

# Red List of the bryophytes in Bulgaria

Rayna Natcheva<sup>1</sup>, Anna Ganeva<sup>1</sup> & Geko Spiridonov<sup>2</sup>

<sup>1</sup>Institute of Botany, Bulgarian Academy of Sciences, Akad. G. Bonchev St., bl. 23, 1113 Sofia, Bulgaria, e-mail: renimoss@bio.bas.bg ; animoss@bio.bas.bg

<sup>2</sup>Wilderness Fund, 7, Gotse Delchev Blvd., 1618 Sofia, Bulgaria, e-mail: gspiridonov@wf-bg.org

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**Abstract.** The present Red List of Bulgarian Bryophytes includes 251 species (34.9% of the total bryophyte flora of Bulgaria). Of these, 228 (31.7%) are Threatened (28 Critically Endangered, 42 Endangered, and 158 Vulnerable), and 23 species are Near Threatened. Further, 37 species are Data Deficient and 24 recently found species are Not Evaluated but are potential candidates for a threat category. The approach to the IUCN categories is described and further priorities for the bryophyte conservation in Bulgaria are outlined.

**Key words:** bryophytes, Bulgaria, conservation, IUCN threat categories, liverworts, mosses, Red List

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## Introduction

The preliminary Red List of the bryophytes in Bulgaria included 201 species (59 liverworts and 142 mosses, known from one or two localities), or ca. 30% of all bryophyte species in the country (Ganeva 1998). By the time of this evaluation, 670 species were recorded in Bulgaria (Petrov 1975). According to the most recent account 719 bryophyte species occur in Bulgaria (Ganeva & Natcheva 2003; Natcheva & Ganeva 2005; and unpublished data of the authors), of which 543 are mosses, 174 are liverworts, and 2 are hornworts. The intensive inventory studies of many regions in Bulgaria in the last years provided new data for bryophyte distribution and several new species were found (Ganeva & Natcheva 1999; Ganeva 2002; Ganeva & Gecheva 2002; Ganeva & Ros-Espín 2002; Natcheva 2005). The work on the evaluation of habitat quality with implications for habitat conservation in a number of areas gave the opportunity to assess the potential and actual threats experienced by various habitat types (Ganeva 2000a, 2000b; Natcheva 2003). These studies and the recently completed work on compila-

tion of a check-list of Bulgarian bryophytes (Ganeva & Natcheva 2003; Natcheva & Ganeva 2005) provided the basis for a more rigorous evaluation of the threat status of Bulgarian bryophyte flora, taking into account the distribution of the species and the vulnerability of their habitats.

In this paper we present the updated Red List of the bryophytes in Bulgaria.

## Methods

We evaluated all bryophyte species from the check-lists of the bryophytes in Bulgaria according to the IUCN criteria version 3.1 (IUCN 2001, 2003a, b). The guidelines for application of the IUCN criteria to bryophytes proposed by Hallingbäck (1998) and Hallingbäck & al. (1995, 1998) were followed. The assessment of each species that was assigned a threat category, as well as of those under the Near Threatened and Data Deficient categories was documented according to the IUCN requirements, so that their status could easily be re-evaluated in the future.

Throughout the assessment process we have considered the species' distribution and threat status both in Bulgaria and in the neighbouring countries on the Balkan Peninsula (as far as it is known), as well as the biology and ecology of each species (life history, breeding system, habitat preferences). The information on the abundance of species and their threat status for most of the Balkan countries is highly insufficient and fragmentary (only Serbia and Montenegro have a recently published Red List, Sabovljević & al. 2004). Therefore, we have adopted a conservative approach to the application of the IUCN criteria at national level. The species that: 1) are present in at least four out of five neighbouring to Bulgaria countries, 2) regularly produce spores (most bisexual and some unisexual species), which are small (less than 25 µm, i.e. species with fugitive, colonist s.l., and perennial s.l. life histories, During 1992), and 3) occupy habitats that are relatively common on the Balkan Peninsula, were considered to have a good potential for longer distance dispersal and recolonization from source populations outside Bulgaria. Such species were downgraded one level according the Guidelines for Application of the IUCN Criteria at Regional Levels (IUCN 2003a).

Species requiring specific and vulnerable habitats that are known from one or less than five locations were assigned to the Critically Endangered (CR) and Endangered (EN) categories, respectively. A specific case represent the species that occur in protected areas, because their habitat is protected at least from human activities. Species with less than five locations, all of which are within protected areas, and do not require special management of the habitat, were assigned to the category Vulnerable (VU, criterion D2). If such species had the potential for recolonization from neighboring countries they were considered Near Threatened.

