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Updated Red List of bryophytes of Slovenia

Andrej Martinčič[1]

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Abstract

Based on floristic data and applied taxonomy there are currently 813 species and subspecies in Slovenia – 638 mosses, 173 liverworts and 2 hornworts. Based on the IUCN 3.1 criteria, which we applied to bryophytes following Hallingbäck et al. (1998), there are 164 species (20.17%) listed under threatened categories, of which 121 (18.97%) are mosses and 43 (24.57%) are liverworts; 7 of them (0.86%) are in the CR category, 83 (10.21%) in the EN category and 74 (9.10%) are listed under the VU category. There are 23 species (2.83%) in the near threatened (NT) category, while 163 species (20.05%) are data deficient (DD). The Least Concern (LC) category currently comprises 463 (56.95%) species.

Izvleček

Trenutno je v Sloveniji na podlagi floristični podatkov in uporabljenih taksonomskih principov 813 vrst in podvrst – 638 vrst listnatih mahov, 173 vrst jetrenjakov in 2 vrsti rogovnjakov. Ob upoštevanju kriterijev IUCN 3.1 in njihove uporabe za mahove po Hallingbäck et al. (1998) je v kategorije ogroženih uvrščenih 164 vrst (20,17%), 121 vrst (18,97%) listnatih mahov in 43 vrst (24,57%) jetrenjakov; od tega v CR 7 (0,86%) vrst, v EN 83 (10,21%) in v VU 74 (9,10%). Potencialno ogroženih (NT) je 23 vrst (2,83%), v kategorijah premalo znane (DD) pa je 163 vrst (20,05%). Trenutno neogroženih vrst (LC) je 463 (56,95%).

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1 Zaloška cesta 78a, 1000 Ljubljana, Slovenia

Introduction

Floristic research of bryophytes of Slovenia, which serves as the necessary basis for threat assessment, can be divided in two periods. The first, very fruitful period started with Scopoli (1772) and ended in 1914. It was followed by a 45-year-long break in floristic investigations. Only a few short papers were published in this period. All data for Slovenia in "Prodromus flore briofita Jugoslavije" (Pavletić 1955) are therefore old, as there was no contemporary information available at the time. After 1960 began a new period, marked with intensive floristic research by S. Grom and A. Martinčič, collection of herbarium material and publication of results. Foreign botanists also contributed several short papers during this new period. Floristic research have reached its peak after 2000 with the publication of "Checklist of Mosses (*Bryopsida*) of Slovenia" (Martinčič 2003) and especially with "Annotated Checklist of Slovenian Liverworts (*Marchantiophyta*) and Hornworts (*Anthocerotophyta*) (Martinčič 2011). The latter includes all available herbarium material in LJU, so a large part of the data is recent.

The first issue of the Red List of Threatened Mosses of Slovenia (Martinčič 1992), which comprised only mosses (*Musci*), dates back more than 20 years. Their threat status was assessed based on the old IUCN criteria. We worked mainly with data from floristic literature that went back to the period before 1914, so most of the data in the first Red List was old. In 2000 we conducted for the Ministry of the Environment and Spatial Planning, Administration of the Republic Slovenia for the Protection of Nature, a study entitled "Analysis of the Status of Bryophyte Biodiversity" (Martinčič 2000), which comprised also the threat status of Slovenian bryophytes. These results were incorporated as Annex 2: Red List of Bryophytes included in the "Rules on the inclusion of endangered plant and animal species in the Red List" (Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam, Anon. 2002). Intensive floristic activity after year 2000 and the processing of recent herbarium material collected so far called for an updated version of the Red List with the application of the new IUCN threat status criteria.

Application of the new criteria for the threat assessment of bryophyte flora (IUCN 3.1 2001) pointed to the fact that despite the breakthrough in floristic research, the only data available for as much as a fifth of bryophyte species is still over 100 years old (category DD-va). Most of these species are from the regions that were the most thoroughly researched in the first period. Floristic investigations in the second period targeted those areas/phytogeographical regions for which there was no data available. This fact guides our future activity as well.

Methods

In our classification of species under the Red List categories we considered the new IUCN criteria 3.1 (IUCN 2001). Their application to bryophytes follows Hallingbäck et al. (1998). However, with the current level of the knowledge that we have on bryophyte flora, not only in Slovenia, it is largely impossible to determine the size of populations, the rate and extent at which they are declining and the number of specimens. The only realistic threat assessment criterion is therefore **criterion B**, which is expressed with the number of currently known localities: 1 (CR), 2–5 (EN), 6–10 (VU). Even though this quantitative criteria depends on the level at which a specific area or country has been investigated, it is the most commonly used today. We therefore applied it also for the threat assessment of individual species in Slovenia. The number of recently reported localities necessary for a species to be listed under a certain threat category was changed in order to take into consideration the lack of floristic research in Slovenia (see Discussion). Potential or actual threat to their habitats was considered only for a few species. Similarly, we inferred from the difference in the number of old and recent localities that the population size has declined.

The Red List consists of the following categories:

Regionally extinct (RE): this category replaces, at a regional scale, the category "extinct – EX" (Gärdenfors 1996), except for endemic species.

Critically endangered (CR): a taxon is known from a single recent locality in a highly threatened habitat, the population is usually small and in turn the risk of rapid extinction extremely high.

Endangered (EN): based on last available data the taxon is recorded on 2–5 localities. The assessment should also take into consideration the difference in the number of old and recently reported localities, which can provide at least an informative insight into the suspected decline in the taxon's area of occupancy in Slovenia and its increased fragmentation. Vulnerability of habitats also significantly increases the threat level.

Vulnerable (VU): recent evidence indicates that the taxon is known from 6–10 localities; extinction poses a threat mainly due to potential destruction of its habitats in the future.

Near threatened (NT): based on recent evidence the taxon is found on more than 10 localities but occurs in vulnerable habitats so there is a possibility that it will qualify for a threatened category, most likely as vulnerable, in the near future.

Data deficient (DD): this category comprises the taxa for which inadequate information is available to make an assessment of their risk of extinction based on their distribution and/or population status.

Data deficient-vanished (DD-va): this subcategory comprises taxa for which there is no recent data available.

Data deficient-new (DD-n): This subcategory comprises recently (e.g. in the last ten years) reported taxa with insufficient information to assess their threat status.

Least concern (LC): Taxa that are not threatened in terms of the number of their localities and do not occur in unstable or threatened habitats. They are not included in this list.

The nomenclature and taxonomy followed Ros et al. (2007) for *Marchantiophyta* and *Anthocerotophyta* and Ros et al. (2013) for *Bryophyta*.

Results

Species list

Liverworts, Hornworts – Jetrenjaki, rogovnjaki (*Anthocerotophyta, Marchantiophyta*)

Critically endangered (CR) – Skrajno ogrožene vrste

Ricciocarpos natans (L.) Corda

SP – 9362/4: Prekmurje, W of the village Mali Bakovci, in derelict gravel pit with water, 1997 (Babij & Jogan, 2001).

Endangered (EN) – Prizadete vrste

Cephaloziella hampeana (Nees) Schiffn.
Cladopodiella fluitans (Nees) H. Buch.
Frullania jackii Gottsche.
Harpanthus flotowianus (Nees) Nees.
Leiocolea badensis (Gottsche) Jörg.
Lophozia bicrenata (Schmidel ex Hoffm.) Dumort.
Lophozia excisa (Dicks.) Dumort.
Lophozia longiflora (Nees) Schiffn.
Marchantia polymorpha L. subsp. ***montivagans*** Bischl. & Boisselier.
Riccia bifurca Hoffm.
Sauteria alpina (Nees) Nees.
Scapania calcicola (Arnell & J. Perss.) Ingham.
Scapania compacta (A. Roth) Dumort.
Scapania helvetica Gottsche.
Tritomaria exectiformis (Breidl.) Loeske subsp. ***exectiformis***.

Vulnerable (VU) – Ranljive vrste

Anthelia juratzkana (Limpr.) Trevis.
Asterella gracilis (F. Weber) Underw.
Athalamia hyalina (Sommerf.) S. Hatt.
Barbilophozia attenuata (Mart.) Loeske
Barbilophozia floerkei (F. Weber & D. Mohr) Loeske.
Barbilophozia quadriloba (Lindb.) Loeske.
Cephalozia ambigua C. Massal.
Cephalozia bicuspidata (L.) Dumort. subsp. ***lammersiana*** (Hueben.) R. M. Schust.
Cephalozia connivens (Dicks.) Lindb.
Cephalozia lacinulata J. B. Jack ex Spruce.
Cephalozia loitlesbergeri Schiffn.
Cephaloziella rubella (Nees) Warnst.
Diplophyllum taxifolium (Wahlenb.) Dumort.
Frullania riparia Hampe ex Lehm.
Gymnocolea inflata (Huds.) Dumort.
Jamesoniella autumnalis (DC.) Steph.
Jungermannia confertissima Nees.
Jungermannia polaris Lindb.
Lophozia elongata Steph.
Lophozia sudetica (Nees ex Huebener) Grolle.
Lunularia cruciata (L.) Lindb.
Metzgeria simplex Lorb. ex Müll. Frib.
Microlejeunea ulicina (Taylor) A. Evans.
Peltolepis quadrata (Saut.) Müll. Frib.
Porella x ***baueri*** (Schiffn.) C. E. O. Jensen.
Scapania cuspiduligera (Nees) Müll. Frib.

Near threatened (NT) – Potencialno ogrožene vrste

Cephalozia pleniceps (Austin) Lindb.
Kurzia pauciflora (Dicks.) Grolle.
Mylia anomala (Hook.) Gray.
Riccia fluitans L.

Data deficient (DD) – Premalo znane vrste

Only the species from subcategories DD-va and DD-n comprises this category.

V okviru te kategorije smo opredeljevali le naslednji dve podkategoriji:

Data deficient-vanished (DD-va) – Premalo znane vrste – stari podatki

Anastrophyllum hellerianum (Nees ex Lindenb.) R. M. Schust.

AL: S – 9654/1: Robanov kot, 1100 m (Breidler 1894; Breidler in: Glowacki 1912). **DN – 0352/3:** Snežniško pogorje: Globoka dolina, 1350 m (Glowacki 1913). **PA – 9856/2:** Gozdnik, W from Laško, 900–1000 m (Breidler 1894).

Anthoceros punctatus L.

AL: P – 9456/1: near Dravograd (Glowacki 1908 leg.

Melling); **9456/4:** bank of river Reka near village Trbonje, 400–500 m (Glowacki 1908). **PA – 9657/3:** near Dobrna (Reichardt 1860); **9952/2:** Ljubljana: Šentvid (Paulin mscr.); Ljubljana: Vič (Glowacki 1913 leg. Deschmann).

Arnellia fennica (Gottsche) Lindb.

AL: J – 9547/4: Mangart (Breidler 1894). **9747/3:** Matajur, N slope, 1500 m (Loitlesberger 1905).

Asterella lindenbergiana (Corda ex Nees) Arnell.

AL: J – 9547/4: Mangart: Rdeča skala, 2000–2300 m (Breidler 1894; Breidler mscr.); Mangart (Loitlesberger 1905; Glowacki 1910); Mangart, "Lahnscharte", 2000–2300 m, (Breidler 1894). **9649/1:** Veliki Draški vrh (Paulin 1911); Pekel above Rjavina (Paulin 1911).

Cephaloziella divaricata (Sm.) Schiffn.

AL: P – reported for the mountain Pohorje, without locality (Glowacki 1908). **AL: S – 9753/1:** Šenturška gora near Kamnik (Robič 1893). **DN – 0354/4:** near Gotenica "Riegerwald zwischen Gottenitz und Eben" (Paulin LJU 1900; Paulin mscr.). **PA – 0053/1:** Ljubljansko barje: near Babna gorica (Deschmann LJU 1862). **9855/1:** near Trojane (Breidler mscr.). **9952/2:** Veliki Vrh above Utik (Paulin mscr.). **PD – 0455/2:** Mozelj near Kočevje, 450 m (Glowacki 1913).

