THE SERPENTINE FLORA IN THE CENTRAL RHODOPES MOUNTAINS, SOUTHERN BULGARIA

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ABSTRACT

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The serpentine flora on the northern slopes of the Central Rhodopes Mts. was studied. The serpentine bodies are located within the lower montane belt. This region is included in the transitional-mediterranean vegetation zone with a prevalence of mesophilous montane-balkan vegetation. In the foothills of the mountain are found secondary in origin plant communities composed of *Carpinus orientalis* and single trees of *Quercus dalechampii* and *Q. pubescens*. Nowadays the natural vegetation close to the serpentine terrains and the villages is almost completely destroyed. At this stage of research more than 150 plant taxa (annuals, perennials, shrubs and trees) bound to serpentine terrains are established. The highest number of species is established for the following families: *Poaceae*, *Asteraceae*, *Caryophyllaceae*, *Fabaceae, Lamiaceae*, *Brassicaceae*, *Scrophulariaceae*. The flora is mainly composed of middle-european and submediterranean geoelements.

Introduction

The distribution of the serpentine bodies in the Rhodopes Mts. coincides with the location of the metamorphic volcanogenic–sedimentary formations that are included in the Precambrian crystalline complex (Kozhoukharova 1984). On the northern slopes of the Central Rhodopes Mts. are observed large serpentine massives near the villages Parvenetz and Hrabrino, and smaller ones near Markovo and Cherven, that fall within the North-Rhodopes fault zone, tectonically linked. From a geological point of view the serpentine bodies in Bulgaria are rather ancient, with a high chemical diversity of the rocks and the soils above them (Kozhoukharova 1984, 1985).

The serpentines belong to the ultrabasic group that is characterized by a low Si content and comparatively high Mg and Fe content (Proctor and Woodell 1971; Brooks 1987). A characteric feature for the Precambrian volcanites in the Rhodopes Mts. is the high Fe content, a fact stated also by Ritter-Studnicka (1970) and Babalonas (1984) for the serpentines on the Bal-

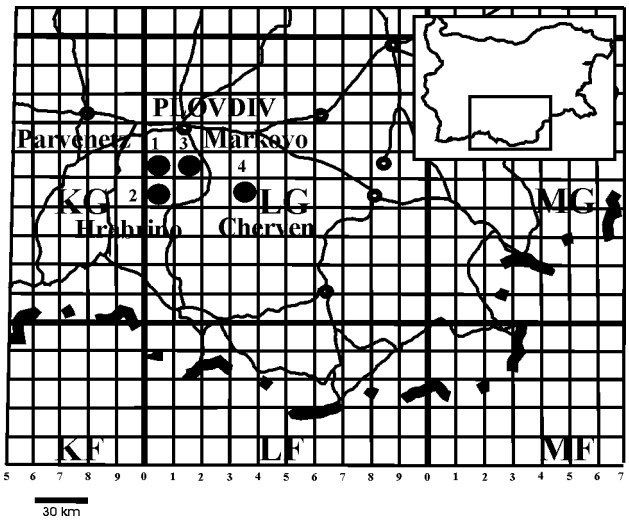

Fig. 1. The study area shown on UTM Grid map

kan peninsula. Their specifical chemical composition influences the soil composition and hence the local flora and vegetation. The typical serpentine areas are poorer compared to the surrounding areas in agricultural aspect and are known as sterile.

The study area

The investigation was concentrated on the serpentine areas near the villages Parvenetz (LG 05), Hrabrino (LG 04), Markovo (LG 15) and Cherven (LG 34) (Fig. 1) that are shown on UTM Grid map 15x15 km. The serpentine areas in this region are among the largest one in the Central Rhodopes Mts. and their state of preservation is comparatively well.

The climate is characterized by mild winters and relatively cool summers (Tishkov 1982). In general tree vegetation is lacking and only shrubby forms of some deciduous trees (shibljaks) are found. The north-facing slopes are deforested, characterized by the spread of mosaic, sparse and xerophilous herb flora. Parts of the north- and south-facing slopes are covered by artificial plantations of *Ailanthus altissima* (Mill.) Swingle and *Robinia pseudoacacia* L. The areas near the villages bear the features of anthropogenic activities - afforestation, tourism, ploughed up ground, livestock-breeding.

