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PLANT BIODIVERSITY OF SPHAGNUM-DOMINATED MIRES IN VITOSHA NATURE PARK

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ABSTRACT: Eighty-four *Sphagnum*-dominated mire complexes on the territory of Vitosha Nature Park were studied. It included spatial inventory as well as full account of plant species and plant community diversity in each mire. The distribution of mires with respect to elevation and exposure was analyzed. We found 121 vascular plant species and 89 bryophytes. This is a substantial biodiversity considering the small total area of this type of habitats in the Park (0.4% of its territory) and their patchiness. We recorded 24 species of conservation importance. The registered phytocoenoses belong to three classes, three orders, five alliances, six plant associations, three subassociations and five plant communities. The major identified threats for *Sphagnum*-dominated mires were changes in the hydrological regime due to natural drainage and climate change, as well as anthropogenic drainage and water catchment. Other negative impacts are deposition of airborne pollutants, trampling by tourists, wastes, grazing and burning. Our work highlights the role of Vitosha Nature Park for the conservation of *Sphagnum*-dominated mires in Bulgaria and the importance of proper management for their protection.

Keywords: plant biodiversity, phytocoenoses, diagnostic species, bryophytes, conservation, Bulgaria.

1 INTRODUCTION

Sphagnum-dominated mires on Mt Vitosha are among the most representative and in the most intact state in Bulgaria [8]. The characteristic climatic conditions and historical development of the mountain determine the formation of various plant communities that are dominated or participated by *Sphagnum* and/or other peat-forming mosses. These communities harbor a large number of species, many of which are of conservation importance. The specific hydrological regime and their vulnerability to various biotic and abiotic factors highlight a number of problems related to adequate management and conservation of *Sphagnum*-dominated mires on the territory of Vitosha Nature Park.

The first mention of *Sphagnum*-dominated mires in Bulgaria, and on Mt Vitosha in particular, was made by Adamovič [1]. He gave a brief description of vegetation and a short list of typical plant species for this type of habitat. Adamovič divided high-mountain mires into two groups – subalpine and alpine. However, he did not treat the mires on Mt Vitosha in more details.

The first extensive treatment of the bryophyte flora of the mires on Mt Vitosha was made by Podpéra [25]. He listed 62 species. Plant communities were briefly mentioned in relation to their bryophyte flora.

Brief information about the flora and vegetation of some mire complexes was provided by [2, 7, 19, 22, 30, 32, 33, 34, 37]. Ruskov [28] studied the development of spruce forests in the *Sphagnum*-mires with respect to their forestry value. Petrov [23] treated in detail four mire complexes in the spruce forests of the mountain. He presented the first comprehensive study of floristic diversity (including bryophytes), hydrology, origin and development of these mires. Hájek et al. [39] made the recent treatment of the vegetation of *Sphagnum*-dominated mires in Mt Vitosha. The authors studied the syntaxonomic diversity of 53 mires and reported 45 bryophyte and 102 vascular plant species. Information about the floristic diversity of Vitosha mires was provided also by Hájkova et al. [12], Hájkova & Hájek [11], and Hájek et al. [9, 10].

Vitosha mires are young formations [5, 6, 19, 23, 35]. They started to form in late Subboreal and developed intensively during the Subatlantic.

Despite the relatively large list of publications mentioning in various respects *Sphagnum*-dominated mires on Mt Vitosha, there is still missing a complete inventory of this habitat type. The aim of this study was to make a comprehensive inventory of the distribution, vegetation and flora of *Sphagnum*-dominated mires in Vitosha Nature Park, to evaluate their nature conservation state and to draw attention to the most important threats for this extremely vulnerable and important habitat type.

2 MATERIAL AND METHODS

2.1 Study site

Vitosha Nature Park occupies the larger part of Mt Vitosha (Fig. 1). This is the oldest designated national Park in Bulgaria. Mt Vitosha is situated in the southwestern part of Bulgaria. The average elevation is 1317 m a.s.l., the highest peak is Cherni vrah (2290 m a.s.l.). The average precipitation is ca 1115 mm (841 mm at 1300 m and 1175 mm at 2286 m a.s.l.), the average temperature is ca. 3°C (7°C at 1300 m and 0,3°C at 2286 m a.s.l.). Mt Vitosha is a relatively young dome-shaped mountain containing an older upper Cretaceous crystalline plutonic core, surrounded by volcanic and volcano-sedimentary rocks [36]. Characteristic for the mountain is the presence of large plateau morphostructures that were further modelled by denudation and cryogenic processes. These structures harbor the largest mire complexes in Mt Vitosha and are the major water source of the mountain.

2.2 Spatial inventory

For the initial spatial inventory we used published data as well as the information for the distribution of habitat type 7140 and 91D0 for Mt Vitosha from the project on the Natura 2000 network in Bulgaria “Mapping and assessment of the conservation status of habitats and species. Phase I”. A preliminary map was drawn which was used for the field trips. At each site the geographical coordinates and elevation of a central point were measured via GPS. This data coupled with current

orthophoto images was used to draw polygons of the studied sites.

2.3 Inventory of plant diversity

At each visited polygon in area with typical mire vegetation was selected a relevé of 25 m² for description of plant communities. For communities along springs and brooks the size of relevés was 16 m². Additionally, floristic diversity was studied in transects along the entire site and the recorded additional species were assigned an abundance score of “+”.

The nomenclature of vascular plants follows [4], of mosses [13], and of liverworts [27].

The classification of plant communities was done using the Braun-Blanquet's approach [3, 38]. The abundance/ dominance of taxa was evaluated using an extended nine-grade Braun-Blanquet scale [14]. Cluster analysis was made using the software Syn-Tax [25]. We applied UPGMA, floristic similarity was calculated using the Penrose index. Some relevé were moved manually considering common diagnostic species. The identified clusters were compared with vegetation descriptions provide by Hájek et al. [9, 39]. If general floristic composition, diagnostic, constant and dominating species coincided, the vegetation clusters were assigned to the respective syntaxa and syntaxonomic categories.

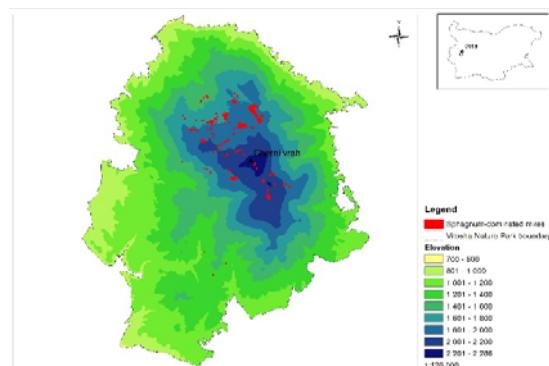


Figure 1: Map of the study area

3 RESULTS

3.1 Distribution of Sphagnum-dominated mires

We studied a total 84 mires on Mt Vitosha (Fig. 1, Annex I). All of them were situated within Vitosha Nature Park. They are distributed in the altitudinal range of 1230-2240 m. The largest number of mires is at 1700-1850 m and above 1900 m a.s.l. with a northern component of exposure (Fig. 2 and Fig. 3). Fewer peatlands are located on the southern slopes due to the prevalence of calcareous bedrock, higher insulation, and lower moisture. These conditions reflect on the vegetation composition and diversity. The total area of all studied mires is 73,3 ha. The average size is 0,9 ha (minimum 0,7 ha, maximum 17,8 ha).

3.2 Plant communities

Plant communities were described at 65 mire polygons. The syntaxonomic analysis revealed that the studied communities belong to three classes, three orders, five alliances, six plant associations, three subassociations and five plant communities (Annex I). Additionally were found plant groups belonging to the rangless category "community". Two of these groups

included five and three relevés, the remaining three were recorded at a single relevé.