Cephaloziella elachista (J. B. Jack ex Gottsche & Rabenh.) Schiffn.

AL: P – 9457/1: near Vuzenica, 350 m (Glowacki 1908). **9559/1:** above Fram, 800 m (Glowacki 1908).

Cephaloziella integerrima (Lindb.) Warnst. **PA – 9756/1:** Žovnek near Braslovče, 350 m (Glowacki 1912).

Cololejeunea rossetiana (C. Massal.) Schiffn.

AL: J – 9647/1: valley Možnica, 1400–1600 m (Glowacki 1910). **AL: S – 9652/4:** valley Kokra, 700 m (Glowacki 1912).

Fossombronia foveolata Lindb.

PA – 9952/2: Ljubljana: Šišenski hrib, marsh, between *Carex rostrata*. IX. & X. 1917 – leg. Loitlesberger (Cryptogamae exsiccatae Nr. 3779).

Fossombronia pusilla (L.) Nees.

AL: P – 9459/4: foot of the mountain Pohorje near Radvanje, 300–400 m (Breidler 1894). **9658/1:** Golek near Zreče, 500 m (Breidler 1894). **AL: S – 9752/2:** near Olševek (Viševk) near Preddvor (Robič 1893). **PA – 9756/1:** Žovnek near Braslovče (Glowacki 1912).

Fossombronia wondraczekii (Corda) Lindb.

AL: S – 9652/4: valley Kokra (Šafer HERB 1886). **9753/1:** Šenturška gora near Kamnik (Robič LJU 1893; Robič 1893). **SM – 0047/4:** Panovec near Nova Gorica (Loitlesberger 1905).

Gymnomitrion concinnatum (Lightf.) Corda.

AL: P – 9458/3: bank of river Plešiščica near Lovrenc na Pohorju, 1000–1200 m (Breidler 1894).

Gymnomitrion corralioides Nees.

AL: P – 9458/3: bank of river Plešiščica near Lovrenc na Pohorju, 1100 m (Breidler 1894).

Harpanthus scutatus (F. Weber & D. Mohr) Spruce

AL: S – 9653/2: Logarska dolina, 800–1000 m (Breidler 1894). **9654/1:** Robanov kot, 800–1000 m (Breidler 1894). **9754/2:** Menina planina above Gornji Grad, 1000 m (Breidler 1894).

Jungermannia subelliptica (Lindb. ex Kaal.) Levier.

AL: P – 9457/4: above Josipdol near Ribnica na Pohorju, 800–900 m (Breidler 1894); above Ribnica na Pohorju, 800–900 m (Breidler 1894). **9458/3:** foot of the peak Kasjak near Lovrenc na Pohorju, 450 m (Breidler 1894); bank of river Plešiščica near Lovrenc na Pohorju, 1250 m (Breidler 1894). **9458/4:** bank of river Lobnica above Ruše, 1000–1200 m (Glowacki 1908).

Leiocolea turbinata (Raddi) H. Buch.

AL: J – 9547/4: Loška stena near Log pod Mangartom, 800–1000 m (Glowacki 1910). **9647/1:** valley Možnica, 800–1000 m (Glowacki 1910). **AL: S – 9554/3:** near Solčava, 500–700 m (Breidler 1894). **9654/2:** near Luče, 500–700 m (Breidler 1894). **PA – 9658/4:** near Slovenske Konjice, 230–600 m (Breidler 1894). **9757/4:** near Celje, 230–600 m (Breidler 1894). **9857/1:** near Laško, 230–600 m (Breidler 1894). **9858/3:** Planina pri Sevnici, 230–600 m (Breidler 1894). **9959/1:** near Kozje, 230–600 m (Breidler 1894). **SM – 0449/3:** in river Rižana (Loitlesberger 1905). **SP – 9361/2:** Polički vrh near G. Radgona, 300 m (Breidler 1894). **9560/2:** Vurberk near Ptuj, 300 m (Breidler 1894).

Mannia fragrans (Balb.) Frye & L. Clark.

AL: Z – 9357/3: Dravski Kozjak – near Muta, 350 m (Breidler 1894); **9459/1:** above Bresternica, 400 m (Breidler 1894). **PA – 9657/2:** near Vitanje (Breidler 1894). **9658/4:** near Slovenske Konjice, 300–500 m (Breidler 1894). **9857/1:** near Laško (Breidler 1894). **9857/3:** Rimske Toplice (Breidler 1894); **9858/3:** Planina pri Sevnici (Breidler 1894). **9959/1:** Kozje, castle hill (Breidler 1894). **SM – 0251/1:** Sovič above Postojna, 650 m (Breidler LJU 1901, Breidler in: Glowacki 1912).

Mannia triandra (Scop.) Grolle.

32 localities, last record in the year 1914.

Marsupella sprucei (Limpr.) Bernet.

AL: P – 9457/4: above Ribnica na Pohorju, 1000–1200 m (Breidler 1894, var. *sprucei* and var. *ustulata*); above Josipdolom, 1000–1200 m (Breidler 1894, var. *ustulata*). **9458/3:** bank of river Plešiščica near Lovrenc na Pohorju, 1000–1300 m (Breidler 1894); near Lovrenc na Pohorju, 1000–1300 m (Breidler 1894). **9458/4:** bank of river Lobnica near Ruše, 1000–1200 m

(Glowacki 1908). **9558/3:** Jagerska peč above Lukanja, 1000–1200 m (Glowacki 1908). **9559/3:** bank of river Bistrica near Slovenska Bistrica, 1000–1200 m (Glowacki 1908).

Moerckia flotowiana (Nees) Schiffn.
DN – 0049/1: Trnovski gozd: Paradana, 1200 m (Loitlesberger 1905).

Moerckia hibernica (Hook.) Gottsche.
AL: J – 9547/4: V Pungartu near Log pod Mangartom, 800–1000 m (Glowacki 1910); Loška stena above Log pod Mangartom, 800–1000 m (Glowacki 1910). **9647/1:** valley Možnica near Bovec, 800–1000 m (Glowacki 1910). **AL: S – 9553/4:** Icmanikova planina above Solčava, 1400 m (Glowacki 1912). **9554/3:** bank of river Savinja near Solčava, 700 m (Breidler 1894). **9652/1:** Beli Potok near Tržič, 900 m (Glowacki 1912). **DN – 0049/1:** Trnovski gozd: Paradana, 1200 m (Loitlesberger 1905).

Nardia geoscyphus (De Not.) Lindb.
AL: J – 9747/3: Matajur, 1600 m (Loitlesberger 1905). **AL: P – 9457/4:** above Ribnica na Pohorju (Dolšak LJU 1927). **9459/3:** near Ruše (Glowacki 1908). **9459/4:** slope above Maribor (Breidler 1894). **9657/2:** above Vitanje (Breidler 1894). **9658/2:** near Oplotnica (Glowacki 1908).

Odontoschisma sphagni (Dicks.) Dumort.
AL: J – 9649/4: Pokljuka: bog Šijec (Paulin 1915); Pokljuka: bog Veliko Blejsko barje (Paulin 1915). **AL: S – 9752/2:** Možjanca above Preddvor (Robič in: Glowacki 1912).

Phaeoceros carolinianus (Michx.) Prosk.
PD – 9953/3: Debeli hrib above Lavrica, 350 m (Flora exsiccata Austro-Hungarica, No.1933 sub *Anthoceros laevis*, leg. Paulin; Paulin LJU 1884 sub *Anthoceros laevis* – det. A. Martinčič).

Phaeoceros laevis (L.) Prosk.
Taxonomic status doubtful, all data are only from literature **AL: P – 9457/1:** near Vuhred, 400 m (Breidler 1894). **9457/4:** near Ribnica na Pohorju, 900 m (Breidler 1894). **9459/4:** above Maribor, 300 m (Glowacki 1908). **AL: S – 9752/2:** Olševek near Preddvor (Robič 1893). **9753/1:** Šenturška gora near Kamnik (Robič 1893). **PA – 9657/3:** near Dobrna (Reichardt 1860). **9952/2:** Ljubljana: Rožnik (Paulin mscr.). **PD – 9953/3:** Ljubljana: Golovec above Štepanja vas (Paulin mscr.).

Riccia canaliculata Hoffm.
SP – 0059/4: near Brežice, forest Dobrava, 160 m (Breidler 1894).

Riccia ciliata Hoffm.
AL: Z – 9459/1: Srednje towards Bresternica, 300–400 m (Breidler 1894).

Riccia glauca L.
20 localities, last record in the year 1894.

Riccia sorocarpa Bisch.
AL: S – 9754/3: Sela near Kamnik (Šafer HERB; Glowacki 1912, leg. Šafer). **AL: Z – 9359/4:** Kozjak, S slope above Maribor, 300–500 m (Breidler 1894). **DN – 0252/2:** Žerovnica near lake Cerkniško jezero (Šafer HERB 1887).

Scapania crassiretis Bryhn.
AL: J – 9549/3: valley Kot near Mojstrana, 900 m (Dolšak LJU 1921 – det. A. Martinčič).

Tritomaria polita (Nees) Jörg.
AL: P – 9557/4: Rakovec above Vitanje, 1200 m (Glowacki 1908).

Data deficient-new (DD-n) – Premalo znane vrste-novi podatki.

Bazzania flaccida (Dumort.) Grolle.
AL: J – 9647/1: valley Možnica, N exs., 700 m (Düll 1999).

Cephaloziella baumgartneri Schiffn.
DN – 0251/2: Rakov Škocjan: near cave Zelške jame (Sguazzin & Polli 1999).

Conocephalum salebrosum Szweyk., Buczkowska. & Odrzykoski.
AL: M – 9455/2: Strojna: valley of river Strojnska reka under Zeleni breg, 500 m (Martinčič LJU 2010).

Frullania inflata Gottsche.
SM – 0148/2: Steske near Dornberk, 100 m (Martinčič DOK 2007).

Gymnomitrion apiculatum (Schiffn.) Müll. Frib.
Reported for Slovenia, without locality and source (Sabovljević & Natcheva 2006; Ros et al. 2007).

Lophozia ascendens (Warnst.) R. M. Schust.
AL: K – 9554/1: Olševa, N slope, 1300 m (Martinčič LJU 2003).

Metzgeria violacea (Ach.) Dumort.
Reported for Slovenia, without locality and source (Sabovljević & Natcheva 2006; Ros et al. 2007).

Mosses (*Bryophyta*) – listnati mahovi

Regionally extinct/Potentially extinct (RE) – Regionalno izumrle/potencialno izumrle vrste

Aschisma carniolicum (F. Weber & D. Mohr) Lindb.
SM – 0250/2: Orehek near Postojna (F. Weber & D. Mohr 1807 leg. Wagner; Sendtner 1848 leg. Wagner; Juratzka 1882 leg. Wagner). Only one record.

Bruchia flexuosa (Schwägr.) Müll. Hal.
AL: SP – 9459/4: near Radvanje near Maribor, 290 m, in the field (Juratzka 1882, leg. Breidler; Breidler 1891).