Methods

The transect method was selected for observations in the study area. Its displacement is between 150 and 400 m a.s.l. The main goal was to study terrains with an outlet to the basic rock in thus ensure confidence in their determination. The field observations were carried out for four successive years (2000–2003) in May-June. The plant material was determined using Bulgarian floras as well as Flora Europaea and Flora of Turkey. A check-list was prepared. The plant specimens were deposited in the University Herbarium (SO). The floristic analysis was performed following the approach for area-diagnosis and geoelements after Meusel (1965) and Gaijc (1980, 1984). The percentage calculations were done on the database summarized by Kozhuharov et al. (1992). At this stage of research the check-list is not completed. Nevertheless, preliminary results are presented for the ratio between the different taxonomical groups and the specificity of the serpentine areas in the different parts of the mountain.

Results

Recent plant cover

The area under study in the Central Rhodopes Mts. belongs to the transitional-mediterranean vegetation zone with the prevailance of mesophilous montane-balkan vegetation (Velčev et al. 1982). The serpentine bodies lie in the xerothermic oak vegetation belt (Velčev et al. 1982). In the foothills of the mountain are found secondary in origin plant communities of *Carpinus orientalis* with single trees of *Quercus dalechampii* and *Q. pubescens* Willd. As a result of the increasing anthropogenic activity the natural vegetation is completely destroyed and degraded. Vast agricultural areas were formed on the place of former xeromesophilous vegetation with participation of *Carpinus orientalis* Mill., *Quercus dalechampii* Ten. and *Pinus nigra* Arm. (village Cherven). The natural vegetation composed of *Q. dalechampii* Ten., *Q. cerris* L. and *Fagus sylvatica* L. was replaced mainly by secondary plant communities of *Carpinus orientalis* Mill.,. Along the river valleys are preserved natural plant communities of *Platanus orientalis* L. The artificial plantations have also a negative effect on the natural vegetation cover. A large part of the serpentine massives is covered by coppice oak woods. On south-facing slopes they change into shiblyaks. The east-facing slopes are lacking tree vegetation and the herb flora is represented by separate, small in size dispersed or mosaic populations. In the composition of the shiblyaks are found also *Juniperus oxycedrus* L., *Fraxinus ornus* L., *Acer campestre* L., *Cotinus coggygria* Scop., *Pistacia terebintus* L., *Rhamnus catarticus* L., *Paliurus spina-cristi* Mill., *Dichantium ischaemum* L., *Chrysopogon gryllus* (L.) Trin. and *Poa bulbosa* L. The herb flora of the shiblyaks and on deforested slopes was the object of the present study. The most common species, predominantly on open areas, are *Taeniatherum crinitum* (Schreb.) Nevski, *Melica ciliata* L., *Cynosurus echinatus* L., *Aegilops neglecta* Req. ex Bertol, *Scleranthus perennis* L., *Sedum hispanicum* L., *Thalictrum minus* L., *Potentilla argentea* L., *Lactuca perennis* L., *etc*.

Taxonomical structure

At this preliminary stage of research were collected 176 taxa – 5 from *Bryophyta*, 4 from *Pteridophyta*, and the rest 167 from *Spermatophyta*. All seed plants, *Juniperus oxycedrus* excluded, belong to *Magnoliophytina*. The dicotyledons (36 families) prevail, while the monocotyledons are represented by only 3 families. The families with the highest number of genera are *Poaceae* (19), *Asteraceae* (13), *Fabaceae* (9), *Lamiaceae* (8), *Caryophyllaceae* (7), *Brassicaceae* (5), *Rubiaceae* (4), *Scrophulariaceae* (5), *etc*. A similar picture is observed for the number of species in each family - *Poaceae* (25), *Asteraceae* (20), *Caryophyllaceae* (13), *Fabaceae* (11), *Lamiaceae* (9), *Brassicaceae* (8), *Rubiaceae* (6), *Scrophulariaceae* (6), *etc*.

The distribution of the taxa in respect to their biological type is as follows: perennials (per) - 92, annuals (ann) - 53, shrubs (h1) – 7, annuals-biennials (ann-bi) – 7, shrubs to trees (h1-h2) – 5, biennials (bi) – 2,

biennials to perennials (bi-per) – 1, tree (h2) – 5, and annuals to perennials (ann-per) – 2, semi shrubs (h) – 1. This pattern of distribution demonstrates the basic characteristics of the floras from the temperate regions. The high number of annual taxa is typical for the floras of the serpentines areas where these plants with short life cycle thrive in extreme conditions.

