

Contribution to the knowledge of the flora and habitats of "Chernata Skala" Protected Site, Eastern Rhodope Mountains, Bulgaria

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Abstract. The "Chernata Skala" Protected Site, established in 2001 and covering 893.7 hectares, aims to conserve the habitats and populations of rare and protected plant and animal species. It is situated in the Eastern Rhodope Mountains in southeastern Bulgaria. According to the Bulgarian Act on Protected Areas, the category of "protected site" (PS) corresponds to IUCN Category IV and is characterised by a relatively low level of protection. This study aims to collect, analyse, and present data on vascular plant species and natural habitats within the PA. The vascular flora comprises 374 species belonging to 228 genera and 69 families. The richest families are Asteraceae (46 species, 12.3%), Poaceae (40, 10.7%), and Fabaceae (35, 9.4%). The ten richest families account for 60% of the total flora. Perennial herbaceous species dominate (48.4%), followed by annuals (32.5%), trees (6.7%), and shrubs (5.6%). Hemicryptophytes are the prevailing life-form group (35.6%). Analysis of floristic elements of the „Chernata Skala“ PS includes 40 groups and shows a predominance of sub-Mediterranean elements – 63 species (16.7%), followed by Euro-Mediterranean – 51 species (13.5 %) and Euro-Asian – 50 (13.3%). The largest group is that of elements containing a Mediterranean component – a total of 186 species (51.2%). A total of 27 species (7.2%) are of conservation concern, including 15 endemic taxa (14 Balkan and 1 Bulgarian). The flora also includes 128 medicinal plant species. Eight natural habitat types were identified, with forest (600 ha – 67.1%) and grassland (70 ha – 7.8%) habitats predominating. These results highlight the significant floristic and habitat diversity of the "Chernata Skala" Protected Site and its importance for the conservation of plant species and habitats in the Eastern Rhodopes.

Key words: Bulgarian flora, floristic diversity, habitats, vegetation, protected areas, plant conservation.

Introduction

National protected areas (PAs) are of 6 categories and cover only about 5% of Bulgaria's territory, but nevertheless, they preserve a significant part of the country's biodiversity. The percentage of coverage of the PAs in the Eastern Rhodopes is even smaller – about 2% (Trifonov et al., 2024a).

Research on the biodiversity of the PAs is crucial for their conservation. The data obtained is also essential for the work of the authorities managing the protected areas.

"Chernata Skala" was designated as a "protected site" (PS, a category of PA with a relatively low level of protection), declared by Order №RD-

473/11.07.2001 of the Minister of the Environment and Water (ExEA, 2025) with a total area of 893.7 ha. It was designated to protect the habitats and populations of protected and endangered plants and animals, including *Verbascum rupestre*, *V. roripifolium*, *Carduus thracicus*, *Fritillaria pontica*, *Anthemis cretica*, and several animal species (mainly birds of prey, vultures, etc.). It is situated in the Eastern Rhodope Mountains (Fig. 1). PA is located north of the Arda River, represented by steep (in

places sheer) volcanic rocks and rocky ridges with chasmophytic vegetation, while the flatter areas are partially covered by forest, shrub-land, and grassland vegetation.

The territory of the PA is partly included in the European ecological network NATURA 2000, especially in SAC BG0001032 Rodopi – Iztochni, according to the Habitats Directive, and SPAs BG0002071 Most Arda and BG0002014 Madzharovo, according to the Birds Directive (Fig. 2)

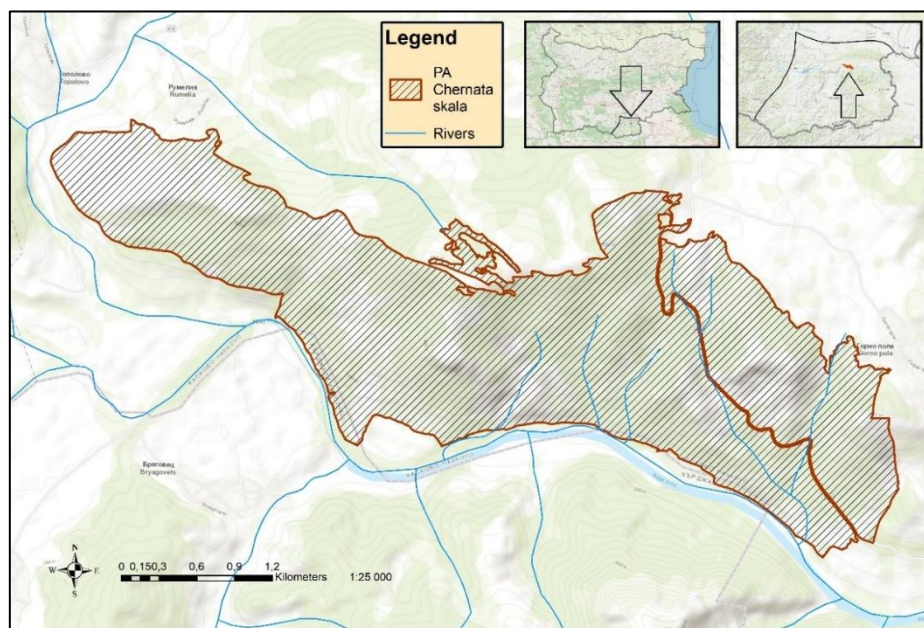


Fig. 1. General map of the “Chernata Skala” PS

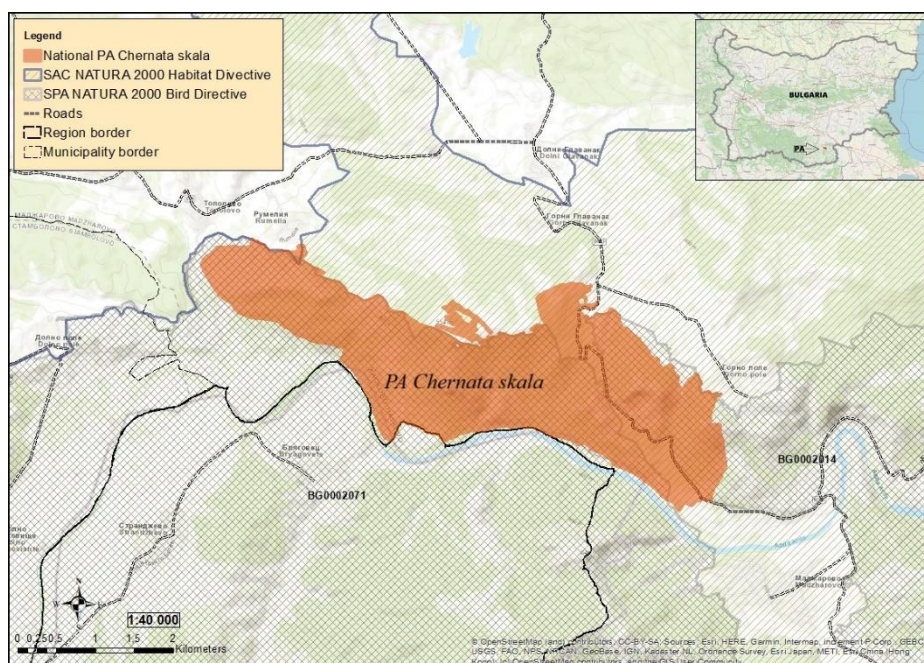


Fig. 2. Map of the “Chernata Skala” PS - overlapping with NATURA 2000 sites.