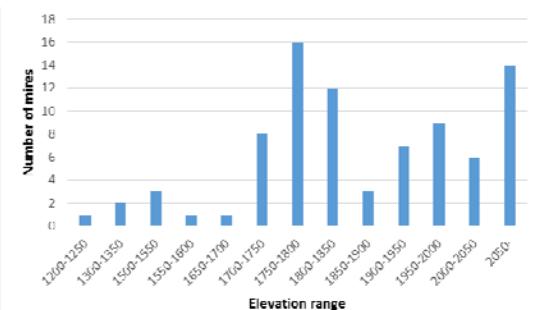


Figure 2: Distribution of Sphagnum-dominated mires in Vitosha Nature Park according to elevation

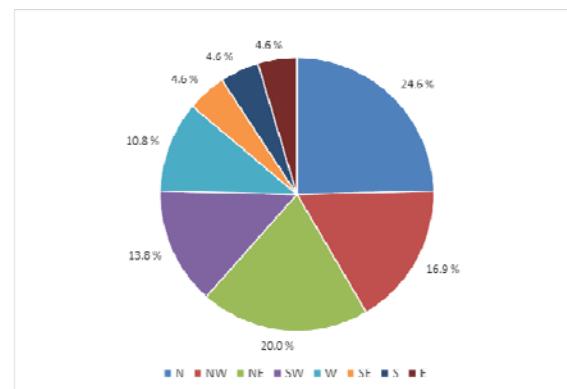


Figure 3: Distribution of Sphagnum-dominated mires in Vitosha Nature park according to exposure

Of the syntaxa described by Hajek et al. [39] only the *Drepanocladetum exannulati* Krajina 1933 was not recorded. The authors point that this association, documented from the Vitosha Mt only by one small relevé, represents the oligotrophic mires dominated by sedges and brown mosses indicating initial, albeit stable, and strongly waterlogged stages of mire formation.

Other communities represented by one locality in Vitosha Mt and distributed mainly in other mountains in Bulgaria [9], were also not identified: ass. *Carici echinatae-Sphagnetum* Soó 1944, ass. *Caricetum nigrae* Braun 1915 subass. *typicum*, var. *Sphagnum teres*, ass. *Dactylorhizo cordigerae-Eriophoretum latifolii* Hájek et al. 2008.

The association *Primulo exiguae-Caricetum echinatae* Roussakova 2000 was found at two relevés. Here are found the diagnostic for this association *Primula exigua*, *Sphagnum platyphyllum*, *Pinguicula balcanica*, and *Pseudorchis frivaldii*. Bryophytes were represented mostly by the genera *Sphagnum*, *Warnstorffia*, and *Polytrichum*.

A large part of mire complexes in Mt Vitosha in the altitudinal range of 1750-1900 m a.s.l. belong to ass. *Cirsio heterotrichi-Caricetum nigrae* (Soo 1957) Hájek, Tzonev, Hájková, Ganeva and Apostolova 2005 [39]. During the present study, this association was found at 18 localities. All of the diagnostic species of the association were registered. Among mosses the largest participation had *Sphagnum warnstorffii*, *Sphagnum capillifolium*, *Sphagnum flexuosum*, *Sphagnum contortum*, *Sphagnum palustre*, *Sphagnum teres*, *Aulacomnium palustre*,

Polytrichum commune, *Warnstorfia exannulata*, *Warnstorfia sarmentosa*, etc. All known successional stages, described as subassociations were present. Subass. *sphagnetosum subsecundi* makes successional and syntaxonomic transition with ass. *Primulo exiguae-Caricetum echinatae*. It was found at 11 localities. The major diagnostic species *Sphagnum subsecundum* was well represented while the remaining diagnostic species *Carex echinata*, *Eriophorum angustifolium*, and *Gentianella bulgarica* had lower constancy and abundance as compared to the original diagnosis of the association. The typical subassociation was present at four relevés. Subass. *eriophoretosum vaginatae* was reported at four relevés and represents the most advanced successional stages within the association.

The largest number of relevés in the present study belonged to ass. *Bruckenthalio-Sphagnetum capillifolii* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005. It represents a more advanced successional stage characterized by shrub and semi-shrub species such as *Juniperus sibirica*, *Vaccinium vitis-idaea*, *Vaccinium myrtillus*, *Vaccinium uliginosum*, *Bruckenthalia spiculifolia*, as well as a number of species typical for wet meadows – *Deschampsia caespitosa*, *Agrostis capillaris*, *Alchemilla vulgaris* agg., *Geum coccineum*, *Allium sibiricum*, *Nardus stricta*, etc. This association was the optimum in the distribution of *Sphagnum capillifolium*. High constancy and abundance had also *Sphagnum platyphyllum*, *Sphagnum subsecundum*, *Warnstorfia exannulata*, *Warnstorfia sarmentosa*, etc. This association was distributed mostly at 1900–2200 m a.s.l.

Association *Angelico pancicii-Calthetum laetae* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005 develops around springs and small water courses. Two relevés belonged to this association. Since the relevés were chosen in order to reveal bryophyte diversity, the abundance of *Caltha palustris* and *Angelica pancicii* was relatively low. Besides the diagnostic *Brachythecium rivulare* and *Rhizomnium punctatum* were detected 10 bryophyte species albeit with lower abundance.

To the spring vegetation belongs the association *Saxifragetum stellaris* Deyl 1940. It was represented at four relevés at 1775–1860 m a.s.l. Of the diagnostic species were found *Saxifraga alpigena*, *Philonotis seriata*, and *Soldanella montana*. Other differential species were *Scapania undulata* and *Oncophorus virens*.

Besides the typical mire and spring vegetation types, Sphagnum mosses develop in hygrophytic communities of order *Molinietalia*. Such were the phytocoenoses of ass. *Scirpetum sylvatici* Ralski 1931, which was found by Hajek et al. [39] as well as in the current study. Differential for this association are *Scirpus sylvaticus*, *Lysimachia vulgaris*, *Scutellaria alpina*, and *Sphagnum fimbriatum*. Other bryophytes are *Dicranella palustris*, *Sphagnum girgensohnii*, *Sphagnum squarrosum*, *Polytrichum commune*, and *Philonotis fontana*.

At some sites were observed phytocoenoses characteristic for advanced successional stages and indicating more mesic conditions – lesser representation of Sphagnum mosses, higher proportion of mesophilic grasses, shrubs and trees. The coenoses of comm. with *Holcus mollis* had relatively high abundance and constancy of species from *Caricetalia fuscae* (*Carex nigra*, *Carex echinata*, *Eriophorum vaginatum*, *Eriophorum latifolium*), as well as species from *Molinietalia* (*Deschampsia caespitosa*, *Angelica pancicii*, *Juncus effusus*, *Scirpus sylvaticus*, *Juncus conglomeratus*,

Potentilla erecta, *Filipendula ulmaria*, etc.). At better-drained places were developed facies dominated by or with higher abundance of *Holcus mollis*, *Calamagrostis arundinacea*, *Rubus idaeus*, *Pinus sylvestris*, and *Alnus glutinosa*. These species indicate a succession towards formation of shrub and forest vegetation types. Differential species were *Holcus mollis* and *Calliergonella cuspidata*. Of bryophytes often occur *Sphagnum warnstorffii*, *Sphagnum subsecundum*, *Scapania undulata*, *Warnstorfia exannulata*, *Sphagnum flexuosum*, *Sphagnum contortum*, etc. Similar species composition had the coenoses of comm. of *Festuca rubra*, where high constancy and relatively high abundance had *Festuca rubra* and *Agrostis capillaris*.

Community of *Carex rostrata* was found at one locality. It developed at a water saturated site at the edge of permanent water pool. Differential and dominant species were *Carex rostrata* and *Carex curta*. Bryophytes with highest abundance were *Sphagnum teres*, *Sphagnum russowii*, *Sphagnum inundatum*, *Polytrichum commune*, *Warnstorfia exannulata*, *Aulacomnium palustre*, and *Philonotis fontana*.

Community of *Carex nigra* and *Luzula sudetica* is transitional between ass. *Primulo exiguae-Caricetum echinatae* and ass. *Saxifragetum stellaris*. Major dominants were *Carex nigra*, *Sphagnum capillifolium*, *Luzula sudetica*, *Carex echinata*, and *Sphagnum flexuosum*. Higher participation had also *Sphagnum contortum*, *Sphagnum inundatum*, *Scorpidium cossonii*, *Philonotis seriata*, *Rhizomnium punctatum*, etc.

Community of *Fissidens adianthoides* and *Hamatocaulis vernicosus* was described at one site with lower cover of vascular plants. A large number of bryophytes without a clear dominant also participated in this community. Differential species were *Fissidens adianthoides* and *Hamatocaulis vernicosus*. The optimum development of the latter species is where herbaceous vascular plants are absent or their abundance is low [31].