The analysis of the floristic elements gives an idea for the phytogeographical specificity of the investigated flora. The vascular plants established are assigned to the following basic groups of floristic elements affter the system of Gaijc (1980, 1984) - circumboreal (5.53%), middle-european (28.74%), mediterranean (23.95%), pontic-middle-asiatic- (8.38%), oriental-turanean (9.55%), euro-asiatic (15.56%) and cosmopolitian (1.19%). The highest proportion belongs to the middle-european, mediterranean and euro-asiatic species. These groups comprise 111 taxa from the analyzed flora (66.46%). The group of mediterranean floristic elements includes 10 taxa in the narrow sense of the word - *Centaurea rutifolia* S. et S. ssp. *jurineifolia, Cirsium creticum* (Lam.) D'Urv*., Crepis sancta* (L.) Babck., *Asyneuma limonifolium* (L.) Janch., *Trifolium hirtum* All., *Sedum pallidum* Bieb., *etc*. The most abundant in this group is the submediterranean floristic element (24), *i.e.* species such as *Orlaya grandiflora* (L.) Hoffm., *Onosma heterophylla* Griseb*., Alyssum desertorum* Stapf*., Silene subconica* Friv., *Sedum album* L*., Teucrium chamaedrys* L*., Psilurus incurvus* (Gouan) Schinz et Thell*., Dasypyrum villosum* (L.) Cand., *etc*. The number of oriental turanian and pontic-middle-asiatic geoelements is 15 and 14 respectively, but they both are of great importance for the serpentine flora in the Central Rhodopes Mts.

The endemic element is represented by 11 taxa or 6.25% from the total number of species established. The Balkan endemics *Crucianella graeca* Boiss., *Inula aschersoniana* Janka, *Campanula sparsa* Friv. ssp. *sphaerothrix* (Griseb.) Hayek, *Scabiosa triniifolia* Friv., *Hypericum rumeliacum* Boiss., *Iris reichenbachii* Heuff., *Koeleria macrantha* (Ledeb.) Schult. et Schult., *Delphinium balcanicum* Pawl. and the Bulgarian endemics *Anthemis rumelica* (DC) Ferdinand, *Verbascum nobile* Vel., *Crepis stojanovii* T. Georg. were found. The last two endemics are included with category "threatened" in the Red Data Book of Bulgaria while the species *Anthemis rumelica* (DC) Ferdinand and *Delphinium balcanicum* Pawl. Are with category "rare".

The most characteristic species on the serpentine areas in the Central Rhodopes Mts. are *Verbascum nobile* Vel., *Rumex tuberosus* L., *Bilderdikya convolvulus* (L.) Dum., *Dasypyrum villosum* (L.) Cand*., Goniolimon collinum* (Griseb.) Boiss., *Inula aschersoniana* Janka, *Trinia glauca* (L.) Dum. and *Cheilanthes maranthae* (L.) Domin.

New for the floristic subregion Central Rhodopes Mts. are the Bulgarian endemics *Anthemis rumelica* (DC) Ferdinand and *Crepis stojanovii* T. Georg. included also in the European List of Rare and Endangered Plants, and the species *Arenaria procera* Spreng. var. *glabra* Fenzl., *Goniolimon collinum* (Griseb.) Boiss., *Triticum boeticum* Boiss., *Milium vernale* Bieb., *Trachynia distichia* (L.) Linn., *Psilurus incurvus* (Gouan) Schinz et Thell. The taxa *Orobanche cumana* Wallr. and *Stipa tirsa* Stev. are new for the floristic region Rhodopes Mts.

Conclusions

The modern flora on the serpentine areas in the Rhodopes massif is of relatively young origin. About 500-1000 years ago vast forests had existed that had impeded the immigration of macrothermic and heliophilous species in this region. Only after the deforestation of the serpentine areas the formation of a fireplace under the influence of the natural selection has become possible. The anthropogenic factor had also played an important role in these processes. The first herb species have irradiated from the serpentine areas in Northern Greece that had been deforested rather earlier (Stojanov 1941).