Campylopus pyriformis (Schultz) Brid.
PA – 0052/1: Ljubljansko barje (Juratzka 1882, leg. Berroyer); Ljubljansko barje: near Bevke (Paulin mscr.). **0053/1:** Ljubljansko barje (Müllner 1893); Ljubljansko barje: near Grmez (Breidler mscr.).
Ephemerum cohaerens (Hedw.) Hampe.
PA – 9952/4: Ljubljana: Mestni log, in the clay excavation area behind the brickwork plant (Juratzka 1882 leg. Deschmann).
Fontinalis squamosa Hedw. var. ***squamosa***.
DN – 0252/1: in the bed of spring Sv. Magdalena near Marof - Cerknica (Šafer HERB; Glowacki 1913, leg. Šafer).
Meesia longiseta Hedw.
PA – 0053/1: Ljubljansko barje: near Grmez (Breidler LJU 1884; Breidler mscr.; Glowacki 1913, leg. Breider); Ljubljansko barje: between Babna gorica and Grmez (Paulin 1915).
Tortula cernua (Huebener) Lindb.
AL: J – 9547/4: Srednji Log under Mangart, 700–750 m, on an old lime kiln (Glowacki 1910); Julian Alps (Sendtner 1857, Limpricht 1890, leg. Sendtner).
Warnstorfia pseudostraminea (Müll.-Hal.) Tuom. & T. J. Kop.
PA – 0053/1: Ljubljansko barje: S from Grmez (Breidler mscr.).

Critically endangered (CR) – Skrajno ogrožene vrste

Cleistocarpidium palustre (Bruch & Schimp.) Ochyra & Bednarek-Ochyra.
9 records/localities in period 1884–1908. Recent record: AL: Z – 9356/3: Košenjak, near farm Armel, on tree trunk, 800 m (Martinčič LJU 2008; Martinčič 2010a).
Drepanocladus turgescens (T. Jensen) Broth.
AL: J – 9749/1: bank of lake Bohinjsko jezero, south border (Kuc 1967).
Meesia triquetra (L. ex Jolycl.) Ångstr.
AL: J – 9649/4: Pokljuka: Mrzli Studenec (Kuc 1967). **AL: P – 9557/2:** Lovrenška jezera, 1520 m (Glowacki 1908). **PA – 0053/1:** Ljubljansko barje: near Grmez, in water pool (Deschmann LJU 1856; Deschmann 1858); Ljubljansko barje: near Lavrica (Pokorny 1858; Glowacki 1913, leg. Deschmann). **SP – 9163/1:** Goričko: springs of river Velika Krka (Boros 1944); **9959/4:** Zg. Velovljek near Ptuj, 225 m (Breidler 1891, leg. Krupička).
Polytrichum pallidisetum Funck.
PD – 0254/4: Dolenja vas near Ribnica, 500 m, *Caricetum lasiocarpae* (Martinčič LJU 1992; Martinčič 1994).
Scorpidium revolvens (Sw. ex anon.) Rubers.
AL: J – 9649/4: Pokljuka: raised bog Veliko Blejsko barje, 1200 m (Martinčič LJU 1977; Martinčič 2003b).
Sphagnum riparium Ångstr.
AL: P – 9558/2: bank of Črno jezero, *Sphagno-Caricetum*, 1170 m (Martinčič LJU 1975; Martinčič 1977).

Endangered (EN) – Prizadete vrste

Anacamptodon splachnoides (Froel. ex Brid.) Brid.
Blindia caespiticia (F. Weber & D. Mohr) Müll. Hal.
Brachythecium erythrorrhizon Schimp.
Campylopus fragilis (Brid.) Bruch & Schimp.
Cynodontium fallax Limpr.
Dicranum tauricum Sapjegin.
Didymodon giganteus (Funck) Jur.
Didymodon insulanus (De Not.) M. O. Hill.
Didymodon validus Limpr.
Ditrichum pallidum (Hedw.) Hampe.
Ditrichum pusillum (Hedw.) Hampe.
Entosthodon muehlenbergii (Turner) Fife.
Entosthodon pulchellus (H. Philib.) Brugués.
Eurhynchiastrum pulchellum (Hedw.) Ignatov & Huttunen var. ***diversifolium*** (Schimp.) Ochyra & Żarnowiec.
Fissidens osmundoides Hedw.
Fissidens serrulatus Brid.
Fontinalis antipyretica Hedw. subsp. ***gracilis*** (Lindb.) Kindb.
Fontinalis hypnoides C. Hartm. subsp. ***hypnoides***.
Grimmia elatior Bruch ex Bals.-Criv. & De Not.
Grimmia ovalis (Hedw.) Lindb.
Grimmia tergestina Tomm. ex Bruch & Schimp.
Gymnostomum viridulum Brid.
Gyroweisia tenuis (Hedw.) Schimp.
Habrodon perpusillus (De Not.) Lindb.
Kiaeria falcata (Hedw.) I. Hagen.
Kiaeria starkei (F. Weber & D. Mohr) I. Hagen.
Lescuraea saviana (De Not.) E. Lawton.
Orthothecium strictum Lorentz.
Orthotrichum patens Bruch ex Brid.
Orthotrichum stellatum Brid.
Philonotis seriata Mitt.
Physcomitrella patens (Hedw.) Bruch & Schimp.
Plagiothecium neckeroideum Schimp.
Plasteurhynchium meridionale (Schimp.) M. Fleisch.
Pohlia drummondii (Mull. Hal.) A. L. Andrews.
Pohlia melanodon (Brid.) A. J. Shaw.
Pohlia obtusifolia (Vill. ex Brid.) L. F. Koch.
Pohlia proligera (Kindb.) Lindb. ex Broth.
Pseudoleskea artariae Thér.
Pterygoneurum ovatum (Hedw.) Dixon.
Racomitrium fasciculare (Hedw.) Brid.
Racomitrium microcarpon (Hedw.) Brid.

Rhynchostegiella curviseta (Brid.) Lindb.
Rhynchostegiella teneriffae (Mont.) Dirkse & Bouman.
Saelania glaucescens (Hedw.) Broth.
Sarmenthypnum sarmentosum (Wahlenb.) Tuom. & T. J. Kop.
Schistidium brunnescens Limpr.
Sciuro-hypnum ornellanum (Molendo) Ignatov & Huttunen.
Scorpiurium sendtneri (Schimp.) M. Fleisch.
Seligeria recurvata (Hedw.) Bruch & Schimp.
Sphagnum compactum Lam. & DC.
Sphagnum fimbriatum Wilson.
Sphagnum majus (Russow) C. E. O. Jensen subsp. ***majus***
Sphagnum teres (Schimp.) Ångstr.
Splachnum ampullaceum Hedw.
Splachnum sphaericum Hedw.
Syntrichia latifolia (Bruch ex Hartm.) Huebener.
Tetraplodon mnioides (Hedw.) Bruch & Schimp.
Timmiella anomala (Bruch & Schimp.) Limpr.
Tortella inflexa (Bruch) Broth.
Tortula mucronifolia Schwägr.
Tortula protobryoides R. H. Zander.
Tortula schimperi M. J. Cano, O. Werner & J. Guerra.
Trichostomum brachydontium Bruch.
Weisia longifolia Mitt.
Weisia squarrosa (Nees & Hornsch.) Müll. Hal.
Weisia wimmeriana (Sendtn.) Bruch & Schimp.

Vulnerable (VU) – Ranljive vrste

Abietinella abietina (Hedw.) M. Fleisch. var. ***hystricosa*** (Mitt.) Sakurai.
Barbula convoluta Hedw. var. ***sardoa*** Schimp.
Bracytheciastrum collinum (Schleich. ex Müll. Hal.) Ignatov & Huttunen.
Bryum elegans Nees.
Bryum intermedium (Brid.) Blandow.
Catoscopium nigritum (Hedw.) Brid.
Cinclidotus riparius (Host ex Brid.) Arn.
Cratoneuron curvicaule (Jur.) G. Roth.
Dicranella crispa (Hedw.) Schimp.
Didymodon tophaceus (Brid.) Lisa.
Drepanocladus lycopodioides (Brid.) Warnst.
Drepanocladus polygamus (Schimp.) Hedenäs.
Drepanocladus sendtneri (Schimp. ex H. Müll.) Warnst.
Fissidens exilis Hedw.
Fissidens viridulus (Sw. ex anon.) Wahlenb. var. ***viridulus***
Hedwigia ciliata (Hedw.) P. Beauv. var. ***leucophaea*** Bruch & Schimp.
Hygroamblystegium fluviatile (Hedw.) Loeske.
Hygroamblystegium humile (P. Beauv.) Vanderp., Goffinet & Hedenäs.
Hygrohypnum duriusculum (De Not.) D. W. Jamieson.
Hygrohypnum eugyrium (Schimp.) Broth.
Hygrohypnum ochraceum (Turner ex Wilson) Loeske.
Hylocomiastrum pyrenaicum (Spruce) M. Fleisch.
Hymenoloma crispulum (Hedw.) Ochyra.
Hypnum pallescens (Hedw.) P. Beauv.
Hypnum sauteri Schimp.
Lescuraea saxicola (Schimp.) Molendo.
Molendoa sendtneriana (Bruch & Schimp.) Limpr.
Nogopterium gracile (Hedw.) Crosby & W. R. Buck
Pleuridium subulatum (Hedw.) Rabenh.
Polytrichastrum sexangulare (Brid.) G. L. Sm.
Polytrichum uliginosum (Wallr.) Schriebl.
Racomitrium aciculare (Hedw.) Brid.
Rhabdoweisia crispata (Dicks.) Lindb.
Rhynchostegium rotundifolium (Scop. ex Brid.) Schimp.
Sarmenthypnum exannulatum (Schimp.) Hedenäs.
Schistidium rivulare (Brid.) Podp.
Schistidium trichodon (Brid.) Poelt var. ***trichodon***
Sciuro-hypnum latifolium (Kindb.) Ignatov & Huttunen.
Sphagnum fuscum (Schimp.) H. Klinggr.
Sphagnum inundatum Russow.
Sphagnum platyphyllum (Lindb. ex Braithw.) Warnst.
Sphagnum tenellum (Brid.) Pers. ex Brid.
Sphagnum warnstorfii Russow.
Syntrichia laevipila Brid.
Tortella humilis (Hedw.) Jenn.
Tortula inermis (Brid.) Mont.
Trichodon cylindricus (Hedw.) Schimp.

Near threatened (NT) – Potencialno ogrožene vrste

Breidleria pratensis (W. D. J. Koch ex Spruce) Loeske.
Buxbaumia aphylla Hedw.
Buxbaumia viridis (Moug. ex Lam. & DC.) Brid ex Moug. & Nestl.
Calliergon giganteum (Schimp.) Kindb.
Dialytrichia mucronata (Brid.) Broth.
Dichodontium palustre (Dicks.) M. Stech.
Drepanocladus aduncus (Hedw.) Warnst.
Drepanocladus trifarius (F. Weber & D. Mohr) Broth. ex Paris.
Hypnum bambergeri Schimp.
Philonotis caespitosa Jur.
Philonotis capillaris Lindb.
Philonotis marchica (Hedw.) Brid.
Physcomitrium pyriforme (Hedw.) Bruch & Schimp.
Sphagnum auriculatum Schimp.
Sphagnum centrale C. E. O. Jensen.
Sphagnum papillosum Lindb.
Sphagnum rubellum Wilson.
Tomenthypnum nitens (Hedw.) Loeske.
Warnstorfia fluitans (Hedw.) Loeske.

Data deficient (DD) – Premalo znane vrste

Only the species from subcategories DD-va and DD-n comprises this category.

V okviru te kategorije smo opredeljevali le podkategoriji DD-va in DD-n.

Data deficient-vanished (DD-va) – Premalo znane vrste-stari podatki

Acaulon muticum (Hedw.) Müll. Hal.

AL: M – 9456/3: Rahtelov vrh above Slovenj Gradec, 600 m, in the clover field (Breidler 1891). **AL: P – 9559/3:** at the foot of mountain Pohorje above Slovenska Bistrica, 400 m (Breidler 1891; Glowacki 1908, leg. Breidler). **AL: S – 9754/3:** Sela near Kamnik (Šafer HERB 1878; Glowacki 1912, leg. Šafer). **AL: Z – 9459/1:** Dravski Kozjak: Srednje near Maribor, 400 m (Juratzka 1882, leg. Breidler; Breidler 1891). **PA – 9953/3:** Ljubljana: Rakovnik, 300 m (Paulin mscr.).

