# Low-altitudinal siliceous and base-rich screes: new habitats to Bulgaria from the Habitats Directive

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**Abstract.** The study presents recent data on the distribution of two new chasmophytic habitats to Bulgaria. They are low-altitudinal siliceous screes distributed mostly in South Bulgaria, and calcareous screes found mostly in the northern part of the country. Their main characteristics, as well as many typical vascular plants, mosses and lichens are given in the paper. The habitats are included in the Habitats Directive under the names 8150 Medio-European upland siliceous screes and 8160* Medio-European calcareous screes at hill and montane levels. This was the reason to make an attempt at calculating their representativeness in the existing NATURA 2000 sites in Bulgaria by means of field researches, GIS models from the Forestry Database and mapping.

**Key words:** acidic and calcareous geological background, chasmophytic vegetation, NATURA 2000

## Introduction

The Bulgarian NATURA 2000 network officially exists since 2007 and includes 90 habitat types from Annex I of the Directive 92/43/EEC and the Bulgarian Biodiversity Act (Gussev & Tzonev 2015). However, the problem of interpretation of habitat definitions obtains not only at national but also at European level (Evans 2006; 2010; Rodwell & al. 2018). Owing to the different habitat classifications (Devillers & al. 1991, 1996; Davies & al. 2004) and variability of scope of the habitat units, it was accepted in many national habitat overviews to give the relations of different habitat classifications (Donita & al. 2005; Chytry & al. 2010; Biserkov & al. 2015). The European Red List of Habitats (Janssen & al. 2016) is the most comprehensive study so far of the existing habitat classifications and their relationship to the Habitats Directive. That study has revealed many problems about habitat definitions and scope not only at European but also at national level. However, it also highlighted some problems in the national interpretation of the characteristics of some habitats from the Habitats Directive. Such an example are the low-altitudinal screes in Bulgaria. Two high-mountain scree types, already described in Bulgaria (Roussakova 2015), correspond to the habitats from Annex I of Directive 92/43/

EEC: 8110 Siliceous screes of the montane to snow level (*Androsacetalia alpinae* and *Galeopsetalia ladani*) and 8120 Calcareous and calk schist screes of the montane to alpine level (*Thlaspietea rotundifolii*). They are well represented in the NATURA 2000 network in Bulgaria. However, the exogenic processes causing rock-falls unfold not only on the high altitudes but also in the foothills, and in some river valleys and gorges in the lower parts of Bulgaria (Alexiev 2002).

According to the published results from the European Red List of Habitats (Janssen & al. 2016), two low-altitudinal scree habitats – H2.5 Temperate, lowland to montane siliceous scree and H2.6a Temperate, lowland to sub-montane base-rich scree (Mikolajczak 2016a, b) – have been also reported in Bulgaria. They correspond to the mentioned habitat types from the Habitat Directive: 8150 Medio-European upland siliceous screes and 8160* Medio-European calcareous screes of hill and montane levels. This has inspired more intensive researches into the ecology, floristic structure and distribution of the habitats in Bulgaria. During the field studies (2018–2019) under the Joint Research Project "Chasmophyte communities – important habitat of rare and endemic plant species" of the Bulgarian and Slovakian Academies of Science, further information was collected on their main ecological peculiarities and range. This study is expected to contribute to better knowledge of these so far not well known habitats in Bulgaria.

## Materials and methods

The flora and vegetation of the low-altitudinal screes were investigated in some representative areas (Vrachanski Balkan, Studen Kladenets Dam, Karlukovo Karst Area) during the vegetation seasons of 2017–2019. Five relevés have been set according to the principles and methods of the Braun-Blanquet's phytosociological school (Braun-Blanquet 1964). However, the checklist of vascular plants, mosses and lichens and the study of ecological features are based not only on those sample plots, but also on other field experiences of the authors.

The taxonomic nomenclature of vascular plants follows Delipavlov & al. (2003). The species of mosses and liverworts are given according to Petrov (1975); Ganeva & Natcheva (2003) and Natcheva & Ganeva (2005); while the lichens follow Mayrhofer & al. (2005). The conservation status of the taxa in the floristic composition of the studied habitats is noted down according to Petrova & Vladimirov (2009). Their protected status is indicated in accordance with the Appendix 3 of the Bulgarian Biological Diversity Act (2002).

