viridis Duchesne Pal,H,RRh, *Malus dasyphylla* Borkh.
PSp,Ph,ERh, *Potentilla argentea* L. PSp,H,ERh,RRh,
Potentilla detommasii Ten. MSm,H,RRh, *Potentilla*
inclinata Vill. Pal,H,Chz, *Potentilla laciniosa* Waldst. &
Kit. ex Nestl. MSm,H,RRh, *Potentilla neglecta* Baumg.
Bor,H,O, *Potentilla pedata* Willd. MSm,H,ERh,RRh,
Potentilla recta L. Pal,H,O, *Potentilla rupestris* L.
Bor,H,Chz, *Prunus cerasifera* Ehrh. ssp. *cerasifera*
Pal,Ph,ERh,RRh, *Prunus spinosa* L. PSp,Ph,ERh,RRh,
Pyrus pyraister Burgsd. MSm,Ph,ERh,RRh, *Rosa agrestis*
Savi MSm,Ph,ERh, *Rosa canina* L. MSm,Ph,Chz,RRh,
Rosa gallica L. Eur,Ph,ERh, RRh, *Rosa myriacanth-*
tha DC. ex Lam. & DC. MSm,Ph,RRh, *Rosa tur-*
cica Rouy MSm,Ph,ERh,RRh, *Rubus canescens*
DC. Eur,Ph,ERh,RRh, *Rubus thyranthus* Focke
Eur,Ph,Chz,ERh, *Sanguisorba minor* Scop. Bor,H,O

Rubiaceae: *Asperula purpurea* (L.) Ehrend.
MSm,H,ERh,RRh, *Asperula tenella* Heuff. ex De-
gen MSm,H,ERh,RRh, *Crucianella angustifolia* L.
MSm,Th,O, *Cruciata laevipes* Opiz Pal,H,RRh, *Cruciata*
pedemontana (Bellardi) Ehrend. Pal,Th,ERh,RRh,
Galium aparine L. Pal,Th,ERh,RRh, *Galium divaricatum*
Pourr. ex Lam. MSm,Th,ERh,RRh, *Galium flavescens*
Borbás BSe,H,Chz, *Galium lovcense* Urum. BSe,H,Chz,
Galium lucidum All. MSm,H,ERh,RRh, *Galium verum*

L. Pal,H, O, *Sherardia arvensis* L. MSm,Th,ERh,RRh

Santalaceae: *Thesium arvense* Horv. MSm,Th,ERh,RRh

Saxifragaceae: *Saxifraga graeca* Boiss. BSe,H,ERh,RRh

Scrophulariaceae: *Digitalis lanata* Ehrh. MSm,H,ERh,
Digitalis viridiflora Lindl. BE,H,RRh, *Euphrasia libur-*
nica Wettst. BSe,Th,ERh,RRh, *Euphrasia pectinata* Ten.
MSm,Th,O, *Euphrasia picta* Wimm. MSm,Th,ERh,
Linaria genistifolia (L.) Mill. ssp. *genistifolia* PSp,H,O,
Linaria pelisseriana (L.) Mill. MSm,Th,ERh,RRh,
Linaria simplex (Willd.) DC. MSm,Th,ERh, *Odontites*
glutinosa (M. Bieb.) Benth. PSp,Th,RRh, *Odontites*
lutea (L.) Clairv. Eur,Th,RRh, *Odontites verna* (Bellardi)
Dumort. ssp. *serotina* (Dumort.) Corb. Eur,Th,RRh,
Parentucellia latifolia (L.) Caruel MSm,Th,ERh, RRh,
Rhinanthus rumelicus Velen. ssp. *rumelicus* BSe,Th,RRh,
Verbascum densiflorum Bertol. MSm, H,RRh, *Verbascum*
humile Janka BE,H,Chz,RRh, *Verbascum lychnitis*
L. BSe,H,ERh,RRh, *Verbascum speciosum* Schrad.
Eur,H,RRh, *Veronica acinifolia* L. MSm,Th,ERh,
Veronica arvensis L. Pal,Th,Chz,RRh, *Veronica jacquinii*
Baumg. ssp. *jacquinii* Eur,Ch,Chz, *Veronica chamae-*
drys L. Pal,H,RRh, *Veronica persica* Poir. Pal,Th,ERh,
Veronica praecox All. Eur,Th,ERh,RRh, *Veronica verna* L.
Pal,Th,O