The Red List (Table 1) includes all threatened (CR, EN, VU) bryophyte species, as well as the Near Threatened (NT) taxa. Taxa that have been reported for the country more than 80 years ago and have not been found afterwards, and that are not represented by specimens in any herbarium, as well as taxa that were reported for the country without precise location and that we have not been able to find during our field studies were treated as insufficiently known (DD). They are listed separately in Table 2. There were also a number of species found in the last five years. Whereas some of them may

be recent migrants to the Bulgarian bryophyte flora (e.g. *Sphagnum fimbriatum*, Natcheva 2005), others have probably been overlooked due to their general rarity (e.g. *Drepanocladus longifolius*) or small size and resemblance in the field to some more common species (e.g. *Dicranoweisia cirrata*). These recently found species were assigned to the NE category (Table 3) until more knowledge about their distribution and threat status is acquired.

Summary for the numbers of species under each threat category is presented in Table 4.

The nomenclature follows the one adopted in the check-lists of the bryophytes in Bulgaria (Ganeva & Natcheva 2003; Natcheva & Ganeva 2005).

## Results and discussion

The results of the present evaluation applying the IUCN criteria (IUCN 2001) revealed that 34.9% of the bryophytes in Bulgaria are red-listed (under the categories CR, EN, VU and NT). 31.7% of the bryophyte flora of Bulgaria is threatened, i.e. is assigned to one of the IUCN threat categories: CR, EN, and VU. The proportions of threatened mosses and liverworts are similar, with liverworts slightly exceeding (34.9%) the mosses (30.8%). Further 11.7% of the bryophytes in Bulgaria are assigned to other IUCN categories (NT, DD, NE). Although the species under NT, DD, and NE categories are not strictly speaking Threatened, as the term is applied by IUCN, these categories indicate that the species deserve special attention. They are likely candidates for a threat category when more information is acquired (DD and NE), or if their habitats change drastically (NT).

Of the species listed in the *Red Data Book of European Bryophytes* (ECCB 1995) one EN, eight VU, 20 Rare, 10 Regionally Threatened, and eight Insufficiently Known bryophytes occur in Bulgaria. These data and the number of threatened species in the preliminary Red List of Bulgarian bryophytes (Ganeva 1998) could not directly be compared with the results from the present assessment, because other criteria have been used and no regional considerations have been made. However, it must be pointed out that most Rare, Insufficiently Known, and Regionally Threatened species of the European Bryophyte Red List that occur in Bulgaria are Threatened, according to the current evaluation.

One reason for the difference between the present and the preliminary Red Lists may be attributed to the improved knowledge on bryophyte distribution in the country and higher awareness of the habitat vulnerability and threats. Therefore, more species were recognized to be threatened in the present evaluation. Most species from the preliminary Red List (Ganeva 1998) are included in the present Red List. Exceptions are *Bryum bicolor*, *Bryum muehlenbeckii*, *Dicranum polysetum*, *Grimmia sessitana*, and *Schistidium agassizii* that proved to be of lower risk and, therefore, were excluded from the Red List. Furthermore, we are aware that this Red List reflects to a large extent our present state of knowledge regarding the species distribution and the threat status of habitats in Bulgaria, which is generally low as compared with other European countries.

It should be noted that red-listing is a continuous process. With the accumulation of new data some species may change their threat status, others may be excluded from the list, or new species may be included, if their habitats become threatened and their populations decline rapidly. According to the requirements of the Directive 92/43/EEC, a re-evaluation will be conducted every six years in order to reveal trends in the threat status of each species and the entire bryophyte flora of Bulgaria.

The high proportion of threatened bryophytes in Bulgaria is red signal that more active measures are needed for their study and protection. Currently, the only legal act in the country where bryophyte protection is considered is Annex II to the Bulgarian Biodiversity Law (2002), where four species from Annex I of Resolution VI (1979) of the Standing Committee of the Bern Convention and Annex II of the Directive 92/43/EEC are included (*Buxbaumia viridis*, *Dicranum viride*, *Hamatocaulis vernicosus* and *Mannia triandra*). We recommend *Meesia longiseta*, a species from the Directive recently found in Bulgaria (Blockeel & al., in press), to be included in the Annex II of the Bulgarian Biodiversity Law. Some of the populations of many bryophytes fall into the network of protected areas. Thus the stability of their habitats is ensured at least with respect to human activities. Monitoring of bryophyte populations and programs for management of the habitats, especially for bryophytes that require recurrent moderate disturbance of the habitat, are needed with the ultimate goal to ensure the protection of bryophyte biodiversity in the country. The Red List is a first and necessary step in the species protection along the way to achievement of this goal.

**Table 1. Red List of the bryophytes in Bulgaria.**

Symbols: \* species from Annex II of the Directive 92/43/EEC and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); E, R, V, K, RT species from the *Red Data Book of European Bryophytes* (ECCB 1995) and their respective category (E – Endangered, R – Rare, V – Vulnerable, K – Insufficiently Known, RT – Regionally Threatened).