3.3 Plant diversity and conservation species

In Sphagnum-dominated mires on the territory of Vitosha Natural Park were found a total of 210 plant species (Table I). Of them 121 were vascular plants and 89 were bryophytes. Nine vascular plants and 15 bryophytes are of conservation importance (Table I). Two species are Critically Endangered, three Endangered, 17 Vulnerable, one Near Threatened, and one Data Deficient [18, 24, 21]. Further three species are included in Annex II and 22 species are included in Annex 2a of Bulgarian Biodiversity Act. One species is included in Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

Further five species are Balkan endemics or sub-endemics (*Angelica pancicii*, *Senecio pancicii*, *Gentianella bulgarica*, *Crocus veluchensis*, and *Cirsium heterotrichum*). Ten bryophyte species (*Sphagnum auriculatum*, *Sphagnum compactum*, *Sphagnum subnitens*, *Calypogeia neesiana*, *Campylium polygamum*, *Plagiomnium ellipticum*, *Scorpidium cossonii*, *Scorpidium revolvens*, *Drepanocladus polygamum*, and *Dichelyma falcatum*) are new to the flora of Mt. Vitosha.

4 DISCUSSION

4.1 Importance of Vitosha Nature Park for the conservation of Sphagnum-dominated mires

Table I: Vascular plant and bryophyte species of conservation importance in *Sphagnum*-dominated mires on the territory of Vitosha Nature Park. Abbreviations: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, DD – Data Deficient, RL – Red list, RDB – Red Data Book of Republic of Bulgaria, BA – Biodiversity Act of Bulgaria.

Nº	Species	Category	National conservation status	Other
Vascular plants				
1.	<i>Angelica pancici</i>	VU	RL	Balkan endemic
2.	<i>Drosera rotundifolia</i>	VU	RL	
3.	<i>Potentilla palustris</i>	VU	RL	
4.	<i>Pseudorchis albida</i>	VU	RL, CITES	
5.	<i>Pseudorchis frivaldii</i>	VU	RL, CITES	
6.	<i>Salix pentandra</i>	CR	RL, RDB, BA	Glacial relict
7.	<i>Senecio pancici</i>	NT	RL	Balkan endemic
8.	<i>Swertia perennis</i>	EN	RL, RDB	Glacial relict
9.	<i>Utricularia minor</i>	EN	RL, RDB, BA	
Bryophytes				
1.	<i>Bryum weigelii</i>	VU	RL	
2.	<i>Calypogeia sphagnicola</i>	VU	RL	
3.	<i>Drepanocladus polygamum</i>	VU	RL	
4.	<i>Cephalozia connivens</i>	VU	RL	
5.	<i>Cephalozia pleniceps</i>	DD	RL	
6.	<i>Cephaloziella hampeana</i>	CR	RL, RDB	
7.	<i>Hamatocaulis vernicosus</i>	VU	RL, RDB, BA, Directive 92/43	
8.	<i>Meesia uliginosa</i>	VU	RL	
9.	<i>Plagiothecium denticulatum var. undulatum</i>	VU	RL	
10.	<i>Riccardia incurvata</i>	VU	RL	
11.	<i>Riccardia multifida</i>	VU	RL	
12.	<i>Scorpidium revolvens</i>	VU	RL, RDB	
13.	<i>Sphagnum fallax</i>	VU	RL	
14.	<i>Sphagnum subnitens</i>	VU	RL, RDB	
15.	<i>Tomentypnum nitens</i>	EN	RL, RDB	

Vitosha Nature Park is an important area for the conservation of *Sphagnum*-dominated mires and their plant species and community diversity in Bulgaria. Mt Vitosha is the richest of *Sphagnum*-mosses phytogeographic region in Bulgaria with 23 species. Despite the restricted and scattered distribution and small size, this type of habitat is characterized by a considerable plant species and plant community diversity. For the first time Stefanoff [32] paid attention to the process of drying out of Vitosha mires. He suggested that measures must be undertaken for their restoration in the light of their importance for the water regime of the mountain. In addition to their role for biodiversity conservation, Vitosha mires provide a number of valuable ecosystem services. The most important of them are related to the water holding and water regulation capacity of *Sphagnum* cover and the peat layer. The rain and snowmelt water penetrate slowly in the peat and thus it supports the even river flow. Most rivers of Mt Vitosha have their sources in *Sphagnum*-dominated mires.

The most important threat to the mires in Mt Vitosha is drying. This is mostly a natural process due to two factors: climate change and lowering of water table due to water erosion of stream beds. The natural processes were enhanced by building of a number of water catchments for drinking water in the spring areas of many mires in the 1950-s and 1960-s. Drying has a twofold effect. On the one hand, it suppresses the development of the major habitat component – *Sphagnum* mosses. On the other hand drying stimulates the development of more competitive vascular plants. The overall effect is gradual displacement of the typical mire species with species of mesophilic meadows. The process of displacement is

enhanced by increased nutrient input from air pollution with nitrogen and sulphur from the nearby urban areas (the city of Sofia and the industrial area of town Pernik) which was considerable during the middle of XIX by the end of XX century.

Proper management of *Sphagnum*-dominated mires on the territory of the Park is needed in order to protect this unique and rich type of habitat. This include mostly preventive measures: careful consideration when new water catchments or infrastructures are built in order to prevent disturbance of water regime, taking measures to avoid passing of tourists through mires, and last but not least raising awareness for the importance and vulnerability of *Sphagnum*-mires. Active restoration of some sites with disturbed water regime may also be undertaken. Such recommendation could be found also in the report for habitat 7140 Transition mires and quaking bogs (distribution and ecological status) as a result of above mentioned project on mapping habitats and species in Natura 2000 sites in Bulgaria (<http://natura2000.moew.government.bg>).

4.2 Comments on some species of conservation importance

Drosera rotundifolia. The species was reported for Mt. Vitosha in 1883 [20]. Since then there are occasional reports [e.g. 23] but the general view was that it is rare. Our study showed that *D. rotundifolia* is a relatively regular member of *Sphagnum*-dominated mires in Mt Vitosha having being found at 18 sites. All of them are situated in the altitudinal range of 1300-1886 m a.s.l. At most sites the populations are numerous and in very good state.

Potentilla palustris. In Mt. Vitosha it has been found for the first time in 1930 [37], and has not been reported since then for the flora of the mountain. We found it at three sites. The populations were represented by a small number of individuals with scattered shoots often barely to be seen above the *Sphagnum* cover. Only at one site the plants were observed with flowers.

Sphagnum subnitens. This is the first report of the species for Mt. Vitosha. The species is known only from Pirin [29] and Rila Mts [17]. On Mt. Vitosha *S. subnitens* was found at one site, represented by few small patches. *Drepanocladus polygamum*. This is the first report of the species for Mt. Vitosha. The species is reported only from Pirin Mt [15] but it was not supported by herbarium specimen. The species has not been observed in Bulgaria since 1966.

Hamatocaulis vernicosus. The occurrence of *H. vernicosus* on Mt. Vitosha has been doubtful. It was reported by Podpéra [26] for loc. Dragalevsko blato, which is located around the springs of Dragalevska river at ca. 1800 m a.s.l. and is today called loc. Kapaklivets. The attempts of the authors to verify the occurrence of the species at this locality proved unsuccessful. Since the conditions at the site differ from the conditions, where *H. vernicosus* is found in Bulgaria at present and is not supported by herbarium specimen, this report was treated as probable misidentification. The location of *H. vernicosus* on the south-western slopes of Mt. Vitosha in the current study is the first confirmed occurrence of the species in Vitosha Nature Park.

Dichelyma falcatum. This species was recently added to the list of bryophytes in Bulgaria. It was found for the first time in Rila Mts at 2300 m a.s.l. [16]. This is the second location of *D. falcatum* in Bulgaria and the first report for Mt. Vitosha. The species had similar ecological requirements on Mt. Vitosha – high elevation (2230 m a.s.l.) growing on acidic rocks in streams that dry out in late summer flowing through *Sphagnum*-mires. The species is not Red-listed because it was found in Bulgaria after the publication of the most recent Red list [18]. However, since its discovery it proved to be rare and grows at extremely vulnerable sites. It will therefore be considered in the next evaluation of Bulgarian bryophytes and will be assigned to a threat category.

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Annex I: Area, elevation and geographic coordinates of the investigated mire in Vitosha Nature Park. Mire numbers correspond to Annex II.