Aloina aloides (Koch ex Schultz) Kindb.

PA – 9848/2: between Tolmin and Most na Soči, 150 m (Glowacki 1910).

Aloina ambigua (Bruch & Schimp.) Limpr.

AL: S – 9655/4: near Mozirje, bank of river Savinja, 340 m (Breidler 1891). **PA – 9851/2:** Suha near Škofja Loka, 350 m (Glowacki 1910). **9947/2:** between Kanal and Ročinj, 100–140 m (Glowacki 1910). **SP – 9459/2:** Kamnica near Maribor, 260 m (Breidler 1891). **0058/2:** near Krško, bank of river Sava, 160 m (Breidler 1891 legit. Glowacki).

Aloina rigida (Hedw.) Limpr.

16 localities, last record in the year 1910.

Amphidium lapponicum (Hedw.) Schimp.

AL: S – 9555/3: Smrekovec, 1460 m (Wallnöfer 1888).

Andreaea rothii F. Weber & D. Mohr.

AL: S – 9652/4: valley Kokra: Leskovec, 570 m (Robič LJU 1885, Robič 1893).

Anomobryum concinnatum (Spruce) Lindb.

18 localities, last record in the year 1912.

Anomobryum julaceum (Schrad. ex P. Gaertn. et al.) Schimp.

AL: J – 9547/4: Mangart, Male špice, 2000–2100 m (Glowacki 1910). **AL: S – 9653/2:** Ojstrica, 1900 m (Glowacki 1912).

Archidium alternifolium (Hedw.) Mitt.

19 localities, last record in the year 1913.

Barbula bicolor (Bruch & Schimp.) Lindb.

AL:J – 9547/4: Mangart, Male Špice (Glowacki 1910); near Log pod Mangartom (Glowacki 1910). **9646/2:** Kanin (Glowacki 1910). **9647/1:** Črnelski vršiči (Sendtner 1848).

Barbula enderesii Garov.

AL: J – 9648/2: valley Zadnjica (Glowacki 1910). **9549/4:** valley Krma (Tomažič LJU 1928, rev. Martinčič). **AL: P – 9557/3:** Gornji Dolič near Mislinja (Glowacki 1908). **DN – 0252/4:** Šteberk near Lipsenj (Šafer HERB 1890; Glowacki 1913, leg. Šafer). **PA – 9851/1:** Selška dolina: Praprotno (Loitlesberger 1909). **9657/3**: castle Gutenek above Dobrna (Breidler 1891). **SM – 0251/1:** Postojna (Dolliner LJU 1860).

Brachydontium trichodes (F. Weber) Milde.

AL: P – 9558/3: Lukanja near Oplotnica (Glowacki 1908). **9457/3:** Hudi kot near Ribnica na Pohorju (Breidler 1891; Breidler in: Glowacki 1908). **9457/4:** Josipdol near Ribnica na Pohorju (Breidler 1891; Breidler in: Glowacki 1908); near Ribnica na Pohorju (Breidler 1891; Breidler in: Glowacki 1908).

Bryoerythrophyllum alpigenum (Venturi) P. C. Chen.

AL: J – 9547/4: Mangart, Male špice, 2100 m (Glowacki 1910); near Spodnji Log pod Mangartom, 600 m (Glowacki 1910). **9647/1:** valley Možnica, 800–900 m (Glowacki 1910). **9748/3:** Vodil vrh above Tolmin, 500–800 m (Glowacki 1910). **AL: P – 9457/4:** bank of river Velka near Ribnica na Pohorju, 400 m (Glowacki 1908).

Bryoerythrophyllum rubrum (Jur. ex Geh.) P. C. Chen

AL: J – 9547/4: Mangart, Male Špice, 2050–2150 m (Glowacki 1910); Mangart, Rdeča skala, 2050–2150 m (Glowacki 1910).

Bryum canariense Brid.

SM – 0349/1: draga Orlek near Sežana (Juratzka 1882, leg. Tommasini). **0447/3:** near Piran (Sendtner 1848, leg. Hornschuch).

Bryum funkii Schwägr.

8 localities, last record in the year 1908.

Bryum klinggraeffii Schimp.

SP – 9561/3: bank of river Drava near Ptuj, 315 m (Breidler 1891).

Bryum kunzei Hornsch.

AL: J – 9547/4: Log pod Mangartom, 650 m (Glowacki 1910). **AL: S – 9653/2:** alp Planina Korošica, 1800 m (Glowacki 1912); alp Plesnikova planina near Solčava, 1300 m (Glowacki 1912). **PA – 9855/1:** Trojane, 500–600 m (Breidler mscr).

Bryum radiculosum Brid.

15 localities, last record in the year 1910.

Bryum schleicheri DC.

16 localities, last record in the year 1912.

Bryum turbinatum (Hedw.) Turner.

20 localities, last record in the year 1913.

Bryum weigelii Spreng.

AL: S – 9653/2: Ojstrica plateau, 1500–1600 m (Glowacki 1912). **9754/2:** right bank of river Dreta near Gornji Grad, 450 m (Breidler 1891). **AL: P –** record (mountain Pohorje) without precise locality, 1200–1300 m (Breidler 1891).

Calliergon richardsonii (Mitt.) Kindb.
AL: J – 9649/1: Velo polje (Paulin 1915); Malo polje at Velo polje, 1700 m (Glowacki 1910). **9648/4:** alp Planina pri Jezeru above Bohinj, 1400 m (Glowacki 1910). **9749/2:** Bohinj: Srednja vas (Glowacki 1910 leg. Krupička).

Campylopus schimperi Milde.
AL: S – 9653/1: Grintovec, 2400–2500 m (Breidler mscr.)

Campylostelium saxicola (F. Weber & D. Mohr) Bruch & Schimp.
PA – 9858/4: between Šentjur pri Celju and Planina pri Sevnici, 450 m (Breidler 1891). **SM – 0047/4:** Rožna dolina near Nova Gorica (Höhnel 1891).

Cnestrum schisti (F. Weber & D. Mohr) I. Hagen.
AL: S – 9655/4: near Mozirje: Sv. Mihael towards Ljubija, 600–700 m (Breidler 1891).

Conardia compacta (Drumm. ex Müll. Hal.) H. Rob.
PA – 9752/3: bank of river Sava near Kranj (Glowacki 1910, 1912 – leg. Krupička).

Coscinodon cribrosus (Hedw.) Spruce.
AL: S – 9652/4: valley Kokra (Robič LJU 1885, Robič 1893). **AL: Z – 9459/1:** Dravski Kozjak: Srednje, 400 m, (Juratzka, 1882, leg. Breidler; Breidler 1891). **AL: M – 9455/4:** valley of Barbarski potok near Prevalje, 450 m (Glowacki 1908). **PA – 9857/3:** Hum near Laško, 350 m (Breidler 1891).

Crossidium squamiferum (Viv.) Jur.
AL: J – 9547/4: between Predel and Mangartska skala (= Rdeča skala), 1650 m (Sendtner 1848, Sendtner in: Glowacki 1910).

Crossidium squamiferum (Viv.) Jur. var. ***pottioideum*** (De Not.) Mönkm.
SM – 0048/1: Sv. Gora above Nova Gorica (Höhnel 1893); Trnovski gozd: W slope above Nova Gorica (Höhnel 1893); Sv. Marija above Vitovlje, 600–700 m (Loitlesberger 1909); Škabrijel, S slope, 200–300 m (Loitlesberger 1909); Sv. Danijel, S slope, 200–300 m (Loitlesberger 1909; Bauer Musci eur. exsic. No. 277, leg. Loitlesberger). **0449/1:** Beka near Ocizla (Juratzka 1867).

Cryphaea heteromalla (Hedw.) D. Mohr.
SM – 0048/3: Vipavska dolina: Vogrsko (Loitlesberger 1909); Vipavska dolina: Renče (Loitlesberger 1909; Bauer Musci eur. exsic. No. 567, leg. Loitlesberger).

Cynodontium bruntonii (Sm.) Bruch & Schimp.
DN – 0454/3: Osilnica, in valley of river Kolpa, 300 m (Glowacki 1913). **PA – 9757/4:** near Celje (Breidler 1891, leg. Kaulfuss).

Cynodontium tenellum (Schimp.) Limpr.
AL: P – 9557/4: Rakovec above Vitanje, 1000 m (Glowacki 1908). **AL: S – 9754/3:** bank of river Dreta near Gornji Grad, 450 m (Breidler 1891).

Dicranella humilis R. Ruthe.
AL: S – 9754/3: Sela near Kamnik, (Šafer HERB 1881, det. Breidler). **SP – 9759/2:** "Schrotlauftberg" near Studenica in the vicinity of Poljčane, 400–500 m (Breidler 1891).

Dicranoweisia cirrata (Hedw.) Lindb.
DN – 0452/2: Snežnik (Biasoletto 1846).

Dicranum brevifolium (Lindb.) Lindb.
AL: J – 9547/4: Mangart, 2500–2600 m (Breidler mscr.). **AL: S – 9654/1:** Ojstrica plateau, above Luče, 1600–1700 m (Glowacki 1912).

Dicranum spadiceum J. E. Zetterst.
AL: J – 9547/4: Mangart, 2300–2600 m (Breidler mscr.; Glowacki 1910). **AL: S – 9653/3:** Vrh Korena (Robič LJU 1885; Robič 1893). **9654/3:** Ojstrica plateau above Luče, 1600–1700 m (Glowacki 1912). **9753/1:** Krvavec, 1850 m (Robič 1893).

Didymodon icmadophilus (Schimp. ex Müll. Hal.) K. Saito.
AL: J – 9547/4: Mangart, 2675 m (Limpricht 1890, leg. Sendtner).

Ditrichum lineare (Sw.) Lindb.
18 localities, last record in the year 1910.

Encalypta longicolla Bruch.
AL: J – 9749/4: Črna prst (Bruch 1828, leg. F. Müller, 1826).

Entosthodon fascicularis (Hedw.) Müll. Hal.
11 localities, last record in the year 1908.

Entosthodon obtusus (Hedw.) Lindb.
L: S – 9752/2: Možjanca above Preddvor (Robič 1893). **9753/1:** Šenturška gora near Kamnik (Robič LJU 1878; Robič 1893). **AL: P – 9658/1:** near Zreče, 400 m (Breidler 1891). **PA – 9757/2:** between Celje and Slatina v Rožni dolini (Breidler LJU 1882); Zadobrova near Celje (Breidler 1891); between Zadobrova and Šmartno v Rožni dolini, 270–300 m (Breidler 1891). **PD – 9953/3:** Golovec above Ljubljana (Deschmann 1862; Juratzka 1882, leg. Berroyer; Müllner 1893).

Ephemerum serratum (Hedw.) Hampe.
9 localities, last record in the year 1908.

Fabronia pusilla Raddi.
DN – region Trnovski gozda-Idrija (Giacomini 1950), without precise locality.

Fissidens gymnandrus Buse.
11 localities, last record in the year 1912.

Fissidens viridulus (Sw. ex anon.) Wahlenb. var. ***incurvus*** (Starke ex Röhl.) Waldh.
AL: P – 9457/4: Legen near Ribnica na Pohorju, 500 m (Glowacki 1908, 1914). **AL: S – 9655/4:** Brezje near Mozirje, 400 m (Breidler 1891).

Fontinalis antipyretica Hedw. subsp. ***kindbergii*** (Renauld & Cardot) Cardot.

DN – 0352/2: near castle Snežnik in Loška dolina, 600 m (Glowacki 1913). **PA – 9752/3:** near Kranj, in the river Sava (Glowacki 1912, leg. Krupička). **9857/3**: in the river Gračnica near Rimske Toplice (Glowacki 1914).