Anthropogenic impact on the PS has been strong in the past, mainly through low-intensity grazing, hunting, and mining activities. Before designation as a protected area, an asphalt road was built in the area, which currently passes through its territory.

So far, no specific surveys of the flora and vegetation of the “Chernata Skala” PS have been conducted. A general description of the vegetation cover and some of the rare plant species is given in the popular book “PAs in the Eastern Rhodopes” (Stoychev & Petrova, 2003).

Data about plant species with conservation importance, as well as, natural habitats, is presented in the unpublished report of the Rhodope Project, UNDP (Tsonev et al., 2007).

For the Eastern Rhodopes floristic region, data on newly recorded species of vascular plants, floristic information, plant species with conservation status, as well as information on protected areas are provided by Stoyanov et al. (1955), Stanev (1994), Pavlova et al. (1997, 2002), Gushev et al. (1998a, b), Petrova et al. (1998, 1999, 2004), Uzunov et al. (2000), Petrova (2004), Trifonov (2005), Petrova & Vladimirov (2009, 2010), Peev et al. (2012), Vladimirov (2014), Stoyanov & Marinov (2020), Doumas et al. (2022), and Trifonov et al. (2024a, b).

The diversity of vascular plants and natural habitats, especially in the PAs in the Eastern Rhodopes floristic region, has not been studied well enough, either. Without knowledge of species and habitat diversity in the PAs, their protection is less effective. To partly fill in this gap, we aim to: (1) study the species composition of the vascular flora, and (2) habitats included in Directive 92/43/EEC in the “Chernata Skala” PS.

A list of the vascular plants and habitats of the PA is provided, and analyses by life forms and biogeographical elements are presented.

Materials and methods

The “Chernata Skala” PS is located to the north of the Arda River in the Eastern Rhodope Mountains, on the territory of the municipality of Madzharovo, Haskovo district (Fig. 2). The altitude in the PA varies from 135 to 558 m a.s.l. The climate is classified as Continental-Mediterranean according to Velev (2002). The main bedrock is volcanic. Soils are shallow or absent on the rocks. Brown soils predominate in the forest habitats, and alluvial soils near the Arda River.

Numerous field surveys have been conducted in 2022–2024 to study the flora and habitats in the PA. The transect method was mainly used. Identification of the vascular plant species was done by “Key to the native and foreign vascular plants in Bulgaria” (Stoyanov et al., 2022) and Flora of Bulgaria (Jordanov, 1963–1979; Velčev, 1982–1989; Kožuharov, 1995; Peev, 2012).

Plant species of conservation significance were checked within Petrova (2006), Petrova & Vladimirov (2009, 2010), Peev et al. (2015), the Biological Diversity Act (2002), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, <https://www.cites.org/eng/>), Directive 92/43/EEC (1992), and the Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats (Bern Convention, 1979).

Endemic plant species and floristic elements are determined according to Assyov & Petrova (2012). Life forms are defined according to Raunkiaer (1934). The medicinal plants list follows the Bulgarian Medicinal Plants Act (2000). The total list of vascular flora in the PA is compared with the Bulgarian list, according to Petrova & Vladimirov (2018), e.g. 4064 species, 921 genera and 159 families.

Habitat types are determined according to the Directive 92/43/EEC (Kavrakova et al., 2009; European Union Habitats Interpretation Manual of European Union Habitats, 2023).

The habitat and vegetation survey followed the Braun-Blanquet approach (Braun-Blanquet, 1965). A total of 22 relevés were collected. They were contributed to the Balkan Vegetation Database (Vassilev et al., 2020) and Balkan Dry Grassland Database (Vassilev et al., 2012). All relevés were plotted in the homogenous areas of grassland communities and were subsequently assigned to relevant habitat types.

Mapping was done using the ArcGIS 10.0 software package (ESRI, 2011). Spatial data was collected in the field using a GPS device Juno BS by Trimble and was later laid over the most recent orthophoto images available. The habitat map was created with the help of the „Intersect” tool by combining the layers, containing forestry data from Forestry Management Plans, as well as data about agricultural areas and habitat data from habitat mapping of NATURA 2000 in Bulgaria. Later, the „Cut polygon” tool was used in order to modify polygon geometry. All the polygons were

outlined manually using all the field collected data as well as the orthophoto images. The habitat map was elaborated in scale of 1:5000.

Results and Discussion

Floristic diversity

The vascular flora of the “Chernata Skala” PS includes 374 species from 228 genera of 69 families (Annex 1). It comprises about 9% of the species diversity of the entire Bulgarian flora.

Polypodiophyta represents 1.6% of the families, 1.8% of the genera, and 4.4% of the species of the flora, Pinophyta – 0.3% of the families, 0.4% of the genera, and 4.4% of the species, and Magnoliophyta respectively – 98.1%, 97.8% and 94.2% (Table 1).

The 10 richest families are: Asteraceae – 48 species (12.8% of the flora), Poaceae – 39 (10.4%), Fabaceae – 36 (9.6%), Apiaceae – 21 (5.6%), Brassicaceae – 18 (4.8%), Lamiaceae – 17 (4.6%), Caryophyllaceae – 16 (4.3%), Rosaceae – 15 (4.0%), Asparagaceae – 10 (2.7%) and Rubiaceae – 9 (2.4%). In total, the species from these families are 229 and represent 61.2% of the species in the flora of the protected area.

The species-richest genera are: *Trifolium* (16), *Carex* (7), *Euphorbia* (5), *Bromus* (5), *Crepis* (5), *Geranium* (5), *Hypericum* (5), *Poa* (5), *Verbascum* (5), *Vicia* (5), *Viola* (5), *Acer* (4), *Galium* (4), and *Lathyrus* (4). They represent 21.4% of all species (Table 1).

The ecological analysis has shown that the flora of the investigated area is of the hemicryptophyta type (Table 2), similar to the flora of the Balkan Peninsula (Turill, 1929). The hemicryptophytes are represented by 35.8%, followed by therophytes 27.1%, geophytes 12.0%, phanerophytes 7.2%, etc. The ratio between hemicryptophytes to therophytes – 1.33 (35.83:27.01) – is similar to that in the flora of Besaparski Hills – 1.27 (41:32.2, Stanev, 1976), and less similar to that is the floras of the Sakar Mt. – 2.21 (49.1:22.2, Jordanoff, 1944), Mt. Golo Bardo – 3.23 (59:18, Apostolova-Stoyanova &

Stoyanov, 2009) and Beli Lom Reserve – 2.18 (53.41:24.52, Bancheva & Vassilev, 2006).