The map of habitat distribution in Bulgaria (Fig. 1) was prepared in the national 10×10 km Universal Transverse Mercator (UTM) grid (projection coordinate system WGS 84 UTM 35N), after processing with software ArcGIS 10.3.1 (ESRI, Redlands, CA, USA). The cell codes of the Military Grid Reference System, MGRS, spatially identical with UTM, were also used. The habitats map was prepared after modeling and selection from the Forestry Database (http://www.procurement.iag.bg:8080/cgi-bin/lup.cgi) of numbers representing some taxation indicators, such as elevation range, kind of forestry subdivisions and bedrock types. The algorithm of polygon selection follows three main steps:

— Elevation range of distribution (0 – 900 – 1100 m depending on the exposition);
— Type of subdivision: 26 – screes and 52 – "rumbles" or rock-falls
— Nomenclature of bedrocks. Siliceous bedrocks are represented by 10 (granite), 11 (quartz porphyry), 12 (rhyolite), 13 (granito-rhyolite), 14 (granite-gneiss), 15 (biotitic gneiss), 16 (clay sandstone), 18 (syenite), 19 (trachyte) ), 27 (diorite), 28 (andesite), 29 (gabbro), 30 (basalt), 31 (diabase), 32 (amphibolite shale), 33 (amphibolite), 34 (chlorine shale), 35 (phyllite), 38 (granodiorite), 39 (latite), 40 (volcanic tuffs), 41 (gneisses), 42 (conglomerates), 43 (breccia), 44 (sandstone), 48 (terrestrial shale), 49 (crystalline shale), 50 (south Bulgarian granite), 51 (shale), 55 (quartzite); 61 (breccia-conglomerates), 62 (porphyry), 67 (Osogovo granite-porphyrite), 68 (andesitic tuffs), and 69 (monocyte). Base-rich bedrocks are represented by: 7 (limestone), 8 (marble), 9 (sandy limestone), 17 (calcareous marls), 23 (calcareous clays), 25 (marls), 26 (clay marls), 36 (clay shale), 45 (dolomite), 46 (clayey slates), 53 (calcareous), 56 (corrosive slates), 57 (limestone sandstones), 58 (slates), 59 (reef limestone), 60 (argillite), and 66 (marbled limestone).

Delineation of the known polygons was also performed. It was based on expert knowledge of the most important for the low-altitudinal screes parts of Bulgaria, still unidentified by modeling: Vrachanski Balkan, Kresna Gorge, Karlukovo Karst Area, Arda River Valley, Teteven town, etc.