Grimmia anodon Bruch & Schimp.
AL: J – 9547/4: Mangart: Rdeča skala, 2000 m (Sendtner 1848, 1857; Glowacki 1910).

Grimmia crinita Brid.
SM – 0349/2: Škocjan near Divača (Sendtner 1848).

Grimmia donniana Sm.
AL: P – 9558/3: Jagerske peči above Lukanja, 1200–1300 m (Glowacki 1908).

Grimmia laevigata (Brid.) Brid.
11 localities, last record in the year 1908.

Grimmia lisae De Not.
AL: J – 9547/4: Strmec na Predelu (Glowacki 1910).

Grimmia muehlenbeckii Schimp.
7 localities, last record in the year 1912.

Grimmia orbicularis Bruch ex Wilson.
10 localities, last record in the year 1911.

Grimmia teretinervis Limpr.
DN – 0048/2: Trnovski gozd: towards Krnica (Loitlesberger 1909). **PA – 9657/2:** Javornik above Vitanje, 600–700 m (Breidler 1891). **9757/4:** Sv. Miklavž near Celje, 300 m (Breidler 1891). **9857/4:** Hum near Laško, 400 m (Breidler 1891).

Haplocladium angustifolium (Hampe & Müll. Hal.) Broth.
SM – 0047/4: Vrtojba near Nova Gorica (Loitlesberger 1909); Šempeter near Nova Gorica (Loitlesberger 1909).

Haplocladium virginianum (Brid.) Broth.
AL: S – 9655/4: Brezje near Mozirje, 480 m (Breidler 1891).

Hennediella heimii (Hedw.) R. H. Zander.
AL: J – 9649/1: Mali Triglav, 2550 m (Glowacki 1910). **DN – 0251/1:** Postojna (Dolliner LJU).

Hygrohypnum molle (Hedw.) Loeske.
AL: J – 9547/4: Mangart (Sendtner 1848).

Hypnum hamulosum Schimp.
AL: S – 9753/1: Šenturška gora near Kamnik (Robič 1893); Šentlenart behind Šenturška gora (Robič 1893).

Hypnum procerrimum Molendo.
DN – 0452/2: Snežniško pogorje: Vk. Snežnik (Ginzberger 1909).

Imbribryum alpinum (Huds. ex With.) N. Pedersen
20 localities, last record in the year 1910.

Imbribryum mildeanum (Jur.) J. R. Spence
13 localities, last record in the year 1912.

Leptobryum pyriforme (Hedw.) Wilson.
13 localities, last record in the year 1913.

Microbryum davallianum (Sm.) R. H. Zander.
AL: S – 9754/3: Sela near Kamnik, in the field (Šafer HERB 1879; Glowacki 1912, leg. Šafer).

Microbryum starckeanum (Hedw.) R. H. Zander.
DN – 0252/2: Solzno near Grahovo (Šafer HERB 1885; Glowacki 1913, leg. Šafer).

Mielichhoferia mielichhoferiana (Funck) Loeske.
AL: S – 9652/4: valley Kokra (Robič LJU; Robič 1893).

Myurella tenerrima (Brid.) Lindb.
AL: J – 9547/4: Mangart, 2100 m (Limpricht 1895, leg. Sendtner; Glowacki 1910). **9647/1:** Možnica valley near Bovec (Glowacki 1910). **PA – 9752/1:** Suha near Kranj (Robič 1893).

Nyholmiella gymnostoma (Bruch ex Brid.) Holmen & Warncke.
SP – 9661/1: Šturmovci near Ptuj, 220 m, (Breidler 1891).

Orthotrichum microcarpum De Not.
DN – 0252/2: Špiček above Grahovo (Burchard 1892, leg. Šafer); Žerovnica at Cerkniško jezero (Burchard 1892, leg. Šafer).

Orthotrichum pulchellum Brunt.
DN – 0252/2: Kamna gorica at Cerkniško jezero (Šafer HERB 1887; Glowacki 1913, leg. Šafer).

Orthotrichum scanicum Gronvall.
10 localities, last record in the year 1908.

Pelekium minutulum (Hedw.) Touw.
PA – 9657/3: vicinity of Dobrna (Reichardt 1860).

Physcomitrium eurystomum Sendtn.
SP – 9460/3: Maribor, Stražun, 250 m (Suanjak 2002, leg. Glowacki 1910).

Physcomitrium eurys. Sendtn. subsp. ***acuminatum*** (Bruch & Schimp.) Giacom.
SP – 9561/3: near Ptuj, 230 m (Breidler 1891).

Pohlia annotina (Hedw.) Lindb.
12 localities, last record in the year 1912.

Pohlia bulbifera (Warnst.) Warnst.
AL: S – 9654/2: Sv. Primož above Ljubno, 440 m (Glowacki 1912, 1914).

Pohlia elongata Hedw. var. ***acuminata*** (Hornsch.) Huebener.
AL: J – 9548/3: Ozebnik near Jalovec (Sendtner 1848).

Pohlia elongata Hedw. var ***greenii*** (Brid.) A. J. Shaw.
AL: J – 9647/1: Rombon (Loitlesberger 1909; Loitlesberger in: Glowacki 1910). **9749/4:** Črna prst (Paulin mscr.). **AL: S – 9554/3:** Logarska dolina – bank of river Jezera (Reichardt 1860). **653/2:** Ojstrica plateau, 1700 m (Glowacki 1912).

Pohlia lescuriana (Sull.) Ochi.
12 localities, last record in the year 1912.

Pohlia lutescens (Limpr.) H. Lindb.
7 localities, last record in the year 1914.

Pohlia vexans (Limpr.) H. Lindb.
AL: J – 9649/4: Pokljuka: Za Mlako, 1200 m (Glowacki 1910). **AL: S – 9554/3:** bank of river Savinja near Solčava, 670 m (Glowacki 1912).

Pseudephemerum nitidum (Hedw.) Loeske.
AL: S – 9753/1: Šenturška gora near Kamnik (Robič LJU 1885; Robič 1893). **PA – 9953/3:** Dol pri Ljubljani (Paulin mscr.). **9952/4:** Ljubljana: Mestni log (Müllner 1893). **SP – 9560/1:** Rače near Maribor (Glowacki 1908). **0059/4:** Dobrava (wood) near Brežice (Breidler 1891).

Pseudobryum cinclidioides (Huebener) T. J. Kop.
AL: J – 9547/4: Mangart, 2100 m (Glowacki 1910). **AL: S – 9653/4:** alp Planina Vodotočnik under Ojstrica, 1880–1900 m (Glowacki 1912).

Pseudocrossidium hornschuchianum (Schultz) R. H. Zander.
AL: J – 9547/4: Srednji Log under Mangart, 600 m (Glowacki 1910). **AL: S – 9655/4:** near Mozirje, bank of river Savinja, 340 m (Breidler 1891). **AL: Z – 9459/2:** Kamnica near Maribor (Juratzka 1882 leg. Breidler; Breidler 1891). **DN – 0252/2:** Žerovnica at lakeCerkniško jezero (Šafer HERB 1890; Glowacki 1913, leg. Šafer). **PA – 9656/3:** Gora Oljka, 400–500 m (Breidler 1891). 9756/1: near Braslovče, bank of river Savinja, 300 m (Glowacki 1912).

Pterygoneurum subsessile (Brid.) Jur.
AL: S – 9754/3: Sela pri Kamniku (Šafer HERB 1878; Glowacki 1912, leg. Šafer).

Ptychomitrium polyphyllum (Dicks. ex Sw.) Bruch & Schimp.
AL: S – 9754/3: under Trobelno, N from Sela pri Kamniku, 600–900 m (Šafer HERB 1878; Breidler 1891, leg. Šafer; Glowacki 1912, leg.Šafer)

Ptychostomum arcticum (R. Br.) J. R. Spence ex Holyoak & N. Pedersen.
AL: J – 9547/4: Mangart (Sendtner 1848, 1857; Sendtner in: Glowacki 1910); Mangart: Male špice (Glowacki 1910).

Ptychostomum cernuum (Hedw.) Hornsch.
AL: J – 9549/2: near Mojstrana (Paulin mscr.).

Ptychostomum compactum Hornsch.
8 localities, last record in the year 1912.

Ptychostomum demissum (Hook.) Holyoak & N. Pedersen.
AL: J – 9547/4: Mangart: Male špice, 2100 m (Glowacki 1910).

Ptychostomum pseudotriquetrum (Hedw.) J. R. Spence & H. P. Ramsay var. ***bimum*** (Schreb.) Holyoak & N. Pedersen.
20 localities, last record in the year 1923.

Ptychostomum rubens (Mitt.) Holyoak & N. Pedersen
14 localities, last record in the year 1914.

Ptychostomum torquescens (Bruch & Schimp.) Ros & Mazimpaka.
SM – 0048/1: Sv. Gora above Nova Gorica (Höhnel 1893). **0147/2:** Miren near Nova Gorica (Loitlesberger 1909).

Rhytidiadelphus subpinnatus (Lindb.) T. J. Kop.
AL: J – 9547/4: near Log pod Mangartom, 700 m (Glowacki 1910). **AL: P – 9757/1:** near Vuhred, 500 m (Breidler 1891). **DN – 0151/4:** cave Planinska jama near Planina, 435 m (Morton 1939). **0251/1:** cave Črna jama near Postojna (Latzel 1942, leg. Morton). **PA – 9851/1:** Luša near Škofja Loka, 400–500 m (Glowacki 1910).

Schistidium agassizii Sull. & Lesq.
AL: J – 9547/4: Mangart (Sendtner 1848, Sendtner in: Glowacki 1910).

Schistidium atrofuscum (Schimp.) Limpr.
AL: J – 9547/4: Mangart: Rdeča skala, 2000–2100 m (Glowacki 1910); Mangart: Male špice, 2000–2100 m (Glowacki 1910). **9648/4:** Greda in Triglav mountains, 1900–2000 m (Glowacki 1910).

Schistidium flaccidum (De Not.) Ochyra.
AL: S – 9654/2: Sv. Primož above Ljubno, 500 m (Breidler 1891, Glowacki 1912). **DN – 0252/1:** Slivnica above Cerknica (Šafer HERB 1887; Glowacki 1913, leg. Šafer).

Schistidium papillosum Culm.
AL: K – 9554/3: Sv. Duh above Solčava, 900 m (Dolšak LJU 1931 det. A. Martinčič).

Scopelophila ligulata (Spruce) Spruce.
AL: S – 9652/4: valley Kokra (Robič LJU, Robič 1893; Robič not Šafer in: Glowacki 1912).

Seligeria calcarea (Hedw.) Bruch & Schimp.
PA – 9957/4: Metni vrh above Sevnica, 300–400 m (Breidler 1891).

Seligeria carniolica (Breidl. & Beck) Nyholm.
AL: S – 9652/4: Dobliški graben between Šenturška gora and Sidrož, 500 m.
(Robič LJU 1884; Breidler & Beck 1884; Robič 1893; Kerner FEAH No. 1526, leg. Robič; Robič in: Glowacki 1912).

Sphagnum affine Renauld & Cardot.
AL: J – 9649/4: Pokljuka: raised bog Šijec, 1200 m (Paulin 1915).

Stegonia latifolia (Schwagr.) Venturi ex Broth.
AL: J – 9547/4: Mangart, 2300–2400 m (Breidler mscr.; Glowacki 1910, leg. Breidler).

Syntrichia fragilis (Taylor) Ochyra.
SM – 0349/1: Lipica, 400 m (Glowacki 1902; 1913).

Syntrichia sinensis (Müll. Hal.) Ochyra.
AL: J – 9647/2: Morež (Sendtner 1842).