Ulmaceae: *Ulmus minor* Mill. Eur,Ph,ERh,RRh

Valerianaceae: *Valerianella carinata* Loisel. Eur,Th,RRh,
Valerianella coronata (L.) DC. Eur,Th, ERh,RRh, *Vale-*
rianella dentata (L.) Poll. Eur,Th,ERh,RRh, *Valerianella*
turgida (Steven) Betcke MSm,Th,ERh,RRh

Violaceae: *Viola aetolica* Boiss. & Heldr. BE,H,RRh,
Viola arvensis Murr. Eur,Th,ERh,RRh, *Viola kitaibe-*
liana Schult. Eur,Th,Chz, *Viola tricolor* L. ssp. *tricolor*
Pal,Th,ERh,RRh

Liliopsida

Alliaceae: *Allium flavum* L. MSm,Cr,ERh,RRh, *Allium*
guttatum (Steven) Regel PSp,Cr,RRh, *Allium moschatum*
L. PSp,Cr,RRh, *Allium oleraceum* L. Eur,Cr,RRh, *Allium*
paczoskianum Tuzson Bse,Cr, RRh, *Allium rhodopaeum*
Velen. BE,Cr,RRh, *Allium rotundum* L. Pal,Cr,Chz,RRh

Asparagaceae: *Asparagus verticillatus* L. PSp,Cr,RRh

Cyperaceae: *Carex caryophyllea* Latourr. Bor,H,RRh, *Carex*
muricata L. Kos,H,ERh,RRh

Iridaceae: *Crocus chrysanthus* (Herbert) Herbert
BSe,Cr,ERh,RRh, *Iris reichenbachii* Heuff. BSe,Cr,Chz,

Romulea linaresii Parl. ssp. *graeca* Bég. MSm,Cr,ERh

Juncaceae: *Juncus bufonius* L. Bor,Th,Chz, *Luzula*
campestris ssp. *campestris* (L.) Lam. & DC. Bor,

H,ERh,RRh, *Luzula forsteri* (Sm.) DC. Bor,H,ERh

Liliaceae: *Colchicum autumnale* L. Eur,Cr,RRh, *Gagea*
pratensis (Pers.) Dumort. Eur,Cr,RRh, *Muscari como-*
sum (L.) Mill. MSm,Cr,ERh,RRh, *Muscari neglectum*
Guss. ex Ten. MSm,Cr,ERh, *Muscari tenuiflorum* Tausch
PSp,Cr,O, *Ornithogalum comosum* L. MSm,Cr,ERh,