Nr.	Area (ha)	Elevation (m a.s.l.)	Longitude	Latitude
1	0.05	1800	23.291063	42.58905
2	0.01	2240	23.282532	42.562478
3	0.06	2235	23.281997	42.562313
4	0.23	2225	23.28138	42.561382
5	0.16	2225	23.28331	42.559605
6	1.73	2150	23.289183	42.551828
7	0.56	2150	23.2935	42.546433
8	0.51	1957	23.279205	42.58437
9	0.28	2130	23.293127	42.544017
10	3.65	2130	23.293842	42.542563
11	0.02	2060	23.29362	42.55549
12	0.31	2060	23.294455	42.555632
13	6.1	1790	23.256981	42.59076
14	0.1	1824	23.232778	42.581372
15	0.01	1952	23.277223	42.5847
16	0.28	1822	23.234676	42.58076
17	1.59	1814	23.230481	42.581557
18	0.04	1727	23.233761	42.587235
19	0.99	1510	23.241319	42.602244
20	0.03	1833	23.246824	42.58457
21	0.25	1887	23.246224	42.58239
22	11.07	1926	23.268523	42.58455
23	0.04	1885	23.243607	42.58194
24	0.11	1787	23.249498	42.58665
25	0.03	1775	23.249945	42.58826
26	0.27	1774	23.249263	42.588952
27	0.02	1755	23.240201	42.58725
28	0.15	1725	23.238814	42.58735
29	0.14	1526	23.239467	42.60144
30	0.4	1545	23.237193	42.59924
31	0.11	1656	23.223465	42.58983
32	0.16	1700	23.224869	42.58817
33	0.33	1776	23.24276	42.58618
34	0.02	1787	23.24408	42.5863
35	0.57	1780	23.244945	42.58667
36	2.73	1793	23.246718	42.58666
37	0.01	1787	23.266442	42.60308
38	0.01	1786	23.266137	42.60312
39	0.01	1790	23.265989	42.60296
40	0.07	1794	23.265603	42.60301
41	0.01	1789	23.265068	42.60321
42	0.18	1785	23.263199	42.6045
43	3.86	1805	23.263971	42.59937
44	5.69	1830	23.284095	42.58901
45	0.52	1840	23.285689	42.59171
46	0.04	1818	23.283812	42.59409
47	0.08	1806	23.282432	42.59687

Nr.	Area (ha)	Elevation (m a.s.l.)	Longitude	Latitude
48	0.11	1815	23.281437	42.59702
49	17.08	1840	23.278615	42.59497
50	0.06	1815	23.296888	42.55645
51	0.04	2010	23.295881	42.55655
52	0.02	2030	23.295526	42.55583
53	0.02	1940	23.307565	42.55028
54	0.01	1950	23.307448	42.54984
55	0.09	1920	23.309799	42.54926
56	0.12	1920	23.310269	42.54851
57	0.22	2140	23.29859	42.549707
58	4.29	1970	23.265713	42.55256
59	0.96	1990	23.261705	42.55737
60	0.04	1573	23.224503	42.56128
61	0.03	1701	23.24201	42.5579
62	0.02	1705	23.2438	42.55762
63	0.03	1706	23.244265	42.55748
64	0.11	1711	23.247182	42.55536
65	0.08	1718	23.247104	42.55622
66	0.01	1230	23.245056	42.50663
67	0.06	1318	23.252863	42.49297
68	0.06	1348	23.262691	42.50016
69	0.04	1879	23.283993	42.58691
70	0.17	2117	23.273196	42.56725
71	0.1	2046	23.270814	42.57024
72	1.62	2040	23.268327	42.56941
73	0.02	2030	23.266009	42.56885
74	0.48	2052	23.259509	42.56709
75	0.02	2051	23.257008	42.56617
76	0.06	2038	23.256381	42.5665
77	0.22	1994	23.248799	42.56785
78	0.81	1996	23.253211	42.56966
79	0.26	1994	23.251895	42.57214
80	0.49	1976	23.254119	42.57277
81	1.62	1954	23.259068	42.57493
82	0.33	1910	23.26425	42.57935
83	0.04	1912	23.264295	42.58301
84	11.07	1926	23.268523	42.58455
85	0.7	1830	23.303	42.571

Annex II: Synoptic table of the phytocoenoses from Vitosha Mts. Mire numbers correspond to Annex I. 1. Syntaxa: 1. ass. *Primulo exiguae-Caricetum echinatae* Roussakova 2000; 2. ass. *Cirsio heterotrichi-Caricetum nigrae* (Soo 1957) Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005 subass. *sphagnetosum subsecundi* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005; 3. ass. *Cirsio heterotrichi-Caricetum nigrae* (Soo 1957) Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005 subass. *typicum* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005; 4. ass. *Cirsio heterotrichi-Caricetum nigrae* (Soo 1957) Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005 subass. *eriophoretosum vaginatae* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005; 5. ass. *Bruckenthalio-Sphagnetum capillifolii* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005; 6. ass. *Angelico pancicii-Calthetum laetae* Hájek, Tzenev, Hájková, Ganeva and Apostolova 2005; 7. comm. with *Holcus mollis*; 8. ass. *Saxifragetum stellaris* Deyl 1940; 9. comm. of *Festuca rubra*; 10. comm. of *Carex rostrata*; 11. ass. *Scirpetum sylvatici* Ralski 1931; 12. comm. of *Carex nigra* and *Luzula sudetica*; 13. comm. of *Fissidens adianthoides* and *Hamatocaulis vernicosus*.

Syntaxa		1	2	3	4	5	6	7	8	9	10	11	12	13
Number of relevés		2	10	4	4	26	2	5	5	3	1	1	1	1
Number of species		75	110	103	64	147	42	78	75	45	24	12	26	26
Taxa	Mire number	CONSTANCY/ABUNDANCE												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Primula *exigua</i>	1, 3-6, 10, 12, 16, 25, 27, 38, 39, 49, 57, 64, 65, 75, 82	V ⁺¹	II ⁺			III ⁺								
<i>Sphagnum platyphyllum</i>	2, 3, 9-11, 16, 25, 49, 50, 69-71, 74, 76, 78, 79	V ^{2m-2b}	I ^{2a}			III ^{2b-3}								
<i>Carex nigra</i>	1, 2, 4, 6-8, 10-13, 15-17, 20, 21, 27-29, 32-35, 37, 43, 57, 61, 63-65, 69-71, 73-75, 78, 82	V ⁺¹	V ⁺⁵	V ⁺³	V ⁺³	V ⁺⁴	V ^{2b-3}	III ^{2a-2b}		+		4		
<i>Molinia caerulea</i>	1, 13, 14, 16, 17, 19-23, 25, 27, 28, 32, 36, 38, 39, 42-44, 49, 50, 60, 69, 71	V ⁺	IV ⁺⁴	V ^{2m-3}	IV ⁺⁴	I ⁺³								+
<i>Succisa pratensis</i>	1, 13, 14, 16-23, 25, 27, 29, 32, 33, 36, 38, 39, 42-44, 60, 63, 65, 69, 77, 81	III ⁺	V ^{+2b}	V ^{+2b}	V ⁺³	II ^{+2b}		I ^{2a}		+				+
<i>Cirsium heterotrichum</i>	1, 3, 4, 6-8, 10, 13, 14-17, 20-22, 25, 27, 29, 32, 34, 35, 37, 42, 43, 49, 50, 57, 61, 64, 65, 69-71, 75, 77-79, 81, 82, 85	V ⁺	IV ⁺	IV ^{+2a}	II ⁺	IV ⁺³	V ⁺	I ^{2a}	I ⁺	IV ⁺	+			
<i>Potentilla erecta</i>	4, 6-10, 12-21, 23, 25, 27-29, 32-39, 42-44, 49, 50, 57, 60, 61, 64, 65, 67-71, 74-79, 81, 82, 85	V ⁺	V ^{+2b}	V ^{+2b}	III ^{2b-3}	V ⁺³	V ⁺	IV ^{+2a}	IV ⁺	V ^{2a-3}	+			+
<i>Dactylorhiza cordigera</i> s.l.	1, 5, 10, 11, 13, 16, 17, 21, 23, 25, 27, 29, 32, 33, 37-39, 42, 43, 49, 60, 61, 62, 63, 65, 69, 75, 77, 82	V ⁺	V ⁺¹	II ¹	III ⁺	II ^{+2a}		III ⁺¹			+			+
<i>Sanguisorba officinalis</i>	1, 7, 13, 14-18, 20, 23, 25, 27, 29, 62, 63, 69, 71, 74, 76, 81, 82, 78	III ⁺	II ⁺	IV ^{+2b}	III ⁺	III ^{+2a}		I ⁺						
<i>Sphagnum warnstorffii</i>	1, 2, 4, 9, 13, 14, 17, 19-21, 23, 27, 28, 33, 42, 43, 49, 50, 60, 61, 62, 70, 78, 81	III ⁺	II ^{2m-2a}	IV ^{2m-2a}	III ^{2-m}	II ^{2m-2b}		III ^{2m-2a}	I ^{2b}					1
<i>Sphagnum subsecundum</i>	2, 4-6, 10, 16-18, 25, 27-29, 34, 35, 38, 42, 50, 57, 57, 62, 64, 67-71, 73-75, 78, 79, 82, 85	III ^{2m}	V ⁺³		II ^{2a}	III ^{2a-2b}	V ^{2b-3}	III ^{2a-2b}	I ^{2b}					
<i>Carex echinata</i>	1, 4, 6, 8-11, 13, 16-18, 20, 21, 25, 28, 34-36, 38, 39, 42, 50, 57, 61, 62, 66, 68, 71, 74, 76, 77, 81, 82, 85	III ⁺	II ⁺¹	III ⁺	V ^{+2a}	IV ⁺³	V ^{+2b}	II ^{+2a}	I ⁺		+		2a	
<i>Eriophorum angustifolium</i>	11, 18, 28, 35, 64, 71, 74	III ⁺	II ^{+2a}	III ^{+2m}	II ⁺	I ³								
<i>Gentianella bulgarica</i>	1, 4, 8, 10, 13, 14, 17, 18, 21, 23, 25, 44, 49, 50, 69-71,	III ⁺	II ⁺	IV ⁺	II ⁺	II ⁺	III ⁺			+				