The high share of therophyte and geophyte groups is related to the stronger Mediterranean influence in „Chernata Skala“ PS, as well as to the widespread occurrence of eroded terrains and xerophytic habitats. In the continental part of the country, geophytes have a lower presence in the range between 5% and 8%. For example, geophytes are 6.3% in the flora of the Beli Lom Nature Reserve, Northeast Bulgaria (Bancheva & Vassilev, 2006) and 9% of Mt Golo Bardo (Apostolova-Stoyanova & Stoyanov, 2009). From an ecological point of view, geophytes are well adapted to seasonal droughts and develop rapidly under favourable conditions with underground storage organs (bulbs, tubers).

The biological spectrum of the species shows predominance of herbaceous perennial (48.1%) and annual (32.1%) plants (Table 3). Shrubs and trees are represented by 12.5%, which is related to the wide distribution of forests and shrubland phytocoenoses.

The floristic spectrum includes 40 floristic elements in the “Chernata Skala” PS (Table 4). Their analysis shows a predominance of sub-Mediterranean elements – 63 species (16.7%), followed by Euro-Mediterranean – 51 species (13.5%), Euro-Asian – 50 (13.3%) and Mediterranean – 40 species (10.6%). The other significant groups of elements in the top ten are: Cosmopolitan – 20 (5.3%), Euro-Siberian – 16 (4.2%), Balkano-Anatolian – 15 (4.0%), Boreal – 15 (4.0%), European – 14 (3.7%), and Balkan – 11 (3.0%), which together include 295 species and make up 78.3% of the flora of the protected area.

The largest group is that of elements containing a Mediterranean component – a total of 186 species – 51.2% of the species composition of the flora in the protected area. The Balkan component is represented by a total of 35 species, or almost 10% of the species composition.

Table 1. Taxonomic structure of the flora of “Chernata Skala” PS.

Taxon	№ of families	№ of genera	№ of species
Polypodiophyta	3	4	6
Pinophyta	1	1	1
Magnoliophyta	65	223	367
<i>Magnoliopsida</i>	51	176	294
<i>Liliopsida</i>	14	47	73
Total	69	228	374

Table 2. Life forms of the plant species in the “Chernata Skala” PS.

Nº	Life form (Raunkiaer)	Nº of taxa	Percentage %
1	Hemicryptophyte	133	35.56
2	Therophyte	103	27.54
3	Geophyte	41	10.96
4	Phanerophyte	29	7.75
5	Hemicryptophyte-Therophyte	27	7.22
6	Hemicryptophyte-Geophyte	21	5.61
7	Chamaephyte	9	2.41
8	Chamaephyte-Hemicryptophyte	7	1.87
9	Hydrophyte	2	0.53
10	Hemicryptophyte-Hydrophyte	1	0.27
11	Phanerophyte-Chamaephyte	1	0.27
	Total	374	100

Table 3. Biological spectrum of the flora in the “Chernata Skala” PS.

Biological type	Number of species	Percentage, %
Perennial	180	48.13
Annual	120	32.09
Tree	24	6.42
Shrub	23	6.15
Biennial	16	4.28
Annual-biennial	9	2.41
Annual-perennial	1	0.53
Total	374	100

Table 4. Floristic elements of the flora of “Chernata Skala” PS.

Nº	Floristic element Assyov & Petrova (2012)	Number of species	Percentage %
1	subMed	63	16.84
2	Eur-Med	51	13.64
3	Eur-As	50	13.37
4	Med	40	10.70
5	Kos	20	5.35
6	Eur-Sib	16	4.28
7	Bal-Anat	15	4.01
8	Boreal	15	4.01
9	Eur	14	3.74
10	Bal	11	2.94
	Other 30 geoelements	79	21.12
	Total	374	100

A total of 27 species with conservation status (7.2% of the species) have been identified in the area of the „Chernata Skala“ PS (Table 5). Of these, 14 species are legally protected under national legislation (Bulgarian Biodiversity Act). Six species are included in the Red Book of the Republic of Bulgaria, Volume 1, Plants and Fungi (Peev et al., 2015) and 19 species are included in the national Red List of Bulgarian vascular plants according to the

IUCN (Petrova & Vladimirov 2009), of which 4 are with category “Endangered” (EN), 10 are “Vulnerable” (VU), 2 are “Near Threatened” (NT), and 3 species are with category “Least Concern” (LC).

Fourteen species are Balkan endemics (3.7% of the flora), and one taxon is a Bulgarian endemic (0.3% of the flora) – *Anthemis macedonica* subsp. *stribnyi*. One species (*Himantoglossum calcaratum*) is included in the appendices of the Bern Con-

vention and in Annex II to Directive 92/43/EEC (Habitats Directive), and 2 other orchid species are included in CITES.

Totally 128 species (34.2%) are medicinal plants (included in the Bulgarian Medicinal Plants Act, 2000).

Table 5. Vascular plant species of conservation concern in the “Chernata Skala” PS.
(in bold – Legally protected; with “*” – included in *Habitat Directive*; with “!” – included in *Bern Convention*).

No	Taxon	Red Data Book	Bg Red List	CITES II	Balkan endemic	Bulgarian endemic
1	<i>Achillea clypeolata</i> Sm.				1	
2	<i>Anacamptis papilionacea</i> (L.) R. M. Bateman, Pridgeon & M. W. Chase		1	1		
3	<i>Anemone hortensis</i> L. subsp. pavonina (Lam.) Arcang.					
4	<i>Anthemis macedonica</i> subsp. stribrnyi (Velen.) Oberpr. & Greuter	1	1			1
5	<i>Campanula phrygia</i> Jaub. & Spach				1	
6	<i>Carduus thracicus</i> (Velen.) Hayek	1	1		1	
7	<i>Cheilanthes persica</i> (Bory) Mett. ex Kuhn		1			
8	<i>Cyanus pichleri</i> (Boiss.) Holub		1			
9	<i>Dianthus corymbosus</i> Sm.				1	
10	<i>Fritillaria pontica</i> Wahlenb.		1			
11	<i>Galanthus elwesii</i> Hook. f.		1			
12	<i>Genista rumelica</i> Velen.				1	
13	<i>Goniolimon incanum</i> (L.) Hepper		1			
14	* ! <i>Himantoglossum calcaratum</i> (Beck) Schltr. subsp. rumelicum (H. Baumann & R. Lorenz) Niketić & Djordjević	1	1	1		
15	<i>Hypericum rumeliacum</i> Boiss.		1		1	
16	<i>Moenchia graeca</i> Boiss. & Heldr.				1	
17	<i>Oenanthe millefolia</i> Janka		1		1	
18	<i>Salix xanthicola</i> K. I. Chr.	1	1		1	
19	<i>Satureja pilosa</i> Velen.				1	
20	<i>Scabiosa triniifolia</i> Friv.				1	
21	<i>Scandix australis</i> L.		1			
22	<i>Spiranthes spiralis</i> (L.) Chev.		1	1		
23	<i>Stefanoffia daucoides</i> (Boiss.) H. Wolff.		1			
24	<i>Trifolium globosum</i> L.	1	1			
25	<i>Verbascum humile</i> Janka		1		1	
26	<i>Verbascum roripifolium</i> (Halácsy) I. K. Ferguson		1		1	
27	<i>Verbascum rupestre</i> (Davidov) I. K. Ferguson	1	1		1	
	Total	6	19	3	14	1