Taxon	Threat category IUCN (2001)	Criteria
1	2	3
<b>Mosses</b>		
<i>Aloina ambigua</i> (Bruch & Schimp.) Limpr.	NT	
<i>Amphidium lapponicum</i> (Hedw.) Schimp.	VU	D2
<i>Anomodon rostratus</i> (Hedw.) Schimp. <sup>R</sup>	CR	B2ab(iii)
<i>Anomodon rugelii</i> (Müll.Hal.) Keissl.	VU	D2
<i>Aphanorhegma patens</i> (Hedw.) Lindb.	CR	B2ab(iii)c(ii,iii)
<i>Aulacomnium androgynum</i> (Hedw.) Schwägr.	EN	B2ab(iii)
<i>Barbula crocea</i> (Brid.) F. Weber & D. Mohr	VU	D2
<i>Brachydontium trichodes</i> (F. Weber) Fürnr. <sup>R</sup>	VU	D2
<i>Brachythecium campestre</i> (Müll. Hal.) Schimp.	VU	D2
<i>Brachythecium geheebii</i> Milde <sup>R</sup>	EN	B2ab(iii)
<i>Brachythecium glaciale</i> Schimp.	VU	D2
<i>Brachythecium latifolium</i> Kindb.	VU	D2
<i>Brachythecium plumosum</i> (Hedw.) Schimp.	VU	D2
<i>Brachythecium starkei</i> (Brid.) Schimp.	VU	D2
<i>Breidleria pratensis</i> (Koch ex Spruce) Loeske	CR	B2ab(iii)
	<b>1</b>	<b>2</b>
<i>Bryum algovicum</i> Sendtn. ex Müll. Hal.		NT
<i>Bryum canariense</i> Brid.		VU D2
<i>Bryum cyclophyllum</i> (Schwägr.) Bruch & Schimp.		EN B2ab(iii)
<i>Bryum gemmiparum</i> De Not.		VU D2
<i>Bryum inclinatum</i> (Brid.) Blandow		NT
<i>Bryum intermedium</i> (Brid.) Blandow		VU D2
<i>Bryum kunzei</i> Hornsch.		VU D2
<i>Bryum mildeanum</i> Jur.		EN B2ab(iii)
<i>Bryum radiculosum</i> Brid.		VU D2
<i>Bryum stirtonii</i> Schimp. <sup>K</sup>		VU D2
<i>Bryum torquescens</i> Bruch ex De Not		VU D2
<i>Bryum weigelii</i> Spreng.		VU D2
<i>Buxbaumia aphylla</i> Hedw. <sup>RT</sup>		EN B2ab(iii)c(iii,iv)
<i>Buxbaumia viridis</i> (DC.) Moug. & Nestl.* <sup>V</sup>		NT
<i>Callicladium haldanianum</i> (Grev.) H.A. Crum <sup>RT</sup>		VU D2
<i>Calliergon giganteum</i> (Schimp.) Kindb.		EN B2ab(iii)
<i>Calliergon richardsonii</i> (Mitt.) Kindb.		VU D2
<i>Campylium polygamum</i> (Schimp.) C.E.O. Jensen		VU D2

Table 1. Continuation.