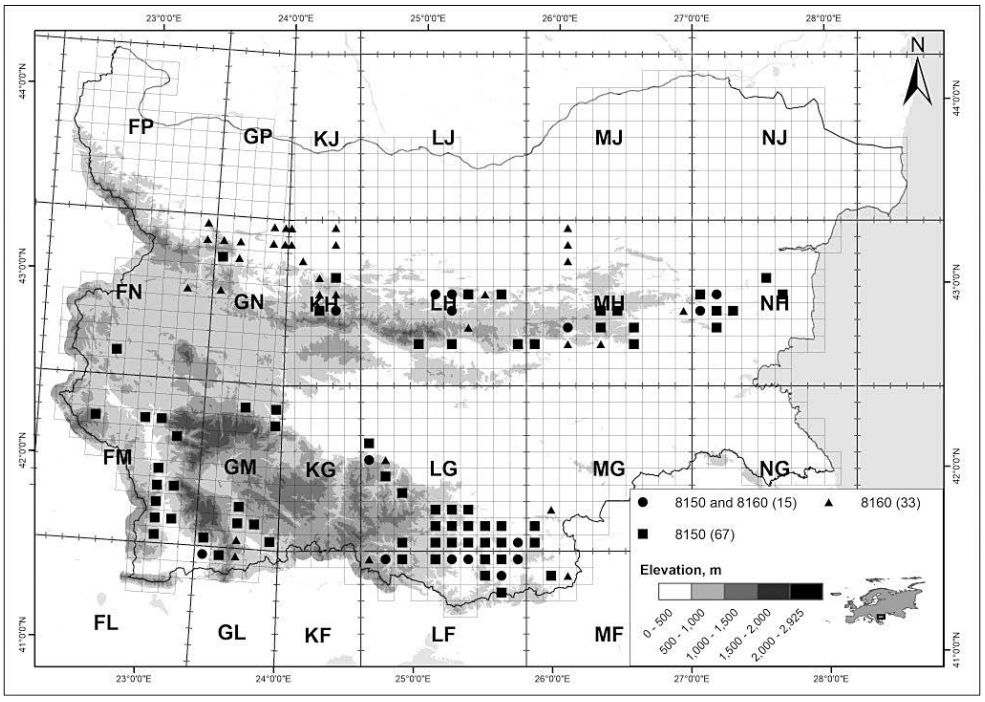


**Fig. 1.** A map of the distribution of low-altitudinal screes in Bulgaria.

## Results and discussion

According to Velchev (2014), typical screes are connected mostly with the peri-glacial geomorphologic weathering. They consist of scree slopes, scree furrows and scree cones. However, the term "scree" generally refers to an accumulation of pieces of broken rock with different size (Pariona 2017) from the surrounding cliffs and mountainsides during rock-falls. After rolling, bouncing, and sliding down nearly vertical cliffs, these rocks come to rest in one concentrated heap. Rock-fall is prompted by several factors, mostly erosion caused by weathering, both from climate and chemical causes. The different types of weathering of the resulting scree include: thermal stress, biotic processes, chemical and mechanical weathering, and topographic stress. The above-cited various exogenic processes are widespread in many parts of Bulgaria, not only in the high mountains (Alexiev 2002).

However, low-altitudinal screes are seldom distributed in Bulgaria (Fig. 1) due to their dependence on the existence of open vertical rocks and rocky walls. Most often they could be found in rocky valleys (gorges), like the valleys of rivers crossing the calcareous plateaus of the Forebalkan, or in the volcanic massifs, typical for the Eastern Rhodope Mts. More seldom such geological forms are distributed at the foothills of some mountains such as the Balkan Range, Mt Malashevska and Pirin Mts (Struma and Mesta river valleys), etc. Depending on the size of material, its mobility, regional climatic factors, etc., the screes could be unvegetated, occupied only by lichens or mosses, or colonized by sparse herbs or even shrubs and small trees.

The vegetation of screes in the Balkans is not well investigated. The existing works (see Dimopoulos & al. 1997; Valachovič & al. 1997) were focused mostly on the mountain areas. In Bulgaria, there were some data on scree vegetation from the high mountains of Pirin (Mucina & al. 1990) and Rila (Roussakova 2000). The other studies were carried out according to the principles and methods of dominant methodology (see Velchev & al. 1969). Such is the work describing the communities of *Centranthus kellereri* and *Silene vulgaris* subsp. *prostrata* (= *S. alpina*) on the limestone screes in Vrachanski Balkan (700 m alt.) by Velchev (1971). The communities of *Centranthus kellereri* have been also described (Velchev &Vassilev 1970) in the Pirin Mts. However, they grew on the high-altitudinal marble screes in this area. *Silene vulgaris* subsp. *prostrata* was also found (Tashev 2006) in a second locality close to Mostovo village, Rhodope Mts. The habitat there was different, as compared to the Vratsa Divide of the Balkan Range, because the communities of *Silene vulgaris* subsp. *prostrata* develop on siliceous (rhyolite) screes. Moreover, the screes there belonged to the high-altitudinal habitat – 8110.

The established new habitats to Bulgaria are characterized by their main features, distribution and species of vascular plants, mosses and lichens:

### H2.5 Temperate, lowland to montane siliceous screes (Fig. 2) – corresponding code from Annex I of Directive 92/43/EEC: 8150 Medio-European upland siliceous screes

**Characteristics:** The habitat is represented by siliceous screes, spread in the lower parts of the mountains and foothills, but below the altitudinal range of 800–1100 m a.s.l., and also depends on the exposition. Baserocks could vary: acidic, mainly of volcanic origin (intrusive and effusive rocks), granites, rhyolites, diorites, syenites, andesites, basalts, etc. They usually do not have any herbaceous vegetation cover, only the synusia of various lichens, liverworts and mosses. However, in the region of the Studen Kladenets village single trees of *Acer monspessulanum* and *Corylus colurna* have been also found growing on the screes.