The middle-european, submediterranean and mediterranean floristic elements had played a basic role in the formation of the serpentine flora in the Central Rhodopes Mts. The presence of the oriental-turanian floristic element testifies to the penetration of more xeromorphic plant structures. These are predominantly xeromorphic species that had found suitable phytoclimatical conditions for their growth provided by the serpentine rocks and the soils.

The flora and vegetation on the serpentine areas in the Central Rhodopes Mts. show great similarities with similar areas in the Eastern part of the Rhodopes Mts. and other Balkan countries. The close geographical location, the low altitudes, and the similar climatic conditions of the Central and Eastern Rhodopes Mts. explain the presence of a number of common species. Unlike the Eastern Rhodopes Mts. where the influence of the oriental-turanian floristic element is higher, in the Central Rhodopes Mts. it is comparatively weakly expressed. A basic role in the formation of this flora has played the middle-european floristic element.

The number of the endemics established for the serpentines in the Central Rhodopes Mts. is 11. This number is rather low compared to other serpentine areas in the Rhodopes Mts. and on the Balkan peninsula (Reichinger 1961; Krause et al. 1963; Babalonas 1984, 1989; Ritter-Studnicka 1970, Tatic & Veljovic 1992). The link between the taxa of the investigated flora of the Central Rhodopes Mts. and the corresponding one of the Eastern Rhodopes Mts., North-

ern Greece, Serbia, Bosnia and Herzegovina, testifies to a refugial character of the processes and not to a strong fireplace. That is why a typical serpentine floristic complex has not still been formed in contrast to Northern Greece and in the former Yugoslavian states.

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Summary

The study area in the Central Rhodopes Mts. belongs to the transitional-mediterranean vegetation zone with prevailance of mesophilous montane-balkan vegetation.The serpentine bodies lie in the xerothermic oak vegetation belt (Velčev et al. 1982). A large part of the serpentine massives is covered by coppice oak woods. On south-facing slopes they change into shiblyaks. The east-facing slopes are lacking tree vegetation and arecovered by separate, small in size, dispersed or mosaic herb populations.

The vascular plants established are assigned to the following basic groups of floristic elements - circumboreal (5.53%), middle-european (28.74%), mediterranean (23.95%), pontic-middle-asiatic- (8.38%), oriental-turanean (9.55%), euro-asiatic (15.56%) and cosmopolitian (1.19%).

The modern flora on the serpentine areas in the Rhodopes massif is of relatively young origin. The central-european, submediterranean, and mediterranean floristic elements had played a basic role in the formation of the serpentine flora in the Central Rhodopes Mts. A typical serpentine floristic complex has not still been formed in contrast to Northern

Greece and the former Yugoslavian states.