1	2	3	1	2	3
<i>Campylophyllum halleri</i> (Hedw.) M. Fleisch.	NT		<i>Grimmia torquata</i> Drumm.	VU	D2
<i>Cheilothea chloropus</i> (Brid.) Broth.	VU	D2	<i>Grimmia unicolor</i> Hook.	VU	D2
<i>Coscinodon cribrosus</i> (Hedw.) Spruce	VU	D2	<i>Gymnostomum viridulum</i> Brid.	VU	D2
<i>Ctenidium procerrimum</i> (Molendo) Lindb.	CR	B2ab(iii)	<i>Hamatocaulis vernicosus</i> (Mitt.) Hedenäs* <sup>K</sup>	VU	D2
<i>Cynodontium fallax</i> Limpr.	VU	D2	<i>Helodium blandowii</i> (F. Weber & D. Mohr) Warnst.	CR	B2ab(iii)
<i>Cynodontium strumiferum</i> (Hedw.) Lindb.	VU	D2	<i>Hydrogrimmia mollis</i> (Bruch & Schimp.) Loeske	VU	D2
<i>Dicranella rufescens</i> (With.) Schimp.	VU	D2	<i>Hygrohypnum norvegicum</i> (Schimp.) J.J. Amann <sup>RT</sup>	VU	D2
<i>Dicranella subulata</i> (Hedw.) Schimp.	VU	D2	<i>Hylocomium brevirostre</i> (Brid.) Schimp.	VU	D2
<i>Dicranodontium denudatum</i> (Brid.) E. Britton	VU	D2	<i>Hylocomium pyrenaicum</i> (Spruce) Lindb.	VU	D2
<i>Dicranum bergeri</i> Blandow	EN	B2ab(iii)	<i>Hypnum callichroum</i> Brid.	VU	D2
<i>Dicranum elongatum</i> Schleich. ex Schwägr.	VU	D2	<i>Hypnum fertile</i> Sendtn. <sup>RT</sup>	EN	B2ab(iii)
<i>Dicranum fulvum</i> Hook	VU	D2	<i>Hypnum pallescens</i> (Hedw.) P. Beauv.	NT	
<i>Dicranum viride</i> (Sull. & Lesq.) Lindb.* <sup>V</sup>	EN	B2ab(iii)	<i>Hypnum revolutum</i> (Mitt.) Lindb.	VU	D2
<i>Didymodon cordatus</i> Jur.	VU	D2	<i>Hypnum sauteri</i> Schimp. <sup>R</sup>	VU	D2
<i>Didymodon ferrugineus</i> (Schimp. ex Besch.) M.O. Hill	VU	D2	<i>Hypnum vaucheri</i> Lesq.	NT	
<i>Distichium inclinatum</i> (Hedw.) Bruch & Schimp.	VU	D2	<i>Isopterygiopsis muelleriana</i> (Schimp.) Z. Iwats.	VU	D2
<i>Ditrichum cylindricum</i> (Hedw.) Grout.	VU	D2	<i>Isopterygiopsis pulchella</i> (Hedw.) Z. Iwats.	VU	D2
<i>Ditrichum lineare</i> (Sw.) Lindb.	VU	D2	<i>Isothecium myosuroides</i> Brid.	CR	B2ab(iii)
<i>Ditrichum pallidum</i> (Hedw.) Hampe	EN	B2ab(iii)	<i>Kiaeria blyttii</i> (Bruch & Schimp.) Broth.	VU	D2
<i>Ditrichum zonatum</i> (Brid.) Kindb.	VU	D2	<i>Leptodictyum humile</i> (P. Beauv.) Ochyra	CR	B2ab(iii)
<i>Drepanocladus sendtneri</i> (Schimp.) Warnst. <sup>RT</sup>	VU	D2	<i>Lescuraea mutabilis</i> (Brid.) Lindb.	VU	D2
<i>Encalypta microstoma</i> Bals.-Criv. & De Not. <sup>R</sup>	VU	D2	<i>Lescuraea saxicola</i> (Schimp.) Molendo	VU	D2
<i>Entodon concinnus</i> (De Not.) Paris	VU	D2	<i>Meesia uliginosa</i> Hedw.	VU	D2
<i>Ephemerum recurvifolium</i> (Dicks.) Boulay <sup>R</sup>	CR	B2ac(iii,iv)	<i>Microbryum starckeanum</i> (Hedw.) R. H. Zander	EN	B2ab(iii)
<i>Eurhynchium flotowianum</i> (Sendtn.) Kartt.	VU	D2	<i>Mielichhoferia mielichhoferiana</i> (Funck) Loeske <sup>K</sup>	VU	D2
<i>Eurhynchium pumilum</i> (Wilson) Schimp.	EN	B2ab(iii)	<i>Mnium ambiguum</i> H. Müll.	VU	D2
<i>Eurhynchium schleicheri</i> (R. Hedw.) Milde	CR	B2ab(iii)	<i>Mnium blyttii</i> Bruch & Schimp.	VU	D2
<i>Fabronia ciliaris</i> (Brid.) Brid.	VU	D2	<i>Neckera pennata</i> Hedw. <sup>V</sup>	VU	B2ab(iii); D2
<i>Fabronia pusilla</i> Raddi	VU	D2	<i>Neckera pumila</i> Hedw.	EN	B2ab(iii)
<i>Fissidens crassipes</i> Wilson ex Bruch & Schimp.	VU	D2	<i>Orthothecium rufescens</i> (Brid.) Schimp.	VU	D2
<i>Fissidens fontanum</i> (Bach-Pyl.) Steud.	CR	B2ab(iii)	<i>Orthotrichum gymnostomum</i> Brid. <sup>RT</sup>	VU	D2
<i>Fissidens gracilifolius</i> Brugg.-Nann. & Nyholm	VU	D2	<i>Orthotrichum patens</i> Bruch ex Brid.	NT	
<i>Fissidens incurvus</i> Starke ex Röhl.	VU	D2	<i>Orthotrichum pumilum</i> Sw.	NT	
<i>Fissidens osmundoides</i> Hedw.	VU	D2	<i>Orthotrichum stellatum</i> Brid. <sup>R</sup>	EN	B2ab(iii)
<i>Fissidens rivularis</i> (Spruce) Schimp.	VU	D2	<i>Orthotrichum urnigerum</i> Myrin	VU	D2
<i>Grimmia crassifolia</i> Lindb. ex Broth.	VU	D2	<i>Paraleucobryum sauteri</i> (Bruch & Schimp.) Loeske <sup>R</sup>	VU	D2
<i>Grimmia crinita</i> Brid.	VU	D2	<i>Philonotis arnellii</i> Husn.	VU	D2
<i>Grimmia decipiens</i> (Schultz) Lindb.	VU	D2	<i>Philonotis caespitosa</i> Jur.	VU	D2
<i>Grimmia elatior</i> Bruch ex Bals.-Criv. & De Not.	VU	D2	<i>Philonotis marchica</i> (Hedw.) Brid.	EN	B2ab(iii)
<i>Grimmia funalis</i> (Schwägr.) Bruch & Schimp.	VU	D2	<i>Philonotis rigida</i> Brid.	VU	D2
<i>Grimmia fuscolutea</i> Hook. <sup>K</sup>	NT		<i>Plagiobryum demissum</i> (Hook.) Lindb.	VU	D2
<i>Grimmia longirostris</i> Hook.	VU	D2	<i>Plagiobryum zieri</i> (Hedw.) Lindb.	VU	D2
<i>Grimmia montana</i> Bruch & Schimp.	VU	D2	<i>Plagiothecium platyphyllum</i> Mönk.	VU	D2
<i>Grimmia muehlenbeckii</i> Schimp.	VU	D2	<i>Plagiothecium ruthei</i> Limpr.	VU	D2
<i>Grimmia ramondii</i> (Lam. & DC) Margad	VU	D2	<i>Plagiothecium undulatum</i> (Hedw.) Schimp.	VU	D2
<i>Grimmia teretinervis</i> Limpr. <sup>V</sup>	VU	D2	<i>Platydictya jungermannoides</i> (Brid.) H.A. Crum	VU	D2