**Distribution in Bulgaria**: Siliceous screes are distributed mostly in the low mountains and foothills of South Bulgaria. The largest areas were found in the Eastern Rhodope Mts (in the former volcanic calderas of the Studen Kladenets Dam and Madzharovo town), but also in the deep valleys (gorges) of Struma and Mesta rivers.

**Vascular flora**: *Achnatherum calamagrostis, Asplenium adiantum-nigrum, Cystopteris fragilis, Cota tinctoria* (= *Anthemis tinctoria*), *Jovibarba heuffelii, Galeopsis ladanum, G. tetrahit, Geranium macrorrhizum, G. robertianum, Epilobium dodonaei, Lactuca viminea, Melica ciliata, Melilotus neapolitana, Micropyrum tenellum, Myosotis ramosissima, Notholaena marantheae, Poa nemoralis, Hylotelephim maximum* (= *Sedum maximum*), *Saxifraga sibirica* (= *S. mollis*), *Silene vulgaris* subsp. *prostrata, Sedum album, Senecio viscosus, Verbascum roripifolium, V. orientale.*

**Mosses**: *Ceratodon purpureus, Rhacomitrium canescens, Bryum argenteum, B. caespiticium, Grimmia pulvinata, Schistidium apocarpum.*

**Lichens**: *Cladonia arbuscula, C. cariosa* s.l., *Diploschistes scruposus*, *Pertusaria* spp., *Stereocaulon paschale, Umbilicaria* spp., *Xanthoparmelia conspersa*, *X. loxodes*, *X. pulla*., *X. stenophylla*.

**Role for preservation of plants with conservation significance:** Siliceous screes are mostly unvegetated or very sparsely vegetated. Small numbers of vascular plants could be rarely found there. Such are *Saxifraga sibirica* (EN) in the Eastern Rhodope Mts. This species is protected under the Bulgarian Biodiversity Act.

**Fig. 2.** Siliceous screes in the Eastern Rhodope Mts. Studen Kladenets village.

### H2.6a Temperate, lowland to sub-montane base-rich screes (Figs. 3, 4) – corresponding code from Annex I of Directive 92/43/EEC: 8160* Medio-European calcareous screes of hill and montane levels

**Fig. 3.** Calcareous scree in the Karlukovo Carst Area. Reselets village.

**Characteristics:** The habitat is represented by calcareous (limestone) screes, widespread in the lower parts of the mountains and foothills, below the altitudinal range of 800–1100 m a.s.l., also depending on the exposition. Baserocks are mainly alkaline organogenic rocks: limestones, dolomites, marble, etc. As compared to the siliceous screes, the calciphilous are often occupied not only by moss and lichen communities, but by some vascular plants, depending on the sliding movement. For example, in the Karlukovo Karst Area, the regional endemic *Seseli degenii* is typical of these screes. According to Velchev (1971), the calcareous screes of the Vrachanski Balkan are comparatively well moisturized due to the water runoff from the surrounding slopes. Two species are well adapted to the scree conditions and dominate there: *Centranthus kellereri* and *Silene vulgaris* subsp. *prostrata.* However, there are other established species with significant participation: *Clinopodium vulgare*, *Calamintha nepeta* and *Vincetoxicum hirundinaria*.