Appendix

BRYOPHYTA
Bryum sp.
***Ceratodon purpureus* (Hedw.) Brid.**
***Grimmia pulvinata* (Hedw.) Sm.**
***Syntrichia ruralis* (Hedw.) F. Weber et D. Moh.**
***Syntrichia subulata* Hedw.**
POLYPODIOPHYTA
ASPLENIACEAE
***Asplenium adiantum-nigrum* L.**
per; EurAs
***Asplenium trichomanes* L.**
per; Kosm
***Ceterach officinarum* DC.**
per; EurAs
SINOPTERIDACEAE
***Cheilanthes maranthae* (L.) Domin**
per; Med-or-turan-him
SPERMATOPHYTA
PINOPHYTINA
CUPRESSACEAE
***Juniperus oxycedrus* L.**
h1; Med-crim-cauc-or-turan**MAGNOLIOPHYTINA**
ANACARDIACEAE
***Cotinus coggygria* Scop.**
h1-h2; Med-As
***Pistatia terrebinthus* L.**
h1-h2; MidEur-med
APIACEAE
***Caucalis platicarpos* L.**
ann; EurAs
***Eryngium campestre* L.**
per; Med-pont
***Ferulago sylvatica* (Bess.) Reichenb.**
per; Submed
***Orlaya grandiflora* (L.) Hoffm.**
ann; Submed
***Trinia glauca* (L.) Dum.**
bi-per; Submed
ARISTOLOCHIACEAE
***Aristolochia clematitis* L.**
per; Eur-Med-An
ASTERACEAE
***Achillea depressa* Janka**
per, Pont
***Achillea pannonica* Schede**
per; Pann-Balk
***Anthemis rumelica* (DC) Ferdinand**
per; Bu E included in Red Data Book of Bulgaria and in European List of Rare and Threatened species with category rare.
***Anthemis tinctoria* L.**
per; Eur-Med
***Centaurea biebersteinii* DC**
bi; Submed
***Centaurea rutifolia* S. et S. ssp. *jurineifolia* (Boiss.) Nym.**
ann; Med
***Centaurea salonitana* Vis.**
per Pont-Med
***Cirsium creticum* (Lam.) D'Urv.**
per; Med
***Crepis pulchra* L.**
ann; Eur-Med
***Crepis sancta* (L.)Babck.**
ann; Med
***Crepis stojanovii* T. Georg.**
ann; Bu E included in Red Data Book of Bulgaria with category threatened.
***Crupina vulgaris* Cass.**
ann; Submed-or-turan
Echinops ritro* *L.
per; EurSib
***Hieracium hoppeanum* Shult.**
per; Eur-Med
***Inula aschersoniana* Janka**
per; Balk E
***Inula oculus-christi* L.**
per; Eur-Med
***Lactuca perennis* L.**
per; MidEur-submed
***Leontodon hispidus* L.**
per; Eur-Med
***Logfia arvensis* (L.) J. Holub.**
ann; Eur-Med
***Senecio vulgaris* L.**
ann-bi, EurAs
BETULACEAE
***Carpinus orientalis* Mill.**
h1-h2; Submed
BORAGINACEAE
***Buglossoides arvensis* (L.) Johnst.**
ann; MidEur-panPont-SubmedMed-Ortur
***Echium vulgare* L.**
per; EurAs
***Myosotis stricta* Link ex Roem. et Schult.**
ann; EurAs
***Onosma heterophylla* Griseb.**
per; Submed

BRASSICACEAE
***Aethionema saxatile* (L.)R.Br.**
ann-per; Submed
***Alyssum desertorum* Stapf.**
ann; Submed
Alyssum murale* W. et K. ssp. *murale
per; Eur-Med
***Alyssum tortuosum* Willd.**
per; Pont-Med
***Clypeola jonthlaspi* L.**
ann; Submed
***Erysimum cuspidatum* (Bieb.) DC.**
ann-bi; Med-Crim-Cauc-An
***Erysimum diffusum* Ehrh.**
bi; Eur-pont-med-or-turan-midAs-sib
***Thlaspi perfoliatum* L.**
ann; Eur-Cauc-(w)As-NAm
CAMPANULACEAE
***Asyneuma limonifolium* (L.) Janch.**
per; Med
***Campanula sparsa* Friv. ssp. *sphaerothrix* (Griseb.) Hayek**
ann; Balk E
CARYOPHYLLACEAE
***Arenaria gypsyphylloides* L.**
per; Eur

***Arenaria serpyllifolia* L.**
ann-bi; EurMed
***Dianthus pinifolius* S. et S.**
per; Balk-An
***Herniaria hirsuta* L.**
ann-bi; EurAs
***Lychnis coronaria* (L.)Desr.**
per; Med-ortur
***Petrorhagia illyrica* Ball et Heyw. ssp. *haynaldiana* (Janka) Ball et Heyw.**
per; Pont-Med
***Petrorhagia prolifera* (L.)Ball et Hayw.**
ann; Eurmed-Cauc
***Scleranthus perennis* L.**
per; Eur-Cauc-An
***Scleranthus polycarpos* L.**
ann-bi; Eur
Silene bupleuroides* L. ssp. *bupleuriodes
per; Eur-Cauc
***Silene conica* L.**
ann; Eur-Cauc-An-midAs
***Silene flavescens* W. et K.**
per; Carp-Balk
***Silene subconica* Friv.**
ann; Submed

CISTACEAE
***Helianthemum nummularium* (L.) Mill.**
h; Submed-med-cauc-ortur

CONVOLVULACEAE
***Convolvulus cantabrica* L.**
per; Pont

CRASSULACEAE
***Sedum album* L.**
per; Submed
***Sedum acre* L.**
per; Eur-Med
Sedum hispanicum
ann-per; MidEur-med-cauc
***Sedum pallidum* Bieb.**
bi; Med
***Sedum rubens* L.**
ann; MidEur-submed