Table 1. Continuation.

1	2	3
<i>Pohlia obtusifolia</i> (Brid.) L.F. Koch	VU	D2
<i>Pohlia prolifera</i> (Kindb.) Broth.	VU	D2
<i>Polytrichum longisetum</i> Brid.	VU	D2
<i>Pseudocalliergon trifarium</i> (F. Weber & D. Mohr) Loeske	VU	D2
<i>Pseudoleskea radicata</i> (Mitt.) Macoun & Kindb.	NT	
<i>Pseudotaxiphyllum elegans</i> (Brid.) Z. Iwats.	VU	D2
<i>Ptilium crista-castrensis</i> (Hedw.) De Not.	EN	B2ab(iii)
<i>Ptychodium plicatum</i> (F. Weber & D. Mohr) Schimp.	VU	D2
<i>Racomitrium affine</i> (F. Weber & D. Mohr) Lindb.	VU	D2
<i>Racomitrium ericoides</i> (Hedw.) Brid.	VU	D2
<i>Racomitrium macounii</i> Kindb.	VU	D2
<i>Racomitrium microcarpon</i> (Hedw.) Brid.	VU	D2
<i>Rhabdoweisia crispata</i> (With.) Lindb.	VU	D2
<i>Rhynchostegiella tenella</i> (Dicks.) Limpr.	VU	D2
<i>Rhynchostegium confertum</i> (Dicks.) Schimp.	NT	
<i>Schistidium atrofusum</i> (Schimp.) Limpr.	NT	
<i>Schistidium brunescens</i> Limpr.	NT	
<i>Schistidium confertum</i> (Funck) Bruch & Schimp.	NT	
<i>Schistidium flaccidum</i> (De Not.) Ochyra	NT	
<i>Scleropodium touretii</i> (Brid.) L.F. Koch	EN	B2ab(iii)
<i>Scorpidium revolvens</i> (Sw.) Rubers	VU	D2
<i>Scorpidium scorpioides</i> (Hedw.) Limpr.	VU	D2
<i>Scorpiurium circinatum</i> (Brid.) M. Fleisch. & Loeske	EN	B2ab(iii)
<i>Seligeria acutifolia</i> Lindb.	VU	D2
<i>Seligeria campylopoda</i> Kindb. <sup>K</sup>	VU	D2
<i>Seligeria donniana</i> (Sm.) Müll. Hal.	VU	D2
<i>Seligeria pusilla</i> (Hedw.) Bruch & Schimp.	VU	D2
<i>Seligeria recurvata</i> (Hedw.) Bruch & Schimp.	NT	
<i>Seligeria tristichoides</i> Kindb. <sup>K</sup>	VU	D2
<i>Sphagnum cuspidatum</i> Ehrh. ex Hoffm.	EN	B2ab(iii)
<i>Sphagnum fallax</i> (H. Klinggr.) H. Klinggr.	VU	D2
<i>Sphagnum riparium</i> Ångstr.	CR	B2ab(iii)
<i>Sphagnum subfulvum</i> Sjörs.	VU	D2
<i>Sphagnum subnitens</i> Russow & Warnst.	VU	D2
<i>Stegonia latifolia</i> (Schwägr.) Venturi ex Broth.	VU	D2
<i>Syntrichia laevipila</i> Brid.	VU	D2
<i>Syntrichia latifolia</i> (Bruch ex Hartm.) Huebener	CR	B2ab(iii)
<i>Syntrichia norvegica</i> F. Weber	NT	
<i>Syntrichia pagorum</i> (Milde) Amann	CR	B2ab(iii)
<i>Syntrichia papillosa</i> (Wilson) Jur.	EN	B2ab(iii)
<i>Syntrichia princeps</i> (De Not.) Mitt.	VU	D2
<i>Syntrichia virescens</i> (De Not.) Ochyra	VU	D2
<i>Taxiphyllum wissgrillii</i> (Garov.) Wijk & Margad.	VU	D2
<i>Tayloria froelichiana</i> (Hedw.) Mitt. ex Broth. <sup>RT</sup>	VU	D2