**Vascular flora**: *Achillea clypeolata, Achnatherum calamagrostis*, *Allium flavum, Alyssum saxatile* subsp. *saxatile*, *Campanula rapunculoides*, *Calamintha nepeta, Centranthus kellereri, Ceterach officinarum, Clinopodium vulgare, Cnidium silaifolium, Cystopteris fragilis*, *Dianthus noeanus*, *Delphinium fissum, Eupatorium cannabinum*, *Jovibarba heuffelii*, *Galeopsis ladanum*, *Geranium macrorrhizum, G. lucidum, Gymnocarpium robertianum*, *Festuca xanthina*, *Hieracium bifidum*, *Lamium garganicum*, *Lunaria annua*, *Melica ciliata*, *Parietaria officinalis*, *Poa nemoralis*, *Senecio rupestris*, *Seseli degenii, Sesleria filifolia, Scrophularia canina*, *Silene csereii, S. vulgaris* subsp. *prostrata*, *Vincetoxicum hirundinaria.*

**Mosses**: *Brachytheciastrum velutinum, Ceratodon purpureus, Conocephalum conicum, Ctenidium molluscum, Didymodon* spp., *Eurhynchium schleicheri, Grimmia pulvinata, G. ovalis, Homalothecium sericeum, Mnium stellare, Plagiomnium affine, Pleurochaete squarrosa, Scapania aspera, Syntrichia ruralis, Tortella tortuosa.*

**Lichens**: *Calloplaca crenulatella* s. l., *Clauzadea immersa*, *Collema tenax*, *Mycobilimbia lurida, Petractis clausa*, *Verrucaria marmorea.*

**Fig. 4.** Calcareous scree in the Vrachanski Balkan Divide. Vratsata Area.

**Role for preservation of plants with conservation significance:** The low-altitudinal base-rich screes are richer in rare and endemic plants in comparison to the siliceous screes. They are the only known habitat of the critically endangered *Centranthus kellereri* in its second locality in the Vrachanski Balkan, and of *Silene vulgaris* subsp. *prostrata* in Bulgaria. However, the second species was also found on siliceous (rhyolite) screes in the Central Rhodope Mts (Tashev 2006). Species with conservation significance on the base-rich screes are also *Seseli degenii* (VU), *Silene vulgaris* subsp. *prostrata* (CR), *Festuca xanthina* (VU), and probably some others. Those species are protected under the Bulgarian Biodiversity Act.

## Representation in the NATURA 2000 sites

Further researches are needed to clarify the actual distribution and the areas occupied by the two habitats in Bulgaria. Mapping and clarification of their floristic structure, representation in the protected areas and other peculiarities should be also included.

Both newly found habitats have been suggested (see Table 1) to be included in the standard data form (SDF) of NATURA 2000 sites, where thir distribution was