Syntrichia virescens (De Not.) Ochyra.
PA – 9657/2: Brezen above Vitanje, 764 m (Breidler

1891). **9757/4:** Bank of river Voglajna near Celje, 235 m (Breidler 1891). **SP – 9459/4:** Radvanje near Maribor, 290 m (Glowacki 1908).

Tayloria lingulata (Dicks.) Lindb.
AL: J – 9647/2: Morež (Sendtner 1848; Sendtner in: Glowacki 1910). **9649/1:** Malo polje near Velo polje, 1700 m (Glowacki 1910).

Tayloria splachnoides (Schleich. ex Schwägr.) Hook.
AL: J – 9647/4: Slatenik above Bovec, upper tree zone (Sendtner 1848).

Tetrodontium brownianum (Dicks.) Schwägr.
AL: P – 9557/4: Rakovec above Vitanje, 1000 m (Glowacki 1908).

Tortella bambergeri (Schimp.) Broth.
AL: J – 9648/4: Greda in Triglav mountains, 1900–2000 m (Glowacki 1910).**9649/1:** Konjska planina in Triglav mountains, 2300 m (Glowacki 1910). **AL: P – 9559/3:** valley of river Bistrica above Slovenska Bistrica, 500 m (Glowacki 1908). **9658/1:** Brinjeva gora above Slovenske Konjice, 400–600 m (Glowacki 1908). **9658/2:** Sv. Neža above Zreče, 400–600 m (Breidler 1891, Glowacki 1908). **DN – 0452/2:** Snežniško pogorje: Nova grajšina, 1500 m (Glowacki 1913). **PA – 9947/2:** bank of river Soča near Kanal, 100 m (Glowacki 1910).

Tortula acaulon (With.) R. H. Zander.
10 localities, last record in the year 1891.

Tortula acaulon (With.) R. H. Zander var. ***pilifera*** (Hedw.) R. H. Zander.
5 localities, last record in the year 1891.

Tortula atrovirens (Sm.) Lindb.
AL: S – 9654/2: Sv. Primož above Ljubno, 500 m (Breidler 1891, Glowacki 1912).

Tortula canescens Mont.
AL: P – 9658/2: Sv. Neža above Zreče, 600 m (Glowacki 1908). **AL: Z – 9459/1:** Kozjak: Hajdov vrh, 350–500 m (Breidler 1891). **9459/1:** Srednje above Bresternica, 350–500 m (Juratzka 1882, leg. Breidler; Breidler 1891). **SM – 0251/1:** Postojna, 550 m (Glowacki 1913). **0047/4:** Panovec near Nova Gorica (Höhnel 1891, 1893). **0048/3:** Stara gora near Nova Gorica (Loitlesberger 1909).

Tortula caucasica Broth.
17 localities, last record in the year 1913.

Tortula laureri (Schultz) Lindb.
AL: J – 9547/4: Mangart, 2100–2678 m (Sendtner 1848, Glowacki 1910).

Tortula lindbergii Broth.
18 localities, last record in the year 1913.

Trematodon ambiguus (Hedw.) Hornsch.
AL: P – 9456/4: Legen near Slovenj Gradec, 450 m (Breidler 1891). **AL: M – 9556/2:** Slovenj Gradec: Štibuh, 450 m (Breidler 1891). **PA – 0053/1:** Ljubljansko barje: near Grmez, 300 m (Deschmann 1858); Ljubljansko barje: between Grmez and Babna gorica, 300 m (Paulin 1915). **PD – 0355/1:** Mahovnik near Kočevje, 450 m (Glowacki 1913). **SP – 9459/4:** Radvanje near Maribor, 300 m (Breidler 1891; Glowacki 1908).

Ulota coarctata (P. Beauv.) Hammar.
18 localities, last record in the year 1913.

Ulota hutchinsiae (Sm.) Hammar.
10 localities, last record in the year 1927.

Weisia levieri (Limpr.) Kindb.
PA – 9757/3: Tremerje near Celje (Glowacki 1914).

Weisia rostellata (Brid.) Lindb.
SM – 0251/1: between Postojna and Orehek, 550 m (Glowacki 1913). **SP – 9459/4:** Sp. Radvanje near Maribor, 290 m (Glowacki 1908; Glowacki 1914).

Weisia rutilans (Hedw.) Lindb.
18 localities, last record in the year 1901.

Data deficient-new (DD-n) – Premalo znane vrste-novi podatki

Andreaea nivalis Hook.
AL: J – 9549/3: Na Jezerih pod Rokavi, 2200 m, *Salicetum herbaceae* (Grom LJU 1967, leg. T. Wraber).

Brachytheciastrum olympicum (Jur.) Vanderp. et al.
AL: K – 9448/3: Peč, 1100 m (Martinčič LJU 2001).

Dicranella howei Renauld & Cardot.
SM – 0447/3: between Piran and Portorož (Sabovljević M. & Sabovljević A. 2009).

Dicranum crassifolium Sérgio, Ochyra & Séneca.
AL: J – 9749/1: at lake Bohinjsko jezero, 537 m (Garilleti et al. 2013).

Didymodon asperifolius (Mitt.) H. A. Crum, Steere & L. E. Anderson.
AL: J – 9547/4: Mangart, Rdeča skala, 2000 m (Martinčič LJU 1970). **AL: K – 9551/4:** Lajb under Ljubelj, 800 m (Martinčič LJU 2001).

Didymodon sicculus M. J. Cano, Ros, Garcia-Zamora & J. Guerra.
SM – 0447/3: between Piran and Portorož (Sabovljević M. & Sabovljević A. 2009).

Orthothecium chryseon (Schwaegr.) Schimp.
AL: J-9547/4: Mangartsko sedlo, 2000 m (Martinčič LJU 1970).

Orthotrichum acuminatum H. Philib.
SM – 0349/2: surroundings of Škocjanske jame (Müller 2009).

Orthotrichum tenellum Bruch ex Brid.
SM – 0349/2: surroundings of Škocjanske jame (Müller 2009).

Seligeria patula (Lindb.) I. Hagen.
AL: J-9547/4: Mangart, Rdeča skala, 2000 m (Martinčič LJU 1970).

Discussion

Based on floristic data and applied taxonomy (Ros et al. 2007) there are currently 813 species and subspecies in Slovenia – 638 mosses, 173 liverworts and 2 hornworts. 164 species (20.17%) are listed under threatened categories, of which 121 (18.97%) are mosses and 43 (24.57%) liverworts; 7 of them (0.86%) are in the CR category, 83 (10.21%) in the EN category and 74 (9.10%) are listed under the VU category. 23 species (2.83%) are near threatened (NT), while 163 species (20.05%) are data deficient (DD). There are currently 463 (56.95%) species in the Least Concern (LC) category. Table 1 shows different percentages of liverworts and mosses in most categories, but the actual likelihood of extinction is distinctly higher for liverworts than for mosses.

Regionally extinct species (RE) – The decision that a species is extinct is often difficult and largely depends also on the extent to which an area has been floristically investigated. By definition, a species may be considered regionally extinct when it has not been possible to find any individual of that species in a known location during the last 50 years (Hallingbäck et al. 1998). In view of the lack of floristic investigations it is impossible to apply this principle in Slovenia, so this category only comprises the species that occurred in habitats that have by now been completely destroyed. All the species were only found once, 100 to 150 years ago. *Campylopus pyriformis, Meesia longiseta* and *Warnstorfia pseudostraminea* were found on the Ljubljana bog at Grmez, where the former bog habitat has been destroyed for years. *Aschisma carniolicum* was found only once, 200 years ago, *Bruchia flexuosa* was found in a field, *Ephemerum cohaerens* in the clay excavation area behind the brickwork plant, *Tortula cernua* on an old lime kiln, while *Fontinalis squamosa* was not detected at all, although we had looked for it, without success, on its only site, in the bed of a spring that has recently been ameliorated.

Critically endangered (CR) – Due to the highly restrictive approach this category comprises only 7 species, all of which have only one recent locality. *Ricciocarpus natans, Drepanocladus turgescens, Polytrichum pallidisetum, Scorpidium revolvens* and *Sphagnum riparium* occur in streams or in small populations in peat bogs. With their vulnerable habitats they are facing a high risk of extinction. Both *Cleistocarpidium palustre* and *Meesia triquetra* have one recent locality and 8–10 localities that are at least 100 years old. We have confirmed that on several localities *Meesia triquetra* no longer occurs as its habitats have been completely destroyed. *Cleistocarpidium palustre* has one recent locality and 10 localities that were reported 100–150 years ago. For the last two species we can infer a high probability of decline in their area of occupancy in Slovenia.

Endangered (EN) – This category comprises the taxa with one recent locality and mainly 2–5 (10) old localities (very few with more) reported at least 100 years ago. In the threat assessment we took into consideration also the difference between the number of old and recent localities, which can provide at least an informative insight into the suspected decline in the area of occupancy of the taxon in Slovenia and increased fragmentation of its population. Habitats in this category, unlike those in the CR category, are not severely threatened. According to Hallingbäck et al. (1998) a taxon is endangered (EN) if it has recently been recorded in 2–5 localities, but we adapted the criterion to make up for the lack of floristic research in Slovenia. Taxa with only one recently reported locality are classified into this category also by Papp et al. (2010).

The EN category currently comprises 83 (10.21%) species, with relatively equal proportions of liverworts and mosses. Especially worth mentioning are *Sauteria alpina, Anacamptodon splachnoides, Ditrichum pallidum, Entosthodon muehlenbergii, Grimmia ovalis, Orthotrichum patens, Pohlia melanodon, Rhynchostegium rotundifolium, Saelania glaucescens, Seligeria recurvata, Trichostomum brachydontium, Weisia longifolia, Weisia wimmeriana*. In addition to one recent locality/information, these species were reported for 11–20 localities that are at least 100 years old. Such substantial differences between recently reported and old data/localities cannot be attributed only to poor floristic research, but most likely also to the decline in the area of occupancy.

Vulnerable (VU) – this category comprises the taxa with two to ten, but mainly up to five recent localities, and with mainly no more than five old localities reported at least 100 years ago. The threat status is mainly associated with the lack of recent localities and much less with the difference between recently reported and old localities or with the threat to habitats. In this category too, the deviation from the criteria set by Hallingbäck et al. (1998) is justified by the absence of sufficient floristic research.

The VU category currently comprises 74 species; the percentage of liverworts is twice as high as the percentage of mosses.

Near threatened (NT) – this category comprises 4 liverworts and 19 mosses. All but four species occur in aquatic, marsh or bog habitats. These habitats are currently stable, so the listed species are only potentially threatened. However, any human intervention poses a risk to this stability. The difference between the number of recent and old localities in *Drepanocladus aduncus, Phi-*

lonotis marchica, Physcomitrium pyriforme could perhaps already be attributed to changes in their habitats and consequently these species could be listed under the VU category. Similar could be said for *Buxbaumia viridis* and *Buxbaumia aphylla*, which grow on decaying tree stumps or on soil in forests.

Data deficient (DD)

Only the species from subcategories DD-va and DD-n comprises this category.

Data deficient-vanished (DD-va) – this subcategory comprises the taxa for which no new or recent localities have been reported. This subcategory was established by Kučera et Váňa (2003) for the Red List of Czech Bryophytes. The term recent is not uniformly defined. The Red List for the Czech Republic (Kučera, Váňa & Hradílek 2012) treats as recent any data available for less than 30 years; the same period is used also by Sérgio & al. (2006) for the Iberian Peninsula and Papp & al. (2010) for Hungary. In terms of Slovenia we consider as recent the data reported after 1960, exceptionally also after 1955. This was the period of resumed floristic investigations into bryophyte flora of Slovenia that followed a 45-year break in floristic research.