CUSCUTACEAE
***Cuscuta europaea* L.**
ann; SubBoreal

DIPSACEAE
***Knautia arvensis* (L.) Coult.**
per; EurSib
***Scabiosa triniifolia* Friv.**
ann; Balk E

EUPHORBIACEAE
***Euphorbia cyparissias* L.**
per; Eur
***Euphorbia myrsinites* L.**
per; Submed
***Euphorbia taurinensis* All.**
ann; Eur-An-Cauc

FABACEAE
***Astragalus onobrychis* L. ssp. *chlorocarpus* (Griseb.) Koz. et Pavlova**
per; EurAs
***Chamaecytisus albus* (Jacq.) Rhotm. ssp. *microphyllus* (Boiss.) Kuzm.**
h1; Eur
***Coronilla emerus* L. ssp. *emeroides* (Boiss. et Sprun.) Hay.**
h1; Submed
Dorycnium herbaceum* Vill. var. *illyricum
per; Eur-cauc-ortur
***Lotus corniculatus* W. et K.**
per; Eur-submed-med
Medicago minima* (L.) Bartel var. *minima
ann; EurAs
***Onobrychis gracilis* Bess.**
per; Submed-med-cauc-or-turan
Trifolium arvense* L. ssp. *strictum
ann; Eur-med-pont-cauc-or-turan
Trifolium campestre* Schreb. var. *campestre
ann; Submed
***Trifolium hirtum* All.**
ann; Med
Vicia hirsuta* (L.) S. F. Gray var. *hirsuta
ann; EurAs

FAGACEAE
***Quercus pubescens* Willd.**
h2; MidEur-submed

GERANIACEAE
***Erodium cicutarium* (L.) L′Herit**
ann-bi; Subboreal
***Geranium columbinum* L.**
ann; EurSubmed

HYPERICACEAE
***Hypericum elegans* Steph. ex Willd.**
per, Eur-An-Cauc-Sib
***Hypericum perforatum* L.**
per; EurAs
***Hypericum rumeliacum* Boiss.**
per; Balk E

IRIDACEAE
***Iris rechenbachii* Heuff.**
per; Balk E

LAMIACEAE
***Acinos arvensis* (Lam.) Dandy**
ann-bi; Eur-Med
***Ajuga laxmanii* (L.) Benth.**
per; MidEur-Cauc-SibAn
***Clinopodium vulgare* L.**
per; Eur-or-turan-cauc-sib-(n)Am
***Leonurus cardiaca* L.**
per; EurAs
***Prunella laciniata* (L.) L.**
per; Eur-or-turan
***Salvia sclarea* L.**
per; (s)Eur- Med-An-(c)As
***Stachys recra* L. ssp. *subcrenata* (Vis.) Briq.**
per; EurMed-cauc-An
***Teucrium chamaedrys* L.**
per; Submed
***Teucrium polium* L.**
per; Eur-submed-med-or-turan

LILIACEAE
***Allium flavum* L.**
per; EurMed
***Allium sphaerocephalon* L.**
per; Med
***Asparagus verticillatus* L.**
h; PontAs
***Hyacintella leucophaea* (Koch) Schur**
per; Pont-Med

***Muscari comosum* (L.) Mill.**
per; (w)Eur-submed
***Ornithogalum comosum* L.**
per; Pont-Balk
***Ornithogalum kochii* Parl.**
per; Eur-Med-An-ortur