Habitat diversity

Habitat diversity on the territory of “Chernata Skala” PS is presented by 8 habitat types (Fig. 3). Totally 752.8 ha is covered by habitats of Directive 92/43/EEC. Woodland vegetation dominates and covers 600 ha (67.1% from the cover of PA) and is represented by 2 habitats (codes 91AA, 91M0). Grasslands are represented by 2 habitat types (approximately 70 ha, 7.8%), followed by chasmophytic habitats (4 types, appr. 66 ha, 7.4%).

Wetland vegetation

3260 Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation (1.16 ha)

Abiotic characteristics: This habitat has a limited distribution along the Arda River floods covered by muddy-clay and gravel-sand deposits.

Vegetation structure: Species-poor phytocoenoses with dynamic species composition, which include species such as *Potamogeton crispus*, *Myrio-*

phyllum spicatum, *Mentha aquatica*, and *Typha latifolia*.

Threats: Pollution from urban areas, water reduction.

Grassland vegetation

6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) (4 ha)

Abiotic characteristics: This habitat has a limited distribution in PA. Terrains are flat or slightly inclined (up to 10°). Soils are shallow to moderately deep. The bedrock type is silicate. It is used as pasture.

Vegetation structure: Species-rich phytocoenoses with semi-closed to closed horizontal structure and total cover of vegetation 90–100%. The coverage of mosses and lichens is 5–8%. Plant communities are dominated by tussock-forming grasses, such as *Chrysopogon gryllus*, *Festuca dalmatica* and *Bothriochloa ischaemum*. Other frequent species are *Dorycnium herbaceum*, *Sanguisorba minor*, *Agrimonia eupatoria*, *Trifolium striatum*, *T. incarnatum*, *Dasypyrum villosum*, etc. In the species composition are also distributed some species typical for neighbouring habitats, such as *Poa bulbosa*, *Trifolium cherleri*, *T. hirtum*, *T. arvense*, *Vulpia myurus*, *V. ciliata*, etc., for habitat 6220 and *Sedum hispanicum*, *S. sartorianum*, *Dianthus pinifolius*, *Scleranthus perennis*, *Filago arvensis* for habitat 8220. This habitat includes communities of alliance *Festucion valesiacae*.

Threats: Invasion of shrubs and trees and natural succession of pastures and meadows to shrub and forest vegetation, abandonment of pastures and meadows, ruderalization, fires.

6220 * Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea* (66 ha)

Abiotic characteristics: The phytocoenoses of this habitat occur on the territory of the whole PA. Slopes are predominantly with a Southern and Eastern component. The terrains are even to slightly inclined (with a slope inclination of up to 10–15°). The soils are predominantly shallow, rarely medium-deep. The main bedrock is silicate. This vegetation type often occurs in places where soil substrate has accumulated between the chasmophytic vegetation of habitat 8230. Due to this, in a part of the mapped polygons mosaic is formed between the two habitat types. Erosion pro-

cesses occur in some of the polygons. They are used as pastures.

Vegetation structure: This vegetation has a semi-open horizontal structure with a total cover of 80–90%. Only in individual localities, the cover reaches 95–98%. They are characterised by a rich biodiversity. The species with a higher total cover and abundance are *Aegilops triuncialis*, *Medicago minima*, *Poa bulbosa*, *Bothriochloa ischaemum*, *Festuca dalmatica*, *Trachynia distachya*, and *Trifolium nigrescens*. The participation of forbs is significant, which is characteristic for the phytocoenoses in the habitat. Species of the *Trifolium* genus (*T. arvense*, *T. purpureum*, *T. cherleri*, *T. hirtum*, *T. nigrescens*, *T. dubium*, *T. angustifolium*, etc.) and *Medicago* genus (*M. rigidula*, *M. minima*) occur often. Some species of conservation importance, like *Spiranthes spiralis*, *Verbascum humile*, *V. roripifolium*, and *V. rupestre*, have also been recorded. In the mosaic polygons where 8230 co-occurs with 6220, other diagnostic species, like *Sedum album*, *Veronica verna*, *Scleranthus perennis*, *Rumex acetosella* are also found. This vegetation type is classified to the class *Tuberarietea guttatae* Rivas Goday et Rivas-Martinez 1963 *mut.* Vassilev et al. 2024, order *Tuberarietalia guttatae* Br.-Bl. in Br.-Bl. et al. 1940 *mut.* Vassilev et al. 2024 and alliance *Romuleion* Oberdorfer 1954.

Threats: Invasion of shrubs and trees and natural succession of pastures and meadows to shrub and forest vegetation, abandonment of pastures and meadows, ruderalization, fires.

Forest vegetation

91AA Eastern white oak woods * (455.4 ha)

Abiotic conditions: This is the most widespread habitat in the protected area. The phytocoenoses of this habitat are found on slopes with various exposures. The terrains are slightly inclined to steep (with an incline of up to 30–35°). The soils are predominantly shallow, rarely medium deep. They are stony, often with rock outcrops. The bedrock is silicate.

Vegetation structure: Due to the unfavourable abiotic conditions (xerothermic conditions, rocky terrains, shallow soils, erosion), the forests of the pubescent oak are characterised by a vertical structure with 3 layers (tree layer, shrub layer and herb layer) and a total cover of up to 85–95%. The dominant species in the tree layer is *Quercus pubescens* and it forms a middle-high tree layer. In

a part of the plots, *Carpinus orientalis* is a co-dominant species that forms a lower tree layer. The total cover of these layers is predominantly 60-70%. The shrub layer is formed by the understory of oriental hornbeam and pubescent oak, but other species like *Paliurus spina-christi*, *Crataegus mono-gyna*, *Rosa canina*, *Prunus spinosa*, *Ulmus minor*, *Cotinus coggygria*, *Euonymus verrucosus* are also found. The total cover varies between 15-65%. The herb layer has a total cover between 20-60% and it depends on the level of shading from the other two layers. The species with a higher cover are *Poa nemoralis*, *Melica uniflora*, *Galium aparine*, *Aremonia agrimonoides* and *Festuca heterophylla*. The mosses and lichens have a total cover of around 5-6%. In the sample plots where outcrops occur and the tree and shrub species are more sparsely distributed this cover reaches up to 10-15%.