1	2	3
<i>Tayloria splachnoides</i> (Schleich. ex Schwägr.) Hook. <sup>V</sup>	CR	B2ab(iii)
<i>Thuidium delicatulum</i> (Hedw.) Schimp.	NT	
<i>Thuidium tamariscinum</i> (Hedw.) Schimp.	VU	D2
<i>Timmia norvegica</i> J.E. Zetterst.	CR	B2ab(iii)
<i>Tomentypnum nitens</i> (Hedw.) Loeske	EN	B2ab(iii)
<i>Tortella fragilis</i> (Hook. & Wilson) Limpr.	VU	D2
<i>Tortella humilis</i> (Hedw.) Jenn.	CR	B2ab(iii)
<i>Tortella nitida</i> (Lindb.) Broth.	CR	B2ab(iii)
<i>Tortula canescens</i> Mont.	EN	B2ab(iii)
<i>Tortula cuneifolia</i> (Dicks.) Turner	VU	D2
<i>Tortula leucostoma</i> (R.Br.) Hook. & Grev.	VU	D2
<i>Tortula protobryoides</i> R.H. Zander	EN	B2ab(iii)c(iii)
<i>Trematodon ambiguus</i> (Hedw.) Hornsch.	CR	B2ab(iii)
<i>Trichostomum brachydontium</i> Bruch	VU	D2
<i>Ulota crispa</i> (Hedw.) Brid.	EN	B2ab(iii)
<i>Ulota hutchinsiae</i> (Sm.) Hammar	EN	B2ab(iii)
<i>Warnstorfia fluitans</i> (Hedw.) Loeske	NT	
<i>Weissia wimmeriana</i> (Sendtn.) Bruch & Schimp.	VU	D2
<b>Liverworts</b>		
<i>Anastrophyllum michauxii</i> (F. Weber) H. Buch	VU	D2
<i>Anthelia juratzkana</i> (Limpr.) Trevis.	VU	D2
<i>Asterella lindenberiana</i> (Corda ex Nees) Arnell	VU	D2
<i>Athalamia hyalina</i> (Sommerf.) S. Hatt.	VU	B1ac(iii);D2
<i>Barbilophozia kunzeana</i> (Huebener) Müll. Frib.	VU	D2
<i>Bazzania flaccida</i> (Dumort.) Grolle	VU	D2
<i>Calypogeia fissa</i> (L.) Raddi	EN	B2ab(iii)
<i>Calypogeia neesiana</i> (C. Massal. & Carestia) Müll. Frib.	VU	D2
<i>Calypogeia sphagnicola</i> (Arnell & J. Perss.) Warnst. & Loeske	VU	D2
<i>Calypogeia suecica</i> (Arnell & J. Perss.) Müll. Frib.	VU	D2
<i>Cephalozia ambigua</i> C. Massal.	VU	D2
<i>Cephalozia catenulata</i> (Huebener) Lindb.	EN	B2ab(iii)
<i>Cephalozia connivens</i> (Dicks.) Lindb.	VU	D2
<i>Cephalozia lacinulata</i> J.B. Jack ex Spruce <sup>V</sup>	VU	D2
<i>Cephalozia loitlesbergeri</i> Schiffn.	CR	B2ab(iii)
<i>Cephalozia hampeana</i> (Nees) Schiffn.	CR	B2ab(iii)
<i>Cephalozia rubella</i> (Nees) Warnst.	EN	B2ab(iii)
<i>Cephalozia turneri</i> (Hook.) Müll. Frib.	CR	B2ab(iii)
<i>Corsinia coriandrina</i> (Spreng.) Lindb.	EN	B2ab(iii)
<i>Eremonotus myriocarpus</i> (Carrington) Pearson	VU	D2
<i>Fossombronina angulosa</i> (Dicks.) Raddi	EN	B2ab(iii)c(ii)
<i>Fossombronina husnotii</i> Corb.	CR	B2ab(iii)c(ii)
<i>Frullania fragilifolia</i> (Taylor) Gottsche & al.	VU	D2
<i>Frullania jackii</i> Gottsche	EN	B2ab(iii)
<i>Frullania riparia</i> Hampe ex Lehm.	CR	B2ab(iii)

Table 1. Continuation.