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	74-79, 81, 82												
<i>Eriophorum vaginatum</i>	2, 3, 5, 6, 8, 10, 12, 15, 19, 22, 23, 25, 35, 37-39, 43, 44, 49, 50, 57, 61, 63, 70, 71, 74, 78, 79, 81, 82	III ⁺	III ^{+2a}	II ⁺	V^{2b-4}	III⁺⁴	III ⁺	I ¹	II ⁺¹	II ⁺			
<i>Juniperus sibirica</i>	1, 2, 4, 5, 7-10, 13, 14-16, 18-21, 23, 25, 27, 29, 37, 42, 44, 49, 57, 62-65, 69-71, 73-75, 79	V ⁺	III ^{+2a}	V ⁺	IV ⁺	IV⁺³	III ³	I ^{2a}	II ⁺				+
<i>Bruckenthalia spiculifolia</i>	4, 7, 9, 10, 12, 13, 16, 20, 21, 23, 25, 28, 29, 32, 37-39, 43, 44, 61, 65, 69, 70, 71, 74	III ^{2m}	IV ^{+2a}	IV ⁺¹	II ⁺	III^{+2a}		I ⁺	II ⁺				
<i>Vaccinium myrtillus</i>	4, 7-10, 13, 16, 17, 21, 25, 27, 29, 36, 42, 44, 50, 57, 65, 69-71, 74, 79, 82	III ⁺	II ⁺	III ^{+2m}		III^{+2b}	III ⁺		I ^{2a}				
<i>Vaccinium vitis-idaea</i>	2, 7, 10, 13, 14-17, 20, 23, 25, 29, 32, 38, 39, 43, 44, 50, 57, 65, 69, 71, 74	III ⁺	III ⁺	IV ^{+2m}	II ⁺	II⁺			I ^{2a}				
<i>Sphagnum capillifolium</i>	1-3, 6, 7, 10-13, 15-17, 19-23, 25, 29, 32, 33, 43, 44, 49, 50, 57, 62-65, 70, 71, 73-76, 78, 79, 81, 82	V ^{2m-2b}	III ^{2a-3}	IV ^{2b-3}	V ^{2b}	V^{2m-3}		II ^{2b}	II ^{2a-2b}				3
<i>Homogyne alpina</i>	2-6, 9, 13, 16, 21, 27, 29, 44, 57, 70, 71, 73-76	III ⁺		II ⁺		III⁺			III ⁺				+
<i>Caltha palustris</i> agg.	4, 6, 13, 18, 21, 33, 37, 57, 60, 69, 77		I ⁺	II ⁺		I ⁺	III^{2b}	I ⁺	II ^{+2a}		+		+
<i>Rhizomnium punctatum</i>	12, 36, 73, 75, 85					I ^{2m}	III^{2a}		II ^{2m}	II ^{2a}			2m
<i>Brachythecium rivulare</i>	8, 11, 17, 37-39, 65, 85		II ⁺¹			I ^{2m}	V^{2a}						
<i>Angelica paniculata</i>	1, 10-13, 16-18, 20, 32, 35, 44, 61-63, 65, 69, 75, 85	III ⁺	II ⁺	IV ⁺¹	II ⁺	II ⁺	III⁺	II ⁺	I ⁺	II ⁺			
<i>Holcus mollis</i>	13, 33, 60, 61, 62, 67, 68			II ¹					V^{+2b}				+
<i>Calliergonella cuspidata</i>	14, 16-18, 23, 25, 28, 33, 60-62, 64, 68, 69	III ^{2a}	II ^{2m-2a}	II ^{2a}	II ^{2a}	I ^{2m-2a}		IV^{2m-2b}	I ^{2a}				2m
<i>Calamagrostis arundinacea</i>	14, 62			I ⁺					I³				
<i>Rubus idaeus</i>	17, 18, 44, 62		I ⁺	II ⁺					I^{2a}				
<i>Pinus sylvestris</i>	1, 13, 14, 16-18, 68	III ⁺	I ⁺	III ⁺		I ⁺			I^{2b}				
<i>Alnus glutinosa</i>	68								I^{2a}				
<i>Saxifraga *alpigena</i>	11, 16, 21, 28, 29, 57, 70, 73	III ⁺				I ⁺			IV^{+2b}				+
<i>Philonotis seriata</i>	5-7, 12, 16, 17, 21, 28, 29, 42, 44, 49, 57, 67, 73, 75, 85	V ^{+2m}	II ^{2m-1}	II ^{2m}		I ^{2m-2b}	III ^{2m}	I ^{2a}	IV^{2a}				2a
<i>Soldanella montana</i>	4, 7, 11, 13, 16, 28, 57, 64, 70, 75, 76	III ⁺		II ⁺		II ⁺			III⁺³				
<i>Scapania undulata</i>	1, 2, 11-13, 16, 17, 19-21, 25, 28, 44, 49, 57, 61, 62, 64, 69, 70, 75, 79	V ^{2m}	II ^{1-2m}	IV ^{1-2m}	II ¹	II ^{2m-2a}		II ¹	V^{2m-2a}				
<i>Oncophorus virens</i>	6, 12, 57					I ^{2m}			III^{2m-2a}				
<i>Festuca rubra</i> agg.	2-4, 6, 13, 18-21, 27-29, 32, 34-37, 44, 62, 69, 70, 73, 81		II ^{+2a}	IV ^{+2m}	II ⁺	II ⁺¹		I ⁺	II ¹	V⁺³			+
<i>Juncus effusus</i>	13, 17, 29, 33-35, 66, 68		I ⁺	II ¹		I ⁺		II ⁺¹		IV^{+2a}		1	
<i>Carex rostrata</i>	4												4
<i>Carex curta</i>	29, 77						I ⁺						2b
<i>Scirpus sylvaticus</i>	33-35, 66								I ^{2b}		IV ^{+2a}		4
<i>Lysimachia vulgaris</i>	14, 17, 66		I ⁺	II ⁺									2a