Threats: Erosion, fires, cutting from the local people, climate change.

91M0 Pannonian-Balkan turkey oak – sessile oak forests (144.6 ha)

Abiotic conditions: The phytocoenoses of the habitat occur in the Central and Eastern parts of PA. It is found on slightly inclined terrains with a slope of up to 10-15°. The soils are predominantly medium-deep, rarely shallow. The main bedrock is silicate.

Vegetation structure: The phytocoenoses are characterised with a semi-open to closed horizontal structure. The total cover is up to 90-95%. Three layers occur in the vertical structure of the stands: tree, shrub and herb layers. The dominant species in the tree layer is *Quercus cerris* (with a cover of 50-60%), but other oak species occur too (*Quercus frainetto*, *Q. dalechampii*, *Q. pubescens*) and their cover in individual stands reaches 10-15%. *Carpinus orientalis*, *Acer campestre*, and *Tilia platyphyllos* are also found in the tree layer. The total cover of the tree layer is around 70-90%. The shrub layer is formed by the undergrowth of the tree species, but other species like *Crataegus monogyna*, *Prunus spinosa*, *Rosa canina*, *Euonymus verrucosus*, *Acer tataricum*, *Ligustrum vulgare*, *Carpinus orientalis*, *Corylus avellana*, *Cornus mas*, *Paliurus spina-christi*, etc., also occur. The density of this layer is defined by the level of shading from the tree layer. In the more open areas, the total cover of the shrubs reaches 50-60%, but is predominantly between 25-

45%. The herb layer has a cover of 20-60%. The characteristic species for this habitat are *Aremonia agrimonoides*, *Festuca heterophylla*, *Poa nemoralis*, *Dactylis glomerata*, *Helleborus odoratus*, *Tanacetum corymbosum*, *Campanula persicifolia*, *Silene italica*, *Physospermum cornubiense*, and *Galium pseudoaristatum*. They are also constant for the phytocoenoses of this habitat. Species with a higher abundance and cover (10-15%) are *Poa nemoralis*, *Festuca dalmatica*, *F. heterophylla* and *Aremonia agrimonoides*. This vegetation was classified to class *Quercetea pubescenti*, order *Quercetalia pubescenti-petreae* and alliance *Quercion confertae*. The association *Quercetum frainetto-cerridis* was the most common one or mixed communities of *Quercus frainetto*, *Q. cerris* and *Q. dalechampii*.

Threats: Erosion, fires, cutting from the local people, climate change.

Chasmophytic vegetation

8150 Medio-European upland siliceous screes (app. 3 ha)

Abiotic conditions: The habitat has a limited distribution and represents screes with Southern exposition. The soil substrate is missing, and the main bedrock is silicate. The habitat is represented by 2 individual polygons covering limited areas and 2 others where it forms a mosaic with 8220, 8230 and 6220 habitats.

Vegetation structure: The vegetation is almost missing and only individual shrubs (*Paliurus spina-christi*, *Quercus* spp., *Cornus mas*, *Carpinus orientalis*) and herb (*Poa nemoralis*, *Scleranthus perennis*, *Sedum album*, *S. hispanicum*, etc.) species are found. The participation of mosses and lichens is more significant and reaches up to 15-25%. Common species are *Bryum argenteum*, *Ceratodon purpureus*, *Cladonia* spp., *Xanthoparmelia* spp.

Threats: No.

8220 Siliceous rocky slopes with chasmophytic vegetation (app. 8 ha)

Abiotic conditions: This vegetation type has a limited distribution and represents almost vertical silicate rocks. The conditions are unfavourable for vegetation formation. The slope inclination is significant (up to 70-80°). The soil is missing or is partially preserved in the rock cracks. Other unfavourable factors are the strong winds and the significant warming of the rocks during the summer months.

Vegetation structure: The phytocoenoses are characterised by poor species composition and low total cover (20-35% on average). Species like *Sedum hispanicum*, *Anthemis macedonica* subsp. *stribnyi*, *Vulpia myurus*, *Festuca dalmatica*, *Bothriochloa ischaemum* are found in the species composition. Some shrub species are also found - *Paliurus spina-christi*, *Carpinus orientalis*, *Cotinus coggygria*, *Quercus pubescens*, *Juniperus oxycedrus*. The moss and lichen participation is up to 10-15%. This habitat also forms a mosaic with the phytocoenoses of 8150, 8230 and 6220 habitats.

Threats: No.

8230 Siliceous rock with pioneer vegetation of the *Sedo-Scleranthion* or of the *Sedo albi-Veronicion dillenii* (app. 55 ha)

Abiotic conditions: It is found on eroded terrains, often on the main bedrock or eroded rock substrate on even or slightly inclined terrains. The main bedrock is silicate, but soils are missing or shallow. They get significantly warmed up during the summer months and almost constant shortage of water.

Vegetation structure: The phytocoenoses are characterised by medium rich species composition and open horizontal structure with a total cover of 60-85%. The common species are xerophytes and therophytes with short vegetation cycles. Most of the species are in their optimum during the period between the end of spring and the beginning of summer (April to the first half of June). The dominant species are *Scleranthus perennis*, *Sedum album*, and *S. hispanicum*. Other common species are *Vulpia myurus*, *V. ciliata*, *Psilurus incurvus*, *Galium divaricatum*, *Poa bulbosa*, *Filago arvensis*, *Bromus squarrosus*, *Thymus zygioides*, *Anthemis macedonica* subsp. *stribnyi*, *Crepis foetida*, *C. sancta*, *Clinopodium acinos*. These phytocoenoses often form mosaics together with the communities of habitat 6220, which is found in proximity to terrains with preserved soil substrate. Species like *Taenatherum caput-medusae*, *Trifolium arvense*, *T. cherleri*, *T. purpureum*, *T. hirtum*, *Aegilops triuncialis*, *A. neglecta*, *Helianthemum salicifolium*, and *Sedum rubens* migrate from it to the phytocoenoses of habitat 8230.

Threats: No.