1	2	3
<i>Gymnomitrium coralloides</i> Nees	VU	D2
<i>Jungermannia caespiticia</i> Lindenb.	CR	B2ab(iii)
<i>Jungermannia confertissima</i> Nees	VU	D2
<i>Jungermannia exsertifolia</i> Steph. subsp. <i>cordifolia</i> (Dumort.) Váňa	VU	D2
<i>Jungermannia gracillima</i> Sm.	VU	D2
<i>Jungermannia pumila</i> With.	VU	D2
<i>Lophozia ascendens</i> (Warnst.) R. M. Schust. <sup>R</sup>	VU	D2
<i>Lophozia decolorans</i> (Limpr.) Steph. <sup>R</sup>	VU	D2
<i>Lophozia longidens</i> (Lindb.) Macoun.	EN	B2ab(iii)
<i>Lophozia longiflora</i> (Nees) Schiffn.	VU	D2
<i>Mannia androgyna</i> (L.) A. Evans	CR	B2ab(iii)
<i>Mannia pilosa</i> (Hornem.) Frye & L. Clark	VU	D2
<i>Mannia triandra</i> (Scop.) Grolle <sup>*R</sup>	EN	B2ab(iii)
<i>Marchantia alpestris</i> (Nees) Burgeff	NT	
<i>Marsupella adusta</i> (Nees emend. Limpr.) Spruce <sup>K</sup>	VU	D2
<i>Marsupella alpina</i> (Gottsche ex Husn.) Bernet	VU	D2
<i>Marsupella brevissima</i> (Dumort.) Grolle	VU	D2
<i>Marsupella funckii</i> (F. Weber & D. Mohr) Dumort.	VU	D2

1	2	3
<i>Mylia anomala</i> (Hook.) Gray	VU	D2
<i>Nardia geoscyphus</i> (De Not.) Lindb.	EN	B2ab(iii)
<i>Pedinophyllum interruptum</i> (Nees) Kaal.	NT	
<i>Porella baueri</i> (Schiffn.) C. E. O. Jensen	NT	
<i>Porella pinnata</i> L.	CR	B2ab(iii)
<i>Ptilidium ciliare</i> (L.) Hampe	EN	B2ab(iii)
<i>Radula lindenbergiana</i> Gottsche ex C. Hartm.	VU	D2
<i>Riccardia incurvata</i> Lindb.	VU	D2
<i>Riccardia multifida</i> (L.) Gray	VU	D2
<i>Riccia crustata</i> Trab. <sup>V</sup>	CR	B2ab(iii)c(ii)
<i>Riccia crystallina</i> L. emend. Raddi	EN	B2ab(iii)c(ii)
<i>Riccia glauca</i> L.	EN	B2ab(iii)c(ii)
<i>Riccia papillosa</i> Moris	EN	B2ab(iii)c(ii)
<i>Scapania apiculata</i> Spruce	CR	B2ab(iii)
<i>Scapania compacta</i> (A. Roth) Dumort.	EN	B2ab(iii)
<i>Scapania helvetica</i> Gottsche	VU	D2
<i>Scapania paludicola</i> Loeske & Müll. Frib.	VU	D2
<i>Scapania scandica</i> (Arnell & H. Buch) Macvicar	EN	B2ab(iii)
<i>Scapania verrucosa</i> Heeg <sup>R</sup>	EN	B2ab(iii)
<i>Trichocolea tomentella</i> (Ehrh.) Dumort.	EN	B2ab(iii)
<i>Tritomaria exsecta</i> (Schmidel) Loeske	VU	D2

Table 2. List of the insufficiently known (DD) bryophytes in Bulgaria.

Abbreviations: E, R, V, K species from the *Red Data Book of European Bryophytes* (ECCB 1995) and their respective category (E – Endangered, R – Rare, V – Vulnerable, K – Insufficiently Known).

Mosses
<i>Aloina rigida</i> (Hedw.) Limpr.
<i>Atrichum angustatum</i> (Brid.) Bruch & Schimp.
<i>Atrichum tenellum</i> (Röhl.) Bruch & Schimp.
<i>Blindia caespiticia</i> (F. Weber & D. Mohr) Müll. Hal.
<i>Bryum creberrimum</i> Taylor
<i>Bryum neodamense</i> Itzigs. <sup>R</sup>
<i>Bryum versicolor</i> A. Braun ex Bruch & Schimp. <sup>R</sup>
<i>Ceratodon conicus</i> (Hampe) Lindb.
<i>Dicranella cerviculata</i> (Hedw.) Schimp.
<i>Dicranum brevifolium</i> (Lindb.) Lindb.
<i>Ephemerum serratum</i> (Hedw.) Hampe
<i>Fissidens exilis</i> Hedw.
<i>Grimmia elongata</i> Kaulf.
<i>Kiaeria falcata</i> (Hedw.) I. Hagen
<i>Microbryum curvicolle</i> (Hedw.) R. H. Zander
<i>Orthotrichum scanicum</i> Gronvall <sup>E</sup>
<i>Pohlia longicollis</i> (Hedw.) Lindb.
<i>Pseudophemerum nitidum</i> (Hedw.) Reimers
<i>Pseudoleskeella tectorum</i> (Funk ex Brid.) Kindb. ex Broth.