continued

continuation of Annex II

<i>Scutellaria alpina</i>	66																			
<i>Sphagnum fimbriatum</i>	66																		2b	
<i>Luzula sudetica</i>	2, 3, 6, 7, 11, 21, 32, 39, 42, 50, 57, 64, 65, 69-71, 73-78		II ⁺			III ^{+2a}			IV ^{+2a}									+		2a
<i>Fissidens adianthoides</i>	60, 74					I ^r														1
<i>Hamatocaulis vernicosus</i>	60																			1
Other vascular plants																				
<i>Achillea millefolium</i>	17, 18, 62			I ⁺					I ⁺											
<i>Agrostis capillaris</i>	1, 2, 4-9, 13, 14, 17-21, 23, 25, 27, 32-36, 44, 50, 57, 62, 64, 69, 70, 74, 75, 78, 79, 85		III ⁺³	V ⁺	III ⁺	IV ⁺¹	V ⁺	II ^{+2b}	I ⁺	V ⁺³										
<i>Alchemilla vulgaris</i> agg.	1, 5, 7, 11-13, 25, 27, 28, 33, 57, 65, 69-71, 82, 85		I ⁺	II ⁺		II ⁺	III ⁺	I ⁺	III ⁺											
<i>Allium sibiricum</i>	2, 3, 5-7, 10-14-17, 20, 22, 27, 28, 32, 37-39, 43, 44, 50, 57, 69, 70, 71, 74, 75, 78, 79, 82	III ⁺	III ^{+2b}	V ^{+2a}	II ⁺	IV ⁺³				IV ^{+2b}										
<i>Athyrium filix-femina</i>	13, 16, 17, 66	III ⁺	I ⁺	II ^{2m}															+	
<i>Betula pendula</i>	17, 32		I ⁺																	
<i>Bistorta major</i>	2, 7, 13, 15-17, 19-21, 29, 43, 44, 49, 82	V ^{+2a}	II ⁺	IV ^{+2m}	II ⁺	I ^{+2a}														
<i>Briza media</i>	67								I ⁺											
<i>Campanula abietina</i>	32, 44		I ⁺	II ⁺																
<i>Cardamine rivularis</i>	1, 4, 11, 13, 17, 37, 57, 70		I ⁺	II ^{2m}		I ⁺				I ¹										
<i>Carex ovalis</i>	32		I ⁺																	
<i>Carex pallescens</i>	2, 5, 13, 50, 70			II ¹		I ⁺														
<i>Cirsium appendiculatum</i>	1, 4, 21, 28		I ⁺			I ⁺				II ⁺										
<i>Crepis paludosa</i>	1, 2, 8, 29					I ^{+2a}	III ⁺													
<i>Crocus veluchensis</i>	3-6, 18, 44, 81		I ⁺	II ⁺		I ⁺														
<i>Cruciata glabra</i>	1, 13, 18		I ⁺	II ⁺																
<i>Deschampsia caespitosa</i>	1-15, 17, 18, 20, 21, 23, 25, 28, 32, 34-37, 42-44, 49, 50, 57, 60, 62, 64, 68, 70, 71, 73-79, 81, 82	III ⁺	IV ⁺¹	V ^{+2a}	II ⁺	V ^{+2b}	III ⁴	II ⁺³	IV ⁺¹	V ¹⁻³	2b							+	+	
<i>Deschampsia flexuosa</i>	8, 13, 15, 17, 21, 35, 37, 42, 44, 57, 69-71, 74		II ⁺	III ^{+2m}		I ⁺¹	III ⁺		I ¹	II ¹										
<i>Dianthus superbus</i>	1, 15, 60-64, 69, 79				II ⁺	I ⁺¹			II ^{1-2a}											+
<i>Doronicum austriacum</i>	4					I ⁺														
<i>Drosera rotundifolia</i>	13, 16, 17, 23-26, 28, 32, 43, 49, 61-65, 67, 68	V ⁺	II ⁺	II ^{2m}	III ⁺	I ⁺		II ⁺												
<i>Epilobium angustifolium</i>	14, 17, 44, 49, 71	III ⁺	I ⁺	III ⁺																
<i>Epilobium palustre</i>	4, 11, 13, 18, 20, 22, 34, 36, 69, 74-76, 79		I ⁺	III ⁺	II ⁺	II ⁺				IV ⁺										
<i>Equisetum hiemale</i>	61, 63, 66				II ⁺				I ⁺									+		
<i>Equisetum palustre</i>	13, 17, 23, 33-35, 44, 50, 68, 77		I ⁺	III ⁺¹	II ⁺	I ⁺			II ⁺		IV ⁺	+								
<i>Eriophorum latifolium</i>	1, 2, 4, 7, 10-14, 16, 17, 27, 29, 37-39, 44, 49, 57, 61,	V ^{+2a}	II ⁺¹	IV ^{+2a}		IV ⁺³	III ⁴	I ³	IV ^{+2b}											+

continued

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	64, 65, 69-71, 73-76, 79, 82, 85												
<i>Euphrasia rostkoviana</i>	6, 11, 16, 32, 64, 69, 71, 82	III ⁺	I ⁺										
<i>Festuca valida</i>	8							III ⁺					
<i>Filipendula ulmaria</i>	1, 17, 18, 33, 34		I ⁺			I ⁺		I ^{2a}		II ⁺			
<i>Galium palustre</i>	1, 32-34		I ⁺			I ⁺		I ¹		II ⁺			
<i>Gentiana pneumonanthe</i>	6, 10, 11, 16, 49, 57, 68, 75, 78, 82	V ⁺				II ⁺		I ⁺	I ⁺				
<i>Geum coccineum</i>	1-13, 16-18, 21, 23, 25, 28, 29, 32, 34-37, 42-44, 50, 57, 61, 64, 65, 69, 71, 73-77, 81, 82, 85	III ⁺	IV ⁺	III ⁺¹	II ⁺	IV ^{+2a}	V ⁺	I ⁺	V ⁺	V ⁺	+	+	
<i>Geum montanum</i>	4, 7					I ⁺							
<i>Hieracium cymosum</i>	21								I ⁺				
<i>Hypericum maculatum</i>	6-8, 17, 18, 20, 21, 32, 62, 69, 73		I ⁺	II ⁺		I ⁺	III ⁺	I ⁺	II ⁺				+
<i>Hypericum perforatum</i>	17, 18, 67		I ⁺					I ⁺					
<i>Juncus articulatus</i>	1, 7, 8, 11, 12, 14-16, 29, 33, 49, 50, 61, 63, 65	V ^{+2m}		II ⁺	II ⁺	II ⁺¹	III ⁺	II ⁺	I ⁺				
<i>Juncus conglomeratus</i> agg.	1, 8, 11, 14, 16-18, 21, 25, 28, 35, 36, 61-64, 67, 69, 85	III ⁺	I ⁺	II ⁺	II ⁺	I ⁺	V ^{+2b}	III ⁺	II ^{2a}	IV ⁺			
<i>Juniperus communis</i>	68							I ⁺					
<i>Lathyrus pratensis</i>	1, 8, 32-35, 61, 62		I ⁺			I ⁺	III ⁺	III ⁺		IV ⁺			
<i>Leontodon autumnalis</i>	3-5, 10-12, 18, 25, 27, 32, 33, 61, 62, 64, 65, 67, 69, 71, 75, 76, 78, 82		I ⁺			III ⁺		IV ⁺	I ⁺				
<i>Luzula forsteri</i>	43		I ⁺										
<i>Luzula luzuloides</i>	27					I ⁺							
<i>Luzula sylvatica</i>	13, 18, 27, 29		I ⁺	II ¹		I ⁺							
<i>Lysimachia nummularia</i>	18, 35, 37		I ⁺							II			
<i>Lythrum salicaria</i>	13, 17, 18, 60, 67		I ⁺¹	II ^{2m}				I ⁺					+
<i>Matricaria caucasica</i>	2, 4, 5, 9, 67					I ⁺		I ⁺					
<i>Mentha arvensis</i>	67							I ⁺					
<i>Meum mutellina</i>	2-7, 10-12, 17, 18, 33, 34, 62, 69, 74, 82		I ⁺			III ^{+2a}		II ⁺	I ⁺	II ¹			
<i>Myosotis scorpioides</i> agg.	1, 11, 15, 21, 33, 34, 37, 57, 69		I ⁺			I ⁺		I ⁺	I ⁺	II ⁺			
<i>Nardus stricta</i>	1-5, 6, 8, 13, 18, 21, 29, 44, 62, 64, 68, 69-71, 73-76, 78, 79, 85		I ⁺¹	III ⁺¹		IV ⁺³	V ⁺	II ⁺				1	
<i>Parnassia palustris</i>	1, 7, 8, 10, 12, 13, 16, 17, 25, 32, 57, 60, 63, 64, 77-79, 81, 82, 85	III ⁺	I ⁺	II ^{2m}	II ⁺	II ⁺	V ⁺		II ⁺		+		+
<i>Persicaria maculata</i>	6, 10, 11					I ⁺							
<i>Phleum alpinum</i>	2, 23, 25, 28, 44, 49	III ⁺		II ⁺	II ⁺	I ⁺			I ⁺				
<i>Phragmites australis</i>	33							I ⁺					
<i>Picea abies</i>	8, 13, 14, 16-19, 23, 32, 42, 44, 49	V ⁺	II ⁺	IV ⁺	III ⁺	I ⁺	III ⁺						