92/43 Directive Habitats in Chernata skala Protected Site

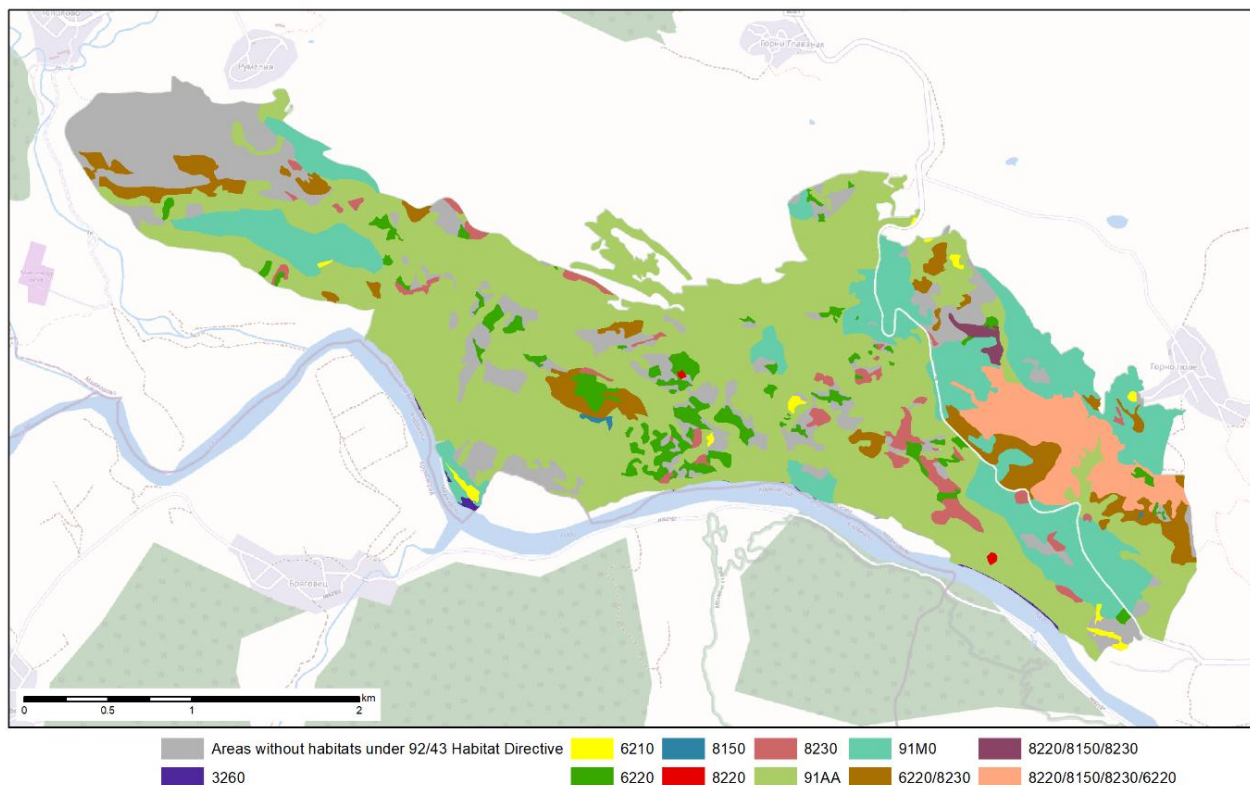


Fig. 3. Map of habitats from Directive 92/43/EEC of "Chernata Skala" PS.

Conclusions

The present study provides the first comprehensive floristic and habitat assessment of the “Chernata Skala” Protected Site in the Eastern Rhodopes, Bulgaria. The recorded 374 vascular plant species, belonging to 228 genera and 69 families, represent approximately 9% of the Bulgarian flora, confirming the site’s high floristic richness despite its limited area. The floristic spectrum is dominated by hemicryptophytes and therophytes, reflecting the pronounced Mediterranean influence and the prevalence of xerophytic habitats.

A total of 27 species (7.22%) are of conservation concern, including Balkan and Bulgarian endemics, Red List species, and taxa protected under national and international legislation. Eight habitat types have been identified in the PA, dominated by *Quercus pubescens* forests (91AA) and Pannonian-Balkan oak forests (91M0). The significant representation of chasmophytic and pseudo-steppe habitats further emphasises the area’s importance as a biodiversity refuge within the Eastern Rhodopes.

The study of the “Chernata Skala” PS confirms its key conservation significance for the Eastern Rhodopes, demonstrating rich species and habitat diversity with a strong Mediterranean character, which, through its mosaic structure, functions as an important refuge for numerous rare and endemic plant species.

The obtained data contribute to the national knowledge base on vascular plant diversity and habitats of European importance. They underline the necessity of continued field monitoring and prevention of anthropogenic pressures to preserve the floristic and habitat diversity of the “Chernata Skala” Protected Site.

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Annex 1. List of the vascular plant species in "Chernata Skala" Protected Site.

Equisetophyta

Equisetaceae *Equisetum hyemale* L.

Polypodiophyta

Aspleniaceae *Asplenium ceterach* L., *A. septentrionale* (L.) Hoffm., *A. trichomanes* L.

Dennstaedtiaceae *Pteridium aquilinum* (L.) Kuhn.

Pteridaceae *Cheilanthes persica* (Bory) Mett. ex Kuhn

Pinophyta

Cupressaceae *Juniperus deltoides* R. P. Adams.

Magnoliophyta

Aceraceae *Acer campestre* L., *A. monspessulanum* L., *A. negundo* L., *A. tataricum* L.

Alismataceae *Alisma plantago-aquatica* L.

Alliaceae *Allium flavum* L.

Anacardiaceae *Cotinus coggygria* Scop., *Pistacia terebinthus* L.

Amaryllidaceae *Galanthus elwesii* Hook. f.

Apiaceae *Bupleurum flavum* Forssk., *Chaerophyllum aureum* L., *Conium maculatum* L., *Daucus carota* L., *D. guttatus* Sm. subsp. *zahariadii* Heywood., *Eryngium campestre* L., *Ferulago sylvatica* (Besser) Rchb., *Heracleum sphondylium* (L.) subsp. *sibiricum* (L.) Simonk., *Myrrhoides nodosa* (L.) Cannon., *Oenanthe millefolia* Janka., *O. silaifolia* M. Bieb., *Orlaya grandiflora* (L.) Hoffm., *O. kochii* Heywood., *Physospermum cornubiense* (L.) DC., *Pimpinella peregrina* L., *Scandix australis* L., *Smyrniium perfoliatum* L., *Stefanoffia daucoides* (Boiss.) H. Wolff., *Tordylium maximum* L., *Torilis arvensis* subsp. *heterophylla* (Guss.) Hayek, *T. nodosa* (L.) Gaertn.

Araceae *Arum maculatum* L.

Aristolochiaceae *Aristolochia clematitis* L.

Asparagaceae *Asparagus acutifolius* L., *Hyacinthella leucophaea* subsp. *leucophaea* (K Koch) Schur., *Leopoldia tenuiflora* (Tausch) Heldr., *Muscari botryoides* (L.) Mill., *M. neglectum* Guss., *Ornithogalum narbonense* L., *O. orthophyllum* subsp. *kochii* (Parl.) Zahar., *O. sigmoideum* Freyn & Sint., *Prospero autumnale* (L.) Speta., *Ruscus aculeatus* L.