- Ornithogalum kochii* Parl. **Eur,Cr,O**, *Ornithogalum sibthorpii* Greuter **BSe,Cr,ERh**, *Ornithogalum sphaerocarpum* A. Kern. **Msm,Cr,ERh,RRh**, *Tulipa australis* Link **Msm,Cr,Chz**
- Orchidaceae:** *Orchis morio* L. **Eur,Cr,ERh**, *Orchis papilionacea* L. **Msm,Cr,RRh**, *Orchis purpurea* Huds. **Msm,Cr,ERh**
- Poaceae:** *Aegilops geniculata* Roth **Msm,Th,ERh**, *Aegilops lorentii* Hochst. **Msm,Th,ERh**, *Aegilops neglecta* Req. ex Bertol. **Msm,Th,ERh**, *Aegilops triuncialis* L. **Pal,Th,O**, *Agrostis capillaris* L. **Bor,H,Chz,RRh**, *Agrostis castellana* Boiss. & Reut. ssp. *byzantina* (Boiss.) Hack. ex Kneuck. **Msm,H,ERh,RRh**, *Aira elegantissima* Schur **Msm,Th,ERh,RRh**, *Anthoxanthum odoratum* L. **Pal,H,O**, *Apera spica-venti* (L.) P. Beauv. **Bor,Th,ERh,RRh**, *Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl. **Pal,H,RRh**, *Avenula compressa* (Heuff.) Sauer & Chmel. **BSe,H,O**, *Bellardiachloa violacea* (Bellardi) Chiov. **Msm,H,Chz,RRh**, *Brachypodium sylvaticum* (Huds.) P. Beauv. **Pal,H,ERh,RRh**, *Briza media* L. **Eur,H,ERh,RRh**, *Bromus mollis* L. **Bor,Th,O**, *Bromus racemosus* L. **Eur,Th,ERh**, *Bromus secalinus* L. **Bor,Th,ERh**, *Bromus squarrosus* L. **Msm,Th,O**, *Bromus tectorum* L. **Bor,Th,ERh,RRh**, *Chrysopogon gryllus* (L.) Trin. **Psp,H,O**, *Cleistogenes serotina* (L.) Keng **Eur,H,Chz,RRh**, *Cynosurus cristatus* L. **Eur,H,O**, *Cynosurus echinatus* L. **Msm,Th,ERh,RRh**, *Dactylis glomerata* L. **Pal,H,O**, *Dasyphyrum villosum* (L.) Cand. **Msm,Th,O**, *Dichanthium ischaemum* (L.) Roberty **Pal,H,O**, *Elymus hispidus* (Opiz) Melderis ssp. *hispidus* **Psp,H,RRh**, *Festuca dalmatica* (Hack.) K. Richt. **Msm,H,Chz,RRh**, *Festuca rupicola* Heuff. **BSe,H,RRh**, *Festuca valesiaca* Schleich. ex Gaudin **Psp,H,ERh,RRh**, *Holcus lanatus* L. **Eur,H,ERh,RRh**, *Koeleria macrantha* (Ledeb.) Schult. **Eur,H,RRh**, *Koeleria nitidula* Velen. **Psp,H,Chz,ERh**, *Lerchenfeldia flexuosa* (L.) Schur ssp. *flexuosa* **Bor,H,Chz**, *Lolium perenne* L. **Pal,H,ERh,RRh**, *Lolium rigidum* Gaudin **Msm,Th,ERh**, *Melica ciliata* L. **Eur,H,ERh,RRh**, *Microphyrum tenellum* Link **Msm,Th,O**, *Milium vernale* M. Bieb. **Msm,Th,ERh**, *Molineriella minuta* (L.) Rouy **Msm,Th,ERh**, *Phleum montanum* C. Koch **Msm,H,Chz,RRh**, *Phleum phleoides* (L.) Karst. **Pal,H,ERh**, *Phleum subulatum* (Savi) Asch. & Graebn. ssp. *subulatum* **Pal,Th,ERh**, *Poa annua* L. **Kos,Th,ERh**, *Poa bulbosa* L. **Pal,Th,O**, *Poa compressa* L. **Eur,H,ERh,RRh**, *Poa trivialis* L. **Bor,H,ERh**, *Psilurus incurvus* (Gouan) Schinz & Thell. **Msm,Th,Chz,RRh**, *Sesleria latifolia* (Adamović) Degen **BE,H,Chz**, *Stipa pulcherrima* Koch **Psp,H,RRh**, *Taeniatherum caput-medusae* (L.) Nevski **Pal,Th,ERh,RRh**, *Ventenata dubia* (Leers) Coss. **Psp,Th,ERh,RRh**, *Vulpia ciliata* Dumort. **Msm,Th,ERh**, *Vulpia myurus* (L.) C. C. Gmel. **Bor,Th,O**