LINACEAE

***Linum austriacum* L.**
per; Submed

OLEACEAE

***Fraxinus ornus* L.**
h1-h2; Submed
***Jasminum fruticans* L.**
h1; Med

OROBANCHACEAE

***Orobanche cumana* Wallr.**
per; EurAs
***Orobanche minor* Sm. in Sm. et Sowery**
per; Eur-Med-Cauc-An

PAPAVERACEAE

***Papaver dubium* L.**
ann;Med
***Papaver rhoeas* L.**
ann; Eursib

PLANTAGINACEAE

***Plantago lanceolata* L.**
per; EurAs

PLUMBAGINACEAE

***Goniolimon collinum* (Grsb.) Boiss.**
per; Pont

POACEAE

***Aegilops neglecta* Req. ex Bertol**
ann; Submed-med-ortur
***Aira elegantissima* Schur**
ann; Submed-med-cauc-or-turan-midAs
***Bromus squarrosus* L.**
ann; Submed-cAs
***Bromus tectorum* L.**
ann; Eur-Med-cauc-(w)sib-or-turan-midAs-sinojap
***Chrysopogon gryllus* (L.) Trin.**
per; PontMed
***Cynosurus echinatus* L.**
per; MidEur-submed
Dactylis glomerara* L. ssp. *glomerata
per; EurAs
***Dasypyrum villosum* (L.) Cand.**
per; Submed***Dischantium ischaemum* (L.) Roberty**
per; MidEur-med-pont-or-turan-IndoMalay
***Koeleria macrantha* (Ledeb.) Schult. et Schult.**
per; Balk E
***Koeleria nitidula* Vel.**
per; Pont
***Koeleria shurii* Ujh.**
per; Eur-Med
***Lerchenfeldia flexuosa* (L.) Schur**
per; Boreal
***Lolium perenne* L.**
per; EurAs
***Melica ciliata* L.**
per; MidEur-submed
***Phleum phleoides* (L.) Kasrst.**
per; Eur-or-turan-cauc-midAs-sib-sinojap
Phleum pretense
per; Eur-Submed
***Poa bulbosa* L.**
per; EurAs
***Psilurus incurvus* (Gouan) Schinz et Thell.**
ann; Submed
***Stipa capillata* L.**
per; Eur-submed
***Stipa tirsa* Stev.**
per; Eur-submed
***Taeniatherum caput-medusae* (L.) Nevski**
ann; EurAs
***Trachynia distachya* (L.) Link.**
ann; MedAs
***Vulpia ciliata* Pers.**
ann; Med-midAs
***Vulpia myurus* (L.)C.C. Gmel.**
ann; SubBoreal

POLYGALACEAE

***Polygala major* Jacq.**
per; EurSib

POLYGONACEAE

***Bilderdikya convolvulus* (L.) Dum.**
ann; Eur-med
***Polygonum pulchellum* Loiseli**
ann; EurAs
***Rumex acetosella* L.**
per; Eur-med-cauc-sib-(n)Am
***Rumex tenuifolius* (Wallr.) A. Love**
per; Eur
***Rumex tuberosus* L.**
per; (s)Eur-Med-Cauc-As-An

RANUNCULACEAE

***Delphinium balcanicum* Pawl.**
ann; Balk E included in Red Data Book of Bulgaria with category rare.
Thalictrum minus* L. ssp. *minus
per; Eur-cauc-sib-or-turan

RHAMNACEAE

***Paliurus spina-christi* Mill.**
h1; Med-pont-midAs
***Rhamnus catharticus* L.**
h1-h2; EurAs

ROSACEAE

***Filipendula vulgaris* Moench**
per; Eur-Med
***Potentilla argentea* L.**
per; Eur
***Potentilla pedata* Willd.**
per; Med
Sanguisorba minor* Scop. ssp. *minor
h1; SubBoreal

RUBIACEAE

***Asperula cynanchica* L.**
per; Eur-Med
***Asperula purpurea* (L.) Ehrend.**
per; Submed
***Crucianella graeca* Boiss.**
ann; Balk E
***Galium parisiense* L.**
ann; Submed
***Galiun verum* L.**
per; EurAs
***Sherardia arvensis* L.**
ann; Eur-Med-An-cAs

SCROPHULARIACEAE

***Celsia orientalis* L.**
ann; Balk-An-cauc

***Digitalis lanata* Ehrh.**
per; Submed
***Linaria simplex* (Willd.) DC.**
ann; Med
***Verbascum nobile* Vel.**
ann; Bu E included in Red Data Book of Bulgaria with category threatened.
***Veronica arvensis* L.**
ann; Kosm
***Veronica austriaca* L. ssp. *jaquinii* (Bamg.) Maly**
per; Pont

VALERIANACEAE
***Valerianella dentata* (L.) Poll.**
ann; Eur-med-midAs

VIOLACEAE
***Viola arvensis* Murr.**
ann**;** Eur
***Viola kitaibeliana* Schult.**
ann; MedEur-An

VITACEAE
***Vitis vinifera* L.**
h1; Submed