Asteraceae *Achillea clypeolata* Sm., *A. millefolium* L., *A. nobilis* subsp. *neilreichii* (A. Kern.) Vel., *Anthemis macedonica* subsp. *stribrnyi* (Velen.) Oberpr. & Greuter, *A. ruthenica* M. Bieb., *Arctium lappa* L., *Artemisia scoparia* Waldst. & Kit., *Bellis perennis* L., *Carduus acanthoides* L., *C. nutans* subsp. *leiophyllus* (Petrović) Stoj. & Stef., *C. thracicus* (Velen.) Hayek., *Carthamus lanatus* L., *Centaurea solstitialis* L., *C. stoebe* L., *Chondrilla juncea* L., *Cichorium intybus* L., *Cirsium ligulare* Boiss., *Cota tinctoria* (L.) J. Gay., *Crepis foetida* L., *C. pulchra* L., *C. rubra* L., *C. sancta* (L.) Babč., *C. tectorum* L., *Crupina vulgaris* Cass., *Cyanus pichleri* (Boiss.) Holub, *C. thirkei* (Sch. Bip.) Holub, *C. triumfettii* (All.) Dostal ex Á. Löve & D. Löve subsp. *triumfettii*, *Echinops sphaerocephalus* L., *Filago arvensis* L., *F. lutescens* Jord., *Inula britannica* L., *I. oculus-christi* L.,

Onopordum acanthium L., *O. tauricum* L., *Pilosella piloselloides* subsp. *bauhinii* (Schult.) S. Bräut. & Greuter, *Prenanthes purpurea* L., *Scorzonera mollis* M. Bieb., *Scorzoneroides cichoriacea* (Ten.) Greuter, *Senecio leucanthemifolius* Poir. subsp. *vernalis* (Waldst. & Kit.) Greuter, *Tanacetum corymbosum* (L.) Sch. Bip., *Taraxacum serotinum* (Waldst. & Kit.) Poir., *Tragopogon dubius* Scop., *T. orientalis* L., *Tyrimnus leucographus* (L.) Cass., *Xanthium spinosum* L., *Xeranthemum annuum* L., *X. cylindraceum* Sm.

Betulaceae *Alnus glutinosa* (L.) Gaertn., *Carpinus betulus* L., *C. orientalis* Mill., *Corylus avellana* L.

Boraginaceae *Anchusa officinalis* L., *Buglossoides arvensis* (L.) I. M. Johnst., *B. purpureoerulea* (L.) I. M. Johnst., *Myosotis ramosissima* Rochel., *M. stricta* Link ex Roem. & Schult., *M. sylvatica* Ehrh. ex Hoffm., *Symphytum ottomanum* Friv.

Brassicaceae *Alliaria petiolata* (M. Bieb.) Cavara & Grande., *Alyssum alyssoides* (L.) L., *A. desertorum* Stapf., *A. murale* Waldst. & Kit., *Aurinia saxatilis* subsp. *orientalis* (Ard.) T. R. Dudley, *Berteroa incana* (L.) DC., *Calepina irregularis* (Asso) Thell., *Capsella bursa-pastoris* (L.) Medicus, *Cardamine graeca* L., *C. hirsuta* L., *Erophila verna* (L.) Chevall., *Erysimum cuspidatum* (M. Bieb.) DC., *E. diffusum* Ehrh., *Hesperis laciniata* All., *Rorippa pyrenaica* (L.) Rchb., *Sisymbrium officinale* (L.) Scop., *Thlaspi perfoliatum* L., *T. praecox* Wulfen.

Campanulaceae *Campanula phrygia* Jaub. & Spach, *C. persicifolia* L., *C. rapunculoides* L., *Jasione heldreichii* Boiss. & Orph.

Caprifoliaceae *Knautia orientalis* L., *Scabiosa triniifolia* Friv., *Valerianella lasiocarpa* (Steven) Betcke.

Caryophyllaceae *Arenaria serpyllifolia* L., *Cerastium glomeratum* Thuill., *C. semidecandrum* L., *Dianthus armeria* L., *D. corymbosus* Sm., *D. pinifolius* Sm., *Holosteum umbellatum* L., *Moenchia graeca* Boiss. & Heldr., *M. mantica* (L.) Bartl., *Petrorhagia prolifera* (L.) P. W. Ball & Heywood, *Scleranthus annuus* L., *S. perennis* L., *Silene compacta* Fisch., *S. italica* (L.) Pers., *Stellaria media* (L.) Vill., *Velezia rigida* L.

Celastraceae *Euonymus verrucosus* Scop.

Cistaceae *Helianthemum oelandicum* (L.) DC. subsp. *incanum* (Willk.) G. Lopez, *H. salicifolium* (L.) Mill.

Colchicaceae *Colchicum autumnale* L.

Convolvulaceae *Convolvulus arvensis* L., *C. cantabrica* L.

Cornaceae *Cornus mas* L.

Crassulaceae *Hylotelephium maximum* (L.) Holub., *Sedum album* L., *S. caespitosum* (Cav.) DC., *S. hispanicum* L., *S. rubens* L., *Umbilicus rupestris* (Salisb.) Dandy

Cyperaceae *Carex caryophyllea* Latourr., *C. cuprina* (Sándor ex Heuff.) Nedtv. ex A. Kern., *C. depauperata* Curtis ex With., *C. divisa* Huds., *C. hirta* L., *C. muricata* L., *C. vulpina* L.

Dioscoreaceae *Dioscorea communis* (L.) Caddick & Wilkin.

Euphorbiaceae *Euphorbia amygdaloides* L., *E. esula* L., *E. falcata* L., *E. myrsinites* L., *E. niciciana* Borbs.

Fabaceae *Amorpha fruticosa* L., *Astragalus onobrychis* L., *Cytisus hirsutus* L. subsp. *hirsutus*, *Genista carinalis* Griseb., *G. lydia* Boiss., *G. rumelica* Velen., *Lathyrus aphaca* L., *L. laxiflorus* (Desf) Kuntze., *L. niger* (L.) Bernh., *L. nissolia* L., *Medicago arabica* (L.) Huds., *M. minima* (L.) Bartal., *M. rigidula* (L.) All., *Melilotus albus* Medik., *Ononis spinosa* L., *Trifolium angustifolium* L., *T. arvense* L., *T. cherleri* L., *T. dubium* Sibth., *T. globosum* L., *T. grandiflorum* Schreb., *T.*

hirtum All., *T. hybridum* L., *T. michelianum* Savi., *T. nigrescens* Viv., *T. pallidum* Waldst. & Kit., *T. patens* Schreb., *T. purpureum* Loisel., *T. repens* L., *T. scabrum* L., *T. striatum* L., *Vicia barbazitae* Ten. & Guss., *V. cracca* L., *V. grandiflora* Scop., *V. hirsuta* (L.) Gray., *V. villosa* subsp. *varia* (Host.) Corb.

Fagaceae *Quercus cerris* L., *Q. dalechampii* Ten., *Q. frainetto* Ten., *Q. pubescens* Willd.

Geraniaceae *Erodium ciconium* (L.) L'Her., *E. cicutarium* (L.) L'Her., *Geranium dissectum* L., *G. lucidum* L., *G. molle* L., *G. purpureum* Vill., *G. pyrenaicum* Burm. f.