continued

continuation of Annex II

	65												
<i>Pinguicula balcanica</i>	3-5, 7-13, 16, 21, 29, 49, 57, 60, 62, 64, 69, 77, 78	V ⁺	I ⁺	II ⁺		III ⁺	III ⁺	I ⁺	II ⁺		+		+
<i>Pinus peuce</i>	42		I ⁺										
<i>Plantago gentianoides</i>	6, 35					I ⁺				II ⁺			
<i>Potentilla palustris</i>	15, 22, 43		I ⁺		II ^{2b}	I ⁺							
<i>Potentilla ternata</i>	3, 4						I ⁺						
<i>Pseudorchis albida</i>	16, 39, 42, 44, 65	III ⁺	I ⁺	II ⁺		I ⁺							
<i>Pseudorchis frivaldii</i>	1, 4, 5, 8-11, 16, 23, 25, 29, 32, 37-39, 44, 49, 65, 70, 71, 79, 81	V ⁺	II ⁺	II ⁺	II ⁺	III ⁺	III ⁺						
<i>Ranunculus sartorianus</i>	2, 4-6, 9, 32-34, 69		I ⁺			II ⁺		I ⁺		II ⁺			
<i>Rhynanthus angustifolius</i>	13, 17, 32, 49	III ⁺	I ⁺	I ⁺									
<i>Rumex acetosa</i>	1, 4, 18, 73		I ^l			I ⁺							+
<i>Salix caprea</i>	17-19, 32, 36, 63, 65		I ⁺		III ⁺	I ⁺				II ⁺			
<i>Salix lapponum</i>	1, 6, 10, 12-17, 35-39, 42-44, 49, 57, 65, 67, 69, 71, 75, 76, 78, 81	V ^{+2m}	II ^{+2a}	IV ⁺¹		III ⁺		I ^{2a}	II ^{+2a}	IV ⁺			
<i>Salix waldsteiniana</i>	12-14, 16, 17, 32, 44, 49, 57, 71	V ^{+2m}	I ⁺¹	IV ⁺		I ⁺			II ⁺				
<i>Senecio nemorensis</i>	3, 7, 10, 20, 23, 50, 70, 79			II ⁺	II ⁺	II ⁺							
<i>Senecio pancicii</i>	3, 5, 10, 13, 16, 17, 25, 28, 44, 49, 69-71, 79	V ⁺	I ⁺	III ⁺		II ⁺			I ⁺				
<i>Sesleria comosa</i>	2, 4, 6, 12, 22, 44, 50, 57, 70, 71, 75, 76, 78, 79, 81, 82			II ⁺	II ⁺	III ⁺			II ⁺				
<i>Stellaria graminea</i>	32		I ⁺										
<i>Swertia perennis</i>	6, 10, 63, 82				II ⁺	I ⁺							
<i>Taraxacum appeninum</i>	3, 4, 70					I ⁺							
<i>Thalictrum aquilegifolium</i>	8						III ⁺						
<i>Thlaspi ptraecox</i>	6, 44			II ⁺		I ⁺							
<i>Trichophorum caespitosum</i>	4, 7-10, 12, 13, 16, 20, 21, 23, 25, 29, 38, 42, 44, 49, 50, 70, 71, 74-76, 78, 79, 81, 82	V ^{2a-2b}	II ^{2a-4}	IV ^{2m-2b}	II ³	III ⁺⁴	III ⁺		I ⁺				
<i>Trifolium michelii</i>	10, 32, 69, 85		I ⁺			I ⁺	III ⁺						
<i>Trifolium pratense</i>	12, 28, 32, 69, 82		I ⁺			I ⁺			II ⁺				
<i>Trifolium spadiceum</i>	10, 12, 13, 18, 28, 32, 62-64, 77, 82		I ⁺	II ⁺	II ⁺	I ^{+2a}		I ^{2a}	II ⁺		+		
<i>Trisetum flavescens</i>	35									II ⁺			
<i>Trolius europaeus</i>	1					I ^{2a}							
<i>Utricularia minor</i>	13, 14, 25, 37			III ⁺									
<i>Vaccinium uliginosum</i>	1, 3, 4, 6, 7, 8, 10-13, 15-17, 23, 28, 29, 32, 37, 39, 42, 44, 50, 57, 69-71, 74-76, 79, 82, 85	III ⁺	II ^{+2a}	III ⁺¹	II ^{+2a}	IV ^{+2b}	V ⁺	III ^{+2b}					
<i>Veratrum lobelianum</i>	1, 8, 12, 13, 17, 19, 20, 21, 23, 25, 27, 32, 34, 35, 37,		II ⁺	IV ⁺	III ^{r+}	II ⁺	III ⁺		II ⁺	IV ⁺			+

continued

continuation of Annex II

	42-44, 50, 64, 69, 71, 73, 74, 79, 81, 82												
<i>Viola dacica</i>	4					I ⁺							
Other mosses													
<i>Aneura pinguis</i>	13			II ^{2m}									
<i>Aulacomnium palustre</i>	2, 3, 5, 6, 9, 12, 13, 15-19, 22, 32, 36, 42, 44, 49, 60, 63, 67-69, 73, 77, 78, 85	V ^{2a}	II ^{2m-2a}	III ^{2m-2a}	III ^{2m-2a}	II ^{2m-2a}	III ^{2m}	II ^{2m}	II ^{2m}	II ^{2a}	2a	2m	1
<i>Barbilophozia atlantica</i>	12								I ^{2m}				
<i>Brachythecium mildeanum</i>	19						I ^{2m}						
<i>Brachythecium reflexum</i>	79						I ¹						
<i>Brachythecium</i> sp.	36										II ^{2m}		
<i>Bryum pallens</i>	3, 12, 61, 62					I ¹		II ¹	I ¹				
<i>Bryum pseudotriquetrum</i>	1, 6, 7, 11-13, 16, 17, 21, 25, 36, 49, 57, 60, 64, 65, 70, 79	V ^{2m}	II ^{+2m}	II ^{2m}		II ^{1-2m}			IV ^{2m}	II ¹			1
<i>Bryum weigelii</i>	11					I ⁺							
<i>Calliergon cordifolium</i>	33							I ¹					
<i>Calypogeia azurea</i>	28, 71, 77, 79					I ^{2m}			I ^{2m}		2m		
<i>Calypogeia muehleriana</i>	13, 71, 76			II ^{2m}		I ^{2m}							
<i>Calypogeia neesiana</i> *	36									II ^{2m}			
<i>Calypogeia sphagnicola</i>	28, 42, 71		I ¹			I ¹			I ¹				
<i>Campylium polygamum</i> *	73											2m	
<i>Cephalozia bicuspidata</i>	12, 13, 28, 71, 75, 79			II ^{2m}		I ^{2m}			II ^{2m}				
<i>Cephalozia connivens</i>	71					I ^{2m}							
<i>Cephalozia pleniceps</i>	6, 35, 70					I ^{+2m}				II ^{2m}			
<i>Cephaloziella divaricata</i>	3					I ^r							
<i>Cephaloziella hampeana</i>	79					I ^{2m}							
<i>Chiloscyphus pallescens</i>	10, 11, 13, 16, 19, 20, 35, 49, 61, 62, 69	V ^{2m}		III ^{1-2m}	II ¹	I ^{2m-2a}		II ^{2m}		II ^{2m}			
<i>Chiloscyphus polyanthos</i>	65, 69, 73					I ^{1-2m}						2m	
<i>Climacium dendroides</i>	1, 6, 8, 15, 19, 20, 27, 33, 60, 64, 69, 73, 81, 82			II ^{2m}	II ^{2m}	II ^{2m-2a}	III ^{2m}	II ^{2a}				2m	2m
<i>Dichelyma falcatum</i>	3	I ^{2m}											
<i>Dicranella palustris</i>	13, 16, 25, 44, 64, 66, 70, 71, 75, 81	III ^{2m}	II ^{2m}	III ^{2m-2a}		I ^{2m-2a}					1		
<i>Dicranum bonjeanii</i>	2, 6, 7, 10, 21, 22, 43, 70, 75		I ¹		II ^{2a}	II ^{1-2a}							
<i>Dicranum scoparium</i>	13, 70, 71, 75			II ^{2a}		I ^{2m-2a}							
<i>Jungermannia leiantha</i>	75					I ^{2m}							
<i>Kiaeria starkei</i>	12, 25, 60, 70, 75					I ^{2m}			I ¹				+