<i>Racomitrium fasciculare</i> (Hedw.) Brid.
<i>Rhynchostegiella tenuicaulis</i> (Spruce) Kartt. <sup>K</sup>
<i>Rhynchostegium rotundifolium</i> (Brid.) Schimp. <sup>R</sup>
<i>Sphagnum obtusum</i> Warnst.
<i>Tortula mucronifolia</i> Schwägr.
<i>Zygodon forsteri</i> (Dicks. ex With.) Mitt. <sup>V</sup>
<b>Liverworts</b>
<i>Barbilophozia attenuata</i> (Mart.) Loeske
<i>Cephalozia pleniceps</i> (Austin) Lindb.
<i>Cephaloziella massalongi</i> (Spruce) Müll. Frib. <sup>R</sup>
<i>Gymnomitrium apiculatum</i> (Schiffn.) Müll. Frib.
<i>Harpanthus scutatus</i> (F. Weber & D. Mohr) Spruce
<i>Lepidozia cupressina</i> (Sw.) Lindenb.
<i>Marsupella sparsifolia</i> (Lindb.) Dumort.
<i>Metzgeria simplex</i> Lorb. ex Müll. Frib.
<i>Odontoschisma sphagni</i> (Dicks.) Dumort.
<i>Porella obtusata</i> (Taylor) Trevis
<i>Ricciocarpos natans</i> (L.) Corda
<i>Tritomaria scitula</i> (Taylor) Jörg.

**Table 3.** List of the Not Evaluated (NE) bryophyte species that were reported for Bulgaria in the last five years.

Symbols: \* species from Annex II of the Directive 92/43/EEC and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); R, RT species from the *Red Data Book of European Bryophytes* (ECCB 1995) and their respective category (R – Rare, RT – Regionally threatened).

Mosses	
<i>Acaulon muticum</i> (Hedw.) Müll. Hal	<i>Meesia longiseta</i> Hedw.* <sup>R</sup>
<i>Amblyodon dealbatus</i> (Hedw.) P. Beauv	<i>Plagiothecium succulentum</i> (Wilson) Lindb.
<i>Andreaea obovata</i> Thed.	<i>Rhizomnium magnifolium</i> (Horik.) T. J. Kop.
<i>Brachythecium mildeanum</i> (Schimp.) Schimp.	<i>Scorpidium cossonii</i> (Schimp.) Hedenäs
<i>Bryum klinggraeffii</i> Schimp.	<i>Sphagnum fimbriatum</i> Wilson
<i>Bryum rubens</i> Mitt.	<i>Syntrichia ruraliformis</i> (Besch.) Cardot
<i>Bryum subapiculatum</i> Hampe	<i>Tortula atrovirens</i> (Sm.) Lindb.
<i>Campyliadelphus elodes</i> (Lindb.) Kanda <sup>RT</sup>	<i>Weissia levieri</i> (Limpr.) Kindb. <sup>R</sup>
<i>Dicranowisia cirrata</i> (Hedw.) Lindb.	
<i>Drepanocladus longifolius</i> (Mitt.) Par.	Liverworts
<i>Hedwigia stellata</i> Hedenäs	<i>Gymnocolea inflata</i> (Huds.) Dumort.
<i>Homalothecium aureum</i> (Spruce) H. Rob.	<i>Scapania crassiretis</i> Bryhn
<i>Hygroamblystegium fluviatile</i> (Hedw.) Loeske	<i>Scapania parvifolia</i> Warnst.

**Table 4.** Summary of the numbers of bryophytes under each IUCN category and their proportion in the total bryophyte flora of Bulgaria.

IUCN category	Mosses		Liverworts		Total	
	No. of species	Proportion	No. of species	Proportion	No. of species	Proportion
<b>Threat categories</b>						
CR	18	3.3	10	5.7	28	3.9
EN	25	4.6	17	9.7	42	5.8
VU	124	22.8	34	19.5	158	22.0
<b>Total</b>	<b>167</b>	<b>30.8</b>	<b>61</b>	<b>34.9</b>	<b>228</b>	<b>31.7</b>
<b>Other categories</b>						
NT	20	3.7	3	1.7	23	3.2
DD	25	4.6	12	6.9	37	5.1
NE	21	3.9	3	1.7	24	3.3
<b>Total</b>	<b>66</b>	<b>12.2</b>	<b>18</b>	<b>10.3</b>	<b>84</b>	<b>11.7</b>
<b>Total</b>	<b>233</b>	<b>42.9</b>	<b>79</b>	<b>45.2</b>	<b>312</b>	<b>43.4</b>
<b>Total Red-listed (CR, EN, VU, NT)</b>	<b>187</b>	<b>34.4</b>	<b>64</b>	<b>36.6</b>	<b>251</b>	<b>34.9</b>

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