Hypericaceae *Hypericum cerastoides* (Spach.) N. Robson., *H. montbretii* Spach., *H. olympicum* L., *H. perforatum* L., *H. rumeliacum* Boiss.

Iridaceae *Crocus chrysanthus* Herb., *C. flavus* West., *C. pulchellus* Herb., *Iris reichenbachii* Heuff., *I. suaveolens* Boiss. & Reut.

Juncaceae *Juncus inflexus* L.

Lamiaceae *Ajuga genevensis* L., *Clinopodium acinos* (L.) Kuntze., *C. graveolens* subsp. *rotundifolium* (Pers.) Govaerts., *Lamium amplexicaule* L., *L. purpureum* L., *Marrubium peregrinum* L., *Mentha aquatica* L., *Micromeria cristata* (Hampe) Grsb., *Prunella laciniata* (L.) L., *P. vulgaris* L., *Satureja pilosa* Velen., *Scutellaria columnae* All., *Sideritis montana* L., *Stachys officinalis* (L.) Trevis., *S. recta* L., *Thymus atticus* Čelak., *T. zygioides* Griseb.

Lemnaceae *Lemna minor* L.

Liliaceae *Fritillaria pontica* Wahlenb., *Gagea bohemica* (Zauschn.) Schult. & Schult. f.

Malvaceae *Alcea pallida* (Willd.) Waldst. & Kit.

Moraceae *Morus alba* L.

Oleaceae *Fraxinus angustifolia* Vahl subsp. *oxycarpa* (Willd.) Franco & Rocha Afonso, *F. ornus* L., *Jasminum fruticans* L., *Ligustrum vulgare* L., *Phillyrea latifolia* L., *Syringa vulgaris* L.

Orchidaceae *Anacamptis papilionacea* (L.) R. M. Bateman, Pridgeon & M. W. Chase., *Himantoglossum calcaratum* subsp. *rumelicum* (H. Baumann & R. Lorenz) Niketić & Djordjević, *Spiranthes spiralis* (L.) Chev.

Orobanchaceae *Parentucellia latifolia* (L.) Caruel.

Paeoniaceae *Paeonia peregrina* Mill.

Papaveraceae *Corydalis solida* (L.) Clairv., *Papaver dubium* L.

Plantaginaceae *Digitalis lanata* Ehrh., *Linaria genistifolia* (L.) Mill., *L. pelisseriana* (L.) Mill., *L. simplex* (Willd.) DC., *Plantago lanceolata* L., *Verbascum humile* Janka., *V. phoeniceum* L., *V. roripifolium* (Halácsy) I. K. Ferguson, *V. rupestre* (Davidov) I. K. Ferguson, *V. xanthophoeniceum* Griseb., *Veronica arvensis* L., *V. chamaedrys* L.

Plumbaginaceae *Goniolimon incanum* (L.) Hepper

Poaceae *Aegilops neglecta* Req. ex Bertol., *A. triuncialis* L., *Agrostis castellana* subsp. *byzantina* (Boiss.) Hack. ex Kneuck., *Aira elegantissima* Schur., *Anthoxanthum odoratum* L., *Apera spica-venti* (L.) P. Beauv., *Avena fatua* L., *Bothriochloa ischaemum* (L.) Keng., *Brachypodium sylvaticum* (Huds) P. Beauv., *Bromus arvensis* L., *B. madritensis* L., *B. squarrosus* L., *B. sterilis* L., *B. tectorum* L., *Chrysopogon gryllus* (L.) Trin., *Cynodon dactylon* (L.) Pers., *Cynosurus cristatus* L., *C. echinatus* L., *Dactylis glomerata* L., *Dasypyrum villosum* (L.) Borb., *Elymus caninus* (L.) L., *Festuca dalmatica* (Hack) K Richt., *F. heterophylla* Lam., *Glyceria notata* Chevall., *Hordeum bulbosum* L., *Lolium perenne* L., *Melica uniflora* Retz., *Phleum montanum* K. Koch., *Piptatherum virescens* (Trin) Boiss., *Poa angustifolia* L., *P. bulbosa* L., *P. nemoralis* L., *P. palustris* L., *P. pratensis* L., *Psilurus incurvus*

(Gouan) Schinz & Thell., *Taeniatherum caput-medusae* (L.) Nevski., *Trachynia distachya* (L.) Link., *Vulpia ciliata* Dumort., *V. myuros* (L.) C. C. Gmel.

Polygonaceae *Fallopia convolvulus* (L.) A. Löve, *Rumex sanguineus* L., *R. tuberosus* L.

Potamogetonaceae *Potamogeton crispus* L.

Primulaceae *Cyclamen hederifolium* Alt., *Primula veris* L.

Ranunculaceae *Anemone hortensis* L. subsp. *pavonina* (Lam.) Arcang., *Ficaria verna* Huds., *Ranunculus illyricus* L., *R. millefoliatus* Vahl., *R. repens* L.

Rhamnaceae *Paliurus spina-christi* Mill.

Rosaceae *Aremonia agrimonoides* (L.) DC., *Crataegus monogyna* Jacq., *Filipendula vulgaris* Moench., *Fragaria viridis* Duch., *Geum urbanum* L., *Potentilla inclinata* Vill., *P. pedata* Willd., *Prunus cerasifera* Ehrh., *P. spinosa* L., *Pyrus elaeagnifolia* Pall., *P. pyrastra* Burgsd., *Rosa canina* L., *Rubus caesius* L., *Sanguisorba minor* Scop., *Sorbus torminalis* (L.) Crantz.

Rubiaceae *Crucianella angustifolia* L., *Cruciata glabra* (L.) Ehrend., *C. laevipes* Opiz., *C. pedemontana* (Bellardi) Ehrend., *Galium aparine* L., *G. divaricatum* Poirret ex Lam., *G. pseudoaristatum* Schur., *G. verum* L., *Sherardia arvensis* L.

Salicaceae *Populus nigra* L., *Salix alba* L., *S. xanthicola* K. I. Chr., *S. fragilis* L.

Scrophulariaceae *Scrophularia canina* L., *Verbascum humile* Janka, *V. phoeniceum* L., *V. roripifolium* (Halácsy) I. K. Ferguson, *V. rupestre* (Davidov) I. K. Ferguson, *V. xanthophoeniceum* Griseb., *Veronica arvensis* L., *V. chamaedrys* L.

Tamaricaceae *Tamarix ramosissima* Led.

Tiliaceae *Tilia platyphyllos* Scop.

Typhaceae *Typha angustifolia* L., *T. latifolia* L.

Ulmaceae *Ulmus minor* Mill.

Urticaceae *Urtica dioica* L.

Verbenaceae *Verbena officinalis* L.

Viburnaceae *Sambucus ebulus* L.

Violaceae *Viola arvensis* Murray., *V. hirta* L., *V. kitaibeliana* Schult., *V. reichenbachiana* Jord. ex Boreau

Vitaceae *Vitis vinifera* L.