The subcategory DD-va comprises 31 liverworts and hornworts and 115 mosses, in total almost a fifth (17.96%) of bryophytes of Slovenia. Such a high percentage of species is mainly a reflection of insufficient research, especially in those regions that had been well investigated before 1914. Most of the species listed in the subcategory DD-va were therefore reported, on one or several localities, before 1914 but not later. As the last available data is more than 100 years old we can reasonably infer that a number of these species no longer occur in the Slovenian territory. This applies to those species in particular that were found on vulnerable habitats, on arable land, trees and some secondary sites that are suspected to have undergone major changes in their habitats. Such species include *Fossombronia foveolata, Mannia triandra* (32 old localities), *Odontoschisma sphagni, Riccia ciliata, Calliergon richardsonii, Conardia compacta, Haplocladium virginianum, Microbryum davallianum, Nyholmiella gymnostoma, Pelekium minutum, Sphagnum affine* var. *affine, Tayloria lingulata, Tayloria splachnoides, Trematodon ambiguus.*

A large part of species in DD-va subcategory were found only once at high elevations in the Julian and Kamnik-Savinja Alps, on alpine grasslands, in rock crevices and marsh habitats. These are stable habitats that have not undergone any significant changes in the last 100 years. The same applies also to the species found on one locality on the silicate Pohorje hills. It is therefore highly likely that these species still occur in these areas.

Future floristic investigations will undoubtedly reduce the number of species under this subcategory, which has already been made evident in certain floristic contributions (Martinčič 2015a, 2015b, in print).

Data deficient-new (DD-n) – this subcategory was introduced by Sérgio et al. (2006) in the Red List of the Bryophytes of the Iberian Peninsula and was later used by other authors as well. The subcategory comprises 17 species, of which all but three were found in the territory of Slovenia in the last ten years. All of them have only one locality, but for now their habitats are not threatened

Table 2 offers a comparison with several other countries. However, although in all listed cases the IUCN 3.1 (2001) and Hallingbäck et al. (2008) serve as the basis for categorisation, the numbers are not entirely comparable. The main reason is that authors tend to adapt these criteria, to some extent, to the specific situation in their respective countries, especially in terms of the number of recently reported localities. Floristic research available for the relevant country also plays a part. In most categories our place is somewhere in the middle, including in the relationship between the red-listed and unthreatened species. We stand out in the category DD – on account of the subcategory DD-va (see Table 1). This subcategory is not directly associated with the threat status of bryophytes, but rather reflects the lack of floristic investigations and insufficient information available for the recent period.

Table 1: Number and percentage of liverworts (incl. hornworts) and mosses in the various categories of the Slovenian red list.

Tabela 1: Število in odstotni sestav jetrenjakov (inkl. rogovnjakov) in listnatih mahov razporejenih v posamezne kategorije v slovenskem Rdečem seznamu.

	Liverworts (jetrenjaki)		Mosses (listnati mahovi)		Total (skupaj)	
RE	0		8	(1,25%)	8	(0,98%)
CR	1	(0,57%)	6	(0,94%)	7	(0,86%)
EN	15	(8,57%)	67	(10,66%)	82	(10,21%)
VU	27	(15,43%)	48	(7,37%)	75	(9,10%)
	43	**(24,57%)**	**121**	**(18,97%)**	**164**	**(20,17%)**
NT	4	(2,29%)	19	(2,98%)	23	(2,83%)
DD	0		0		0	
DD-va	31	(17,71%)	115	(18,03%)	146	(17.96%)
DD-n	7	(4,00%)	10	(1,57%)	17	(2,09%)
	38	**(20,71%)**	**125**	**(19,59%)**	**163**	**(20,05%)**
LC	90	(51,43%)	373	(58,46%)	463	(56,95%)
Total	**175**		**638**		**813**	

Tabela 2: Number and percentage of bryophytes in the various categories in red lists of some European countries: Serbia (Sabovljević et al. 2004), Czech Republic (Kučera et al. 2012), Hungary (Papp et al. 2010), Switzerland (Schnyder et al. 2004), Iberian Peninsula (Sergio et al. 2006), Sweden (Gärdenfors 2005).

Tabela 2: Število in odstotkovni sestav mahov, razporejenih v posamezne kategorije v Rdečih seznamih nekaterih evropskih držav: Srbija (Sabovljević et al. 2004), Češka (Kučera et al. 2012), Madžarska (Papp et al. 2010), Švica (Schnyder et al. 2004), Iberski polotok (Sergio et al. 2006), Švedska (Gärdenfors 2005).

	Serbia	Czech Republic	Hungary	Switzerland	Iberian Peninsula	Sweden
RE	1 (0,14%)	40 (4,5%)	3 (0,45%)	15 (1,4%)	10 (0,9%)	17 (1,5%)
CR	13 (1,88%)	70 (7,8%)	20 (3,0%)	61 (5,6%)	18 (1,5%)	11 (1,0%)
EN	20 (2,89%)	88 (9,9%)	90 (13,7%)	58 (5,3%)	40 (3,6%)	24 (2,2%)
VU	76 (11,0%)	93 (10,4%)	63 (9,5%)	282 (25,8%)	114 (10,4%)	57 (5,2%)
	109 (15,77%)	**251 (28,1%)**	**173 (26,2%)**	**401 (36,7%)**	**172 (15,5%)**	**92 (8,45%)**
NT	53 (7,67%)	66 (7,4%)	114 (17,3%)	67 (6,1%)	26 (2,4%)	69 (6,3%)
DD	23 (3,33%)	54 (6,1%)	139 (21,1%)	98 (9,0%)	163 (14,8%)	38 (3,5%)
LC	505 (73,08%)	480 (53,8%)	230 (34,9%)	512 (46,8%)	732 (66,5%)	777 (71,6%)
	691	**892**	**659**	**1093**	**1102**	**1085**

Povzetek

Uvod

Floristične raziskave mahovne flore v Sloveniji, ki so nujna podlaga za oceno ogroženosti, lahko razdelimo na dva dela. Prvo obdobje, s številnimi prispevki se je začelo s Scopolijem (1772) in končalo z letom 1914. Sledilo je 45 let prekinitve floristčnih raziskav. Zato so v delu "Prodromus flore briofita Jugoslavije" (Pavletić 1955) za Slovenijo vsi podatki stari, ker tedaj ni bilo recentnih. Šele po letu 1960 se je pričelo novo obdobje intenzivnejših floristčnih raziskav mahovne flore (S. Grom, A. Martinčič), nabiranja herbarijskega materiala ter objavljanja rezultatov. Nekaj manjših prispevkov so v tem novem obdobju prispevali tudi tuji botaniki. Intenzivnost floristčnega dela se je povečala zlasti po letu 2000. Rezultat teh aktivnosti je bil, med drugim, "Seznam listnatih mahov (*Bryopsida*) Slovenije (Martinčič 2003), zlasti pa " Seznam jetrenjakov (*Marchantiophyta*) in rogovnjakov (*Anthocerotophyta*) Slovenije (Martinčič 2011). V slednjega je vključen ves razpoložljiv herbarijski material v LJU, zato je velik del podatkov recenten.

Dobrih 20 let je minilo od izdaje prvega Rdečega seznama ogroženih mahov Slovenije (Martinčič 1992), ki pa je obsegal le listnate mahove (*Musci*). Njihovo ogroženost smo ocenjevali na podlagi starih kriterijev IUCN. Delo je temeljilo predvsem na podatkih iz floristične literature, ki se je praktično končala z letom 1914, zato vsebuje še vedno največ starih podatkov. Tudi naslednji prikaz ogroženosti mahovne flore (Martinčič 1996) je temeljil na starih floristčnih podatkih, le da smo vključili tudi jetrenjake. V letu 2000 smo za Ministrstvo za okolje in Prostor, Upravo RS za varstvo narave izdelali študijo "Analiza stanja biotske raznovrstnosti mahov" (Martinčič 2000), ki je vključevala tudi stanje ogroženosti mahovne flore v Sloveniji. Ti rezultati so bili kot Priloga 2: Rdeči seznam mahov vključeni v "Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam" (Anon. 2002). Intenzivno floristično delo zlasti po letu 2000 ter obdelava doslej zbranega recentnega herbarijskega gradiva, je narekovala potrebo po dopolnjenem Rdečem seznamu, z uporabo novih IUCN kriterijev za oceno ogroženosti.

Uporaba novih kriterijev za oceno ogroženosti mahovne flore (IUCN 3.1 2001) je pokazala na dejstvo, da imamo, kljub napredku v floristčnih raziskavah, še vedno kar za petino vrst mahovne flore na razpolago samo podatke, stare 100–150 let (kategorija DD-va). Največ teh vrst je v predelih, ki so bili v prvem obdobju najbolje raziskani.

Metode

Za opredelitev pripadnosti vrst posameznim kategorijam ogroženosti smo upoštevali nove IUCN kriterije 3.1 (IUCN 2001). Njihovo uporabo za mahove pa smo povzeli po Hallingbäck et al. (1998). Vendar je na sedanji stopnji poznavanja mahovne flore, ne samo v Sloveniji, ugotavljanje velikosti populacij, hitrost in obseg njihovega zmanjševanja in številčno stanje primerkov večinoma nemogoče. Zato je edini realni kriterij za oceno ogroženosti – **kriterij B**, ki se izraža s številom trenutno poznanih recentnih nahajališč: 1 (CR), 2–5 (EN), 6–10 (VU). Čeprav je ta kvantitativni kriterij odvisen od stopnje preiskanosti določenega območja, države, se danes

najpogosteje uporablja. Zato smo ga uporabili tudi za oceno ogroženosti določene vrste v Sloveniji. Vendar smo število recentnih nahajališč, ki so potrebne za uvrstitev v posamezne kategorije ogroženosti spremenili zaradi vpoštevanja slabše floristične raziskanosti Slovenije (glej poglavje Diskusija). Le pri nekaterih vrstah smo upoštevali tudi potencialno ali dejansko ogroženost njihovih habitatov. Pravtako smo pri manjšem številu vrst sklepali na zmanjševanje populacij iz razlike v številu starih in recentnih nahajališč.

V Rdečem seznamu smo uporabili naslednje kategorije:

Regionalno izumrla vrsta (RE) – *Regionally extinct*: kategorija v regionalnem merilu nadomešča kategorijo "izumrla vrsta – EX" (Gärdenfors 1996), razen če gre za endemite.

Skrajno ogrožena vrsta (CR) – *Critically endangered*: takson je poznan le z enega recentnega nahajališča v zelo ogroženem habitatu, populacija je navadno majhna, zato je nevarnost hitrega izginotja zelo velika.

Prizadeta vrsta (EN) – *Endangered*: na podlagi recentnih podatkov je takson zabeležen na 2–5 nahajališčih. Pri tem je potrebno pri oceni upoštevati tudi razliko v številu starih in recentnih nahajališč, ki lahko da vsaj orientacijski vpogled v ev. zmanjševanje areala poseljenosti taksona v Sloveniji ter večanje njegove fragmentacije. Tudi ranljivost habitatov pomembno povečuje stopnjo ogroženosti.

Ranljiva vrsta (VU) – *Vulnerable*: na podlagi recentnih podatkov je takson znan iz 6–10 nahajališč, izginotje preti predvsem zaradi možnega uničevanja habitatov v prihodnosti.

Potencialno ogrožena vrsta (NT) – *Near threatened*: na podlagi recentnih podatkov obsega takson nad 10 nahajališč, vendar uspeva v ranljivih habitatih, zato obstaja možnost, da bo v bližnji prihodnosti prišlo do ogroženosti, najverjetneje do uvrstitve v kategorijo VU.

Premalo znana vrsta (DD) – *Data deficient*: v to kategorijo uvrščamo taksone, za katere nimamo dovolj podatkov za oceno ogroženosti bodisi na podlagi njihove razširjenosti in/ali stanja populacije.