continued

continuation of Annex II

<i>Lophocolea heterophylla</i>	36									II ^{2m}			
<i>Lophozia obtusa</i>	12								I ^{2m}				
<i>Lophozia ventricosa</i>	70, 71, 75, 79					I ^{2m-2a}							
<i>Marchantia polymorpha</i>	19				I ^{2m}								
<i>Meesia uliginosa</i>	12							I ¹					
<i>Palustriella decipiens</i>	6-8, 10, 11, 16, 17, 21, 57, 75	III ^{2m}	I ^{2m}		I ^{2m-2a}	III ^{2a}		II ^{2m}					
<i>Pellia epiphylla</i>	16, 17, 35, 44, 69	III ^{2m}	I ^{2m}	II ^{2m}	I ^{2m}				II ^{2m}				
<i>Pellia neesiana</i>	22, 25, 36		I ^{2m}		II ^{2m}				II ^{2m}				
<i>Philonotis fontana</i>	6, 8, 21, 60-62, 66		I ¹		I ^{2m}	III ^{2m}	II ¹				1		1
<i>Plagiochila poreloides</i>	36								II ^{2m}				
<i>Plagiommium affine</i>	61, 62							II ^{2m}					
<i>Plagiommium ellipticum</i>	33, 36-39, 60		I ¹				I ^{2a}		II ^{2a}				2m
<i>Plagiommium undulatum</i>	36, 60								II ^{2b}				2m
<i>Plagiothecium denticulatum</i> var. <i>undulatum</i>	35								II ^r				
<i>Pohlia nutans</i>	61						I ^r						
<i>Polytrichum commune</i>	2, 5, 8, 9, 12-17, 19, 20, 22, 32, 35, 37-39, 43, 44, 49, 50, 60-62, 66, 68, 69, 71, 77, 79, 85	V ^{2a}	II ^{2m-2a}	V ^{2m-2a}	III ^{2a}	II ^{2m-2b}	V ^{2a}	III ^{2m-2a}	I ^{2a}	II	2a	2a	2m
<i>Polytrichum strictum</i>	6, 15, 16, 43, 44, 49, 62, 70, 74, 79, 81	V ^{2m-2a}	I ^{2a}	II ^{2m}		II ^{2a-2b}		I ^{2a}					
<i>Rhizomnium magnifolium</i>	8, 13			II ^{2m}			III ^{2m}						
<i>Rhizomnium pseudopunctatum</i>	19					I ^{2m}							
<i>Rhytidadelphus squarrosus</i>	73												2m
<i>Riccardia incurvata</i>	13, 57			II ^{2m}					II ¹				
<i>Riccardia multifida</i>	13, 60-62			II ^{2m}				II ⁺					1
<i>Sanionia uncinata</i>	75					I ^{2m}							
<i>Schistidium rivulare</i>	21		I ^r										
<i>Scorpidium cossonii</i>	6, 73, 76, 82					I ^{2a}							2a
<i>Scorpidium revolvens</i>	12, 13, 76			II ^{2m}		I ^{2m}			I ^{2a}				
<i>Sphagnum angustifolium</i>	13, 16, 19-21, 23, 42, 43	III ^{2a}	II ^{1-2m}	III ^{1-2m}	III ^{1-2m}								
<i>Sphagnum auriculatum</i>	3, 9, 10, 12-14, 16, 17, 22, 37-39, 49, 57, 71, 74, 76, 82	V ^{2m-2a}	II ^{2m-2a}	III ^{2a-2b}	II ^{2a}	II ^{2a-2b}			III ^{2b}				
<i>Sphagnum centrale</i>	17, 21, 25, 32, 36, 68, 71		I ^{2m-2a}			I ^{2m}		I ^{2b}		II ^{2b}			
<i>Sphagnum compactum</i>	50					I ^{2m}							
<i>Sphagnum contortum</i>	9, 10, 13, 14, 16, 17, 19, 20, 22, 23, 29, 33, 44, 49, 57, 61, 62, 73, 78, 81	V ^{2a-2b}	I ^{2b}	V ^{2a-2b}	IV ^{2b}	I ^{2a-2b}		III ^{2a-3}	III ^{2a}				2a

continued

continuation of Annex II

<i>Sphagnum fallax</i>	16, 21, 23, 32, 35, 42, 71	III ^{2a}	II ^{2m-2a}		II ^{2a}	I ^{2a}				II ^{2m}				
<i>Sphagnum flexuosum</i>	13, 14, 16, 17, 21, 23, 25, 27, 28, 32, 33, 35, 36-39, 42-44, 49, 60, 62-65, 68, 73, 81, 82	V ^{2a-2b}	III ^{2a-3}	IV ^{2b-3}	III ^{2a-3}	I ^{2a-2b}			III ^{2b}	II ³	IV ^{2b}		2b 1	
<i>Sphagnum fuscum</i>	22, 44			II ^{2b}	II ^{2a}									
<i>Sphagnum girgensohnii</i>	8, 11, 13, 16, 17, 32, 35-39, 42-44, 49, 62, 66, 68, 70, 71, 85	V ^{2m-2a}	III ^{2m-2a}	III ^{2a-2b}		I ^{2a}	V ^{2a}	II ^{2m-3}		IV ^{2a}		2a		
<i>Sphagnum inundatum</i>	1, 9, 60, 68, 69, 73, 77, 78					I ^{2m-2a}		I ^{2m}			2a	2a	2m	
<i>Sphagnum magellanicum</i>	44, 49, 71	III ³		II ^{2b}		I ^{2a}								
<i>Sphagnum palustre</i>	13, 19-21, 23, 25, 35, 36, 43, 44, 49, 50, 65, 71, 79	III ^{2b}	I ^{2a-2b}	IV ^{2a-2b}	III ^{2a-2b}	I ^{2a-2b}				IV ^{2a}				
<i>Sphagnum quinquefarium</i>	1	III ¹												
<i>Sphagnum russowii</i>	13-15, 17, 21, 25, 36, 43, 49, 71, 77, 85	III ^{2a}	I ^{1-2a}	III ^{2m-2a}		I ^{2m-2a}	III ^{2a}			II ^{2a}	2a			
<i>Sphagnum squarrosum</i>	8, 10, 19-21, 32, 34-39, 42, 49, 66, 82	III ^{2m}	III ^{2m-2a}	II ^{2m}	II ^{2m}	I ^{2m-2a}	III ^{2m}			V ^{2a}		2m		
<i>Sphagnum subnitens</i>	75					I ^{2m}								
<i>Sphagnum teres</i>	10, 13, 14, 16, 17, 19-22, 23, 25, 29, 32-39, 44, 62, 63, 70, 77, 82	III ^{2a}	II ^{2a-2b}	V ^{2m-2b}	V ^{2a-2b}	I ^{2a-2b}		II ^{2a}		V ^{2b}	2b			
<i>Straminergon stramineum</i>	1, 6, 13, 16, 17, 19, 20, 22, 28, 36-39, 49, 50, 69-71, 74, 82	V ^{2m}	II ^{2m}	III ^{2m-2a}	III ^{2m-2a}	II ^{2m-2a}			I ^{2a}	II ^{2a}				
<i>Tomentypnum nitens</i>	10, 44			II ^{2m}		I ^{2a}								
<i>Warnstorffia exannulata</i>	2, 4-6, 9, 10, 12-16, 21-23, 25, 28, 29, 32, 33, 37-39, 43, 44, 49, 50, 61-64, 67, 69-71, 74-78, 81, 82	V ^{2m}	III ^{2m-2a}	IV ^{2m-2a}	IV ^{2m-2a}	I ^{4-6, 9, 10, 12-16, 21-23, 25, 28, 29, 32, 33, 37-39, 43, 44, 49, 50, 61-64, 67, 69-71, 74-78, 81, 82}			IV ^{2m-2b}	II ^{2m-2a}		2a		
<i>Warnstorffia sarmentosa</i>	4, 6, 9, 10, 12-14, 16, 19, 20, 23, 25, 28, 49, 50, 57, 61, 62, 70, 71, 75, 78, 79, 81	V ^{2m-2a}	II ^{2a}	IV ^{2m-2a}	III ^{2m-2a}	III ^{2a-2b}		II ¹	IV ^{2a}					



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