**Table 1. Preliminary data for representation in the NATURA 2000 sites of the two scree habitats.**

| Biogeographic region | Name of NATURA 2000 site | 8150 Area (ha) | 8150 % | 8160 Area (ha) | 8160 % |
|---|---|---|---|---|---|
| ALP | **BG0000399 Bulgarka** | 0.06 | 0.37% | – | – |
| ALP | **BG0000220 Dolna Mesta** | 0.16 | 0.99% | – | – |
| ALP | **BG0001021 River Mesta** | 2.89 | 17.56% | – | – |
| ALP | **BG0001031 Rodopes – Central** | 2.29 | 13.91% | – | – |
| ALP | **BG0001030 Rodopes – Western** | – | – | 0.27 | 0.31% |
| ALP | **BG0001028 Central Pirin – Alibotush** | – | – | 0.23 | 0.27% |
| ALP | **BG0001493 Central Balkan – buffer** | 3.99 | 24.24% | 17.16 | 19.91% |
| ALP | **BG0000211 Mt Tvardishka** | 0.29 | 1.75% | – | – |
| ALP | **BG0000166 Vrachanski Balkan** | 0.37 | 2.28% | 60.42 | 70.09% |
| ALP | **BG0001386 Yadenitsa** | 0.17 | 1.03% | – | – |
| ALP | **Outside of Natura 2000 sites** | 6.23 | 37.87% | 8.13 | 9.43% |
| BLS | **BG0000133 Kamchiyska and Emenska Mts** | 0.19 | 100.00% | – | |
| CON | **BG0001033 Brestovitsa** | 3.02 | 1.15% | 5.48 | 8.11% |
| CON | **BG0000214 Dryanovski Monastery** | | 0.00% | 0.48 | 0.70% |
| CON | **BG0000393 Kamchia – Emine Ecocorridor** | 0.33 | 0.13% | – | – |
| CON | **BG0000304 Golak** | 0.97 | 0.37% | – | – |
| CON | **BG0000432 Golyama Reka** | | 0.00% | 1.27 | 1.88% |
| CON | **BG0000420 Grebenets** | 0.59 | 0.22% | – | – |
| CON | **BG0000133 Kamchiyska and Emenska Mts** | 1.64 | 0.63% | 2.09 | 3.10% |
| CON | **BG0001014 Karlukovo** | | 0.00% | 2.60 | 3.84% |
| CON | **BG0000117 Mt Kotlenska** | 1.96 | 0.75% | – | – |
| CON | **BG0000366 Kresna – Ilindentsi** | 25.69 | 9.80% | – | – |
| CON | **BG0001011 Mt Osogovska** | 0.19 | 0.07% | – | – |
| CON | **BG0000137 Dolna Luda Kamchia river** | 0.02 | 0.01% | – | – |
| CON | **BG0000149 Rishki Pass** | | – | 1.21 | 1.78% |
| CON | **BG0001032 Rodopes – Eastern** | 127.51 | 48.63% | 2.82 | 4.17% |
| CON | **BG0001031 Rodopes – Central** | 18.29 | 6.98% | | – |
| CON | **BG0000164 Sinite Kamani** | 1.01 | 0.39% | 0.39 | 0.58% |
| CON | **BG0001013 Skrino** | 0.27 | 0.10% | | 0.00% |
| CON | **BG0001028 Central Pirin – Alibotush** | 7.63 | 2.91% | 3.25 | 4.81% |
| CON | **BG0000240 Studenets** | | 0.00% | 0.22 | 0.32% |
| CON | **BG0001493 Central Balkan – buffer** | 1.33 | 0.51% | 3.05 | 4.51% |
| CON | **BG0000211 Mt Tvardishka** | 0.03 | 0.01% | | – |
| CON | **BG0000190 Vitata Stena** | 1.06 | 0.41% | 1.22 | 1.80% |
| CON | **BG0000166 Vrachanski Balkan** | | – | 25.67 | 37.96% |
| CON | **Outside of Natura 2000 sites** | 70.70 | 26.96% | 17.87 | 26.43% |
| **Total area** | | **278.86** | | **153.80** | |

identified. Their total area was calculated in the same table using the GIS models. The biogeographic regions of the European Union (Roekaerts 2002) are presented in this table with their abbreviations as follows: Continental (CON), Alpine (ALP) and Black Sea (BLS).

A preliminary overview could be made, based on the GIS modeling and mapping of both habitats (Table 1). As the results have shown, the habitats are presented in 26 NATURA 2000 sites for 8150; and in 17 NATURA 2000 sites for 8160. The siliceous screes occupy an area of 279 ha in the country. The base-rich screes have an area of 154 ha. The coverage of siliceous screes is 202 ha, or 73% of them fall into the existing NATURA 2000 sites. The coverage of base-rich screes is 128 ha or 74% of them fall into the existing NATURA 2000 sites. Only the second habitat has priority importance, but probably it is not necessary to declare new sites for preservation.

## Conclusions

The low-altitudinal screes are new to Bulgaria habitats with conservation significance. Considering that they fall under the Habitats Directive, their inclusion in the Annex I of the Bulgarian Biodiversity Act is also necessary. Therefore, they will become target objects for preservation in the sites, where they are found. This also means that they should be supplemented in SDF of the existing NATURA 2000 sites.

We could also suggest their translation into Bulgarian for Annex I of the Bulgarian Biodiversity Act:

– 8150 Medio-European upland siliceous screes;
– 8160* Medio-European calcareous screes of hill and montane levels.

So far there has been no evidence of any significant direct threats to the habitats, especially in the observed sites. The only greater natural threats are the specific destructive processes typical for all areas with rock-falls. However, in some sites like Vrachanski Balkan, invasion of some pioneer alien species as *Ailanthus altissima* has been observed. This will require certain measures for protection and restoration, mostly for the populations of the critically endangered species on the screes, such as *Silene vulgaris* subsp. *prostrata* and *Centranthus kellereri*.

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