Premalo znana vrsta-stari podatki (DD-va) – *Data deficient-vanished*: podkategorija obsega taksone, za katere ni na razpolago novejših, recentnih podatkov.

Premalo znana vrsta-novi podatki (DD-n) – *Data deficient-new*: podkategorija obsega taksone, ki so bili ugotovljeni v najnovejšem času, npr. v zadnjih desetih letih, vendar je premalo podatkov za oceno njihove ogroženosti.

Najmanj ogrožena vrsta (LC) – *Least Concern*: v to kategorijo uvrščamo taksone, ki niso ogroženi z ozirom na število nahajališč, niti ne uspevajo v labilnih ali ogroženih habitatih. V tem seznamu niso navedeni.

V nomenklaturi in taksonomiji smo sledili delu Ros et al. (2007) za *Marchantiophyta* in *Anthocerotophyta* ter delu Ros et al. (2013) za *Bryophyta*.

Diskusija

Trenutno je v Sloveniji na podlagi floristični podatkov in uporabljenih taksonomskih principov 813 vrst in podvrst – 638 vrst listnatih mahov, 173 vrst jetrenjakov in 2 vrsti rogovnjakov. V kategorije ogroženih je uvrščenih 164 vrst (20,17%), 121 vrst (18,97%) listnatih mahov in 43 vrst (24,57%) jetrenjakov; od tega v CR 7 (0,86%) vrst, v EN 83 (10,21%) in v VU 74 (9,10%). Potencialno ogroženih (NT) je 23 vrst (2,832%), v kategorijah premalo znane (DD) pa je 163 vrst (20,05%). Trenutno neogroženih vrst (LC) je 463 (56,95%). Kot je razvidno iz tabele 1, sta procentna deleža jetrenjakov in listnatih mahov v posameznih kategorijah večinoma različna, vendar je dejanska ogroženost jetrenjakov razločno višja od ogroženosti listnatih mahov.

V Sloveniji izumrle vrste (RE) – Odločitev, da je določena vrsta izumrla, je često zelo težavna, močno odvisna tudi od stopnje floristične preiskanosti ozemlja. Po definiciji lahko govorimo o izumrtju, če smo določeno vrsto na vseh nahajališčih v zadnjih 50 letih večkrat brezuspešno iskali (Hallingbäck et al. 1998). V Sloveniji je uporaba takega principa zaradi posebnosti floristični raziskav nesprejemljiva, zato smo v to kategorijo uvrstili samo tiste vrste, ki so uspevale v danes povsem uničenih habitatih. Vse te vrste so bile najdene samo po enkrat, pred 100 do 150 leti. Vrste *Campylopus pyriformis, Meesia longiseta* in *Warnstorfia pseudostraminea* so bile najdene na Ljubljanskem barju, pri Grmezu, kjer je nekdanji močvirski habitat že dolga desetletja uničen. *Aschisma carniolicum* je bila najdena samo enkrat, pred 200 leti, *Bruchia flexuosa* na njivi, *Ephemerum cohaerens* na območju izkopa gline za opekarno, *Tortula cernua* na stari apnenici, *Fontinalis squamosa* pa smo brezuspešno iskali na edinem rastišču, v strugi studenca, ki je bil v novejšem času melioriran.

Skrajno ogrožene vrste (CR) – Zaradi močno restriktivnega pristopa, smo v to kategorijo uvrstili le 7 vrst. Vse imajo le po eno recentno nahajališče. Vrste *Ricciocarpus natans, Drepanocladus turgescens, Polytrichum pallidisetum, Scorpidium revolvens* in *Sphagnum riparium* uspevajo v vodnih telesih ali na sfagnumskih barjih v majhnih populacijah. Njihova ogroženost je zaradi ranljivih habitatov zelo velika. Dve vrsti, *Cleistocarpidium palustre* in *Meesia triquetra* imata po eno recentno nahajališče ter po 8–10 nahajališč, ki so stara 100 in več let. Za vrsto *Meesia triquetra* je ugotovljeno, da na nekaj nahajališčih ne

uspeva več, ker so habitati danes povsem uničeni. *Cleistocarpidium palustre* pa ima eno recentno nahajališče in 10 nahajališč, za katere so podatki stari 100–150 let. V zadnjih dveh primerih z veliko verjetnostjo lahko govorimo o zmanjševanju areala poseljenosti v Sloveniji.

Prizadete vrste (EN) – V to kategorijo smo uvrstili taksone, ki imajo po eno recentno nahajališče ter večinoma 2–5 (10) starih nahajališč (maloštevilne več), za katere so podatki stari 100 ali več let. Pri tem smo pri oceni ogroženosti upoštevati tudi razliko v številu starih in recentnih nahajališč, ki da vsaj orientacijski vpogled v ev. zmanjševanje areala poseljenosti taksona v Sloveniji ter večanje fragmentacije populacije. V nasprotju s kategorijo CR, habitati v tej kategoriji niso močno ogroženi. Hallingbäck et al. (1998) uvrščajo sicer v kategorijo EN taksone, ki imajo 2–5 recentnih nahajališč, vendar smo spremenili zahtevnost kriterija zaradi slabše floristične preiskanosti Slovenije.

Kategorija EN obsega trenutno 83 (10,21%) vrst, odstotna deleža jetrenjakov in listnatih mahov sta dokaj enaka. Posebej bi omenili le vrste *Sauteria alpina, Anacamptodon splachnoides, Ditrichum pallidum, Entosthodon muehlenbergii, Grimmia ovalis, Orthotrichum patens, Pohlia melanodon, Rhynchostegium rotundifolium, Saelania glaucescens, Seligeria recurvata, Trichostomum brachydontium, Weisia longifolia, Weisia wimmeriana*. Poleg enega recentnega nahajališča/podatka imajo te vrste 11–20 vsaj 100 let starih nahajališč. Tako velike razlike med recentnimi in starimi podatki/nahajališči ni mogoče razložiti samo s slabo floristično raziskanostjo. Verjetno gre tudi za zmanjševanje areala poseljenosti.

Ranljive vrste (VU) – v to kategorijo smo uvrstili taksone, ki imajo 2 do največ 10 recentnih nahajališč, večinoma do 5, ter pretežno do 5 starih nahajališč, katerih podatki so stari 100 in več let. Ogroženost je povezana predvsem z maloštevilnostjo recentnih nahajališč, znatno manj z razliko med recentnimi in starimi nahajališči ali z ogroženostjo habitatov. Odstopanje od kriterijev, ki jih postavljajo Hallingbäck et al. (1998) tudi v tem primeru utemeljujemo s slabšo floristično raziskanostjo.

Kategorija VU obsega trenutno 74 vrst, odstotni delež jetrenjakov pa je dvakrat večji od listnatih mahov.

Potencialno ogrožene vrste (NT) – v kategorijo smo uvrstili 4 vrste jetrenjakov in 19 vrst listnatih mahov. Razen štirih vse druge vrste uspevajo v vodnih, močvirnih ali barjanskih habitatih. Trenutno so ti habitati stabilni, zato so vrste le potencialno, ne pa dejansko ogrožene. Vsak poseg človeka pa lahko to stabilnost poruši. Številčno razliko med recentnimi in starimi nahajališči pri vrstah *Drepanocladus aduncus, Philonotis marchica, Physcomitrium pyriforme*, bi morda že lahko razložili s spremembami njihovih habitatov in bi jih lahko uvrstili v kategorijo VU. Podobna razlaga je najbrž utemeljena tudi pri vrstah *Buxbaumia aphylla* in *Buxbaumia viridis*, ki uspevata v gozdovih na razpadajočih štorih.

Premalo znane vrste (DD)

V kategoriji DD smo analizirali le vrste iz podkategorij DD-va in DD-n.

Premalo znane vrste-stari podatki (DD-va) – podkategorija obsega taksone, za katere ni na razpolago novejših, recentnih podatkov o nahajališčih. To podkategorijo sta utemeljila Kučera et Váňa (2003) za Rdeči seznam mahov za Češko. Pojem recentni podatek je opredeljen arbitrarno. V Rdečem seznamu za Češko (Kučera, Váňa & Hradílek 2012) je recentni podatek mlajši od 30 let; enako obdobje uporabljajo npr. tudi Sérgio & al. (2006) za Iberijski polotok ter Papp & al. (2010) za Madžarsko. V primeru Slovenije štejemo za recentne podatke tiste po letu 1960, izjemoma po letu 1955. Takrat so se, po 45-letnem premoru, ponovno pričela floristična raziskovanja mahovne flore Slovenije.

V podkategorijo DD-va smo uvrstili 31 vrst jetrenjakov in rogovnjakov ter 115 vrst listnatih mahov, skupaj skoraj petino (17,96%) mahovne flore Slovenije. Tako visok odstotek vrst je predvsem odraz skromnih floristčnih raziskav, zlasti v tistih predelih, ki so bili do leta 1914 najbolje raziskani. Zato je v podkategoriji DD-va največ takih vrst, ki so bile najdene do leta 1914, na enem ali na nekaj nahajališčih, kasneje pa ne več. Ker so zadnji podatki stari 100 ali več let, lahko upravičeno domnevamo, da določeno število teh vrst ne uspeva več na ozemlju Slovenije. To velja zlasti za vrste, ki so bile najdene na ranljivih habitatih, na obdelovanih površinah, drevesih in na nekaterih sekundarnih rastiščih, kjer so bile potencialno največje spremembe habitatov. Take vrste so npr.: *Fossombronia foveolata, Mannia triandra* (32 starih nahajališč), *Odontoschisma sphagni, Riccia ciliata, Calliergon richardsonii, Conardia compacta, Haplocladium virginianum, Microbryum davallianum, Nyholmiella gymnostoma, Pelekium minutum, Sphagnum affine* var. *affine, Tayloria lingulata, Tayloria splachnoides, Trematodon ambiguus.*

Veliko skupino tvorijo vrste, ki so bile najdene le enkrat v visokogorskih predelih Julijskih in Kamniško-Savinjskih Alp, na alpinskih traviščih, v skalnih razpokah in močvirnih habitatih. V vseh primerih gre za stabilne habitate, ki v zadnjih 100 leih niso bili spremenjeni. Enako velja tudi za vrste, ki so bile najdene na enem nahajališču na silikatnem Pohorju. Zato je velika verjetnost, da te vrste še vedno uspevajo v teh predelih. Nadaljnje floristične raziskave bodo število vrst iz te podkategorije nedvomno zmanjšale.

Premalo znane vrste-novi podatki (DD-n) – to podkategorijo so uvedli Sérgio et al. (2006) v Rdeči seznam mahov Iberskega polotoka, kasneje pa so temu sledili tudi drugi. Podkategorija obsega 17 vrst, ki so bile, razen treh, najdene na ozemlju Slovenije v zadnjih desetih letih. Vse vrste imajo le po eno nahajališče, njihovi habitati pa zaenkrat niso ogroženi.

Primerjava z nekaterimi drugimi državami je prikazana v tabeli 2. Čeprav je v vseh navedenih primerih izhodišče za kategorizacijo IUCN 3.1 (2001) ter Hallingbäck et al. (1998) pa številke niso povsem primerljive. Poglavitni razlog je, da posamezni avtorji v večji ali manjši meri prilagajajo kriterije specifičnim razmeram v posameznih državah – predvsem pomen števila recentnih nahajališč. Določeno vlogo pa ima tudi floristična raziskanost države. V večini kategorij je naše mesto nekako v sredini, tudi pri razmerju med vrstami Rdečega seznama in neogroženimi vrstami. Izstopamo le pri kategoriji DD – na račun podkategorije DD-va (glej tabelo 1). Vendar ta podkategorija ni neposredno povezana z ogroženostjo mahovne flore, temveč kaže bolj na nezadostno floristično raziskanost v sedanjem času, na pomanjkanje recentnih podatkov.

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