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The front cover picture is a line drawing of *Iris hungarica* W. et K. 1807 published in Kitaibel's *Descriptiones et icones plantarum rariorum Hungariae* (Vol. III, tab. 226). Today it is considered as a subspecies of *Iris aphylla* L. It is a characteristic member of forest-steppes in NE Hungary (Zemplén Mts, Szendrőlád, Nyírség). It also occurs in Romania, Slovakia, and Ukraine.

K. Dobolyi

CONTENTS

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CONTRIBUTION TO THE BRYOPHYTE FLORA OF THE METALLIFEROUS AREAS OF THE EASTERN RHODOPI MTS, BULGARIA

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Papp, B., Gospodinov, G. & Natcheva, R. (2026): Contribution to the bryophyte flora of the metalliferous areas of the Eastern Rhodopi Mts, Bulgaria. – *Studia bot. hung.* **56**(2): 5–30. (2025).

Abstract: During investigation of the bryophyte flora formed on igneous rocks enriched in metals, we identified a total of 183 bryophyte taxa (one hornwort, 33 liverworts, and 149 mosses). Nine taxa (two liverworts and 7 mosses) have been reported for the first time from Bulgaria, namely *Riccia michelii*, *Targionia lorbeeriana*, *Didymodon nicholsonii*, *D. tophaceus* subsp. *erosus*, *Epipterygium tozeri*, *Orthotrichum schimperi*, *Lewinskya acuminata*, *Schistidium dupretii*, and *Scorpiurium sendtneri.* Two species (*Philonotis calcarea* and *Syntrichia subpapillosissima*) are included in the European bryophyte red list in the NT and DD category, respectively. Twenty-seven species (6 liverworts and 21 mosses) have conservation importance based on recent knowledge on their distribution and threats affecting them in Bulgaria and neighbouring countries.

Key words: liverworts, mosses, new national records, species of conservation interest, southeastern Europe

INTRODUCTION

The bryophyte flora of Bulgaria has intensively been studied during the recent years (Gospodinov and Natcheva 2022, Natcheva and Gospodinov 2024). Nevertheless, there are still areas that have received less attention. The Eastern Rhodopi Mts is among these poorly known regions in Bulgaria. Only 7 species of liverworts and 65 species of mosses have been published from the area up to date (Gospodinov and Natcheva 2022, Natcheva and Ganeva 2005). A much larger diversity is expected considering the location of the region at the border of the temperate and Mediterranean climatic regions, the extremely diverse geological structure, and the presence of a large variation of habitats.

The aim of this study was to contribute to the knowledge of the bryophyte diversity of the Eastern Rhodopi Mts with a special emphasis on igneous rocks enriched in metals.

MATERIAL AND METHODS

Description of the area investigated

The Eastern Rhodopi Mts is the easternmost part of the Rilo-Rhodopean massif, Southeast Bulgaria (Fig. 1). Geologically, it is the most diverse region in Bulgaria with a complex geological history and lithology. The landscape was formed by several rounds of volcanic activity, starting during the Palaeocene and ending in the late Oligocene. During this period, the territory of the Eastern Rhodopi Mts has been a complex island-arc system, consisting of depressions filled with shallow warm sea and the volcanoes formed islands and archipelagos. The volcanic activity gave rise to several metallogenic ore fields enriched with various heavy metals: Pb, Zn, Cu, Au, Sb, etc. Thus, the present geological structure is composed of various igneous acid to ultrabasic rock formations (rhyolite, andesite, latite, basalt, etc.) and sedimentary (mostly organogenic carbonates and limestone) rocks formed over the Precambrian to Mesozoic metamorphic basement (gneiss, schist, migmatite, and serpentinized ultrabasites) (Georgiev 2012). The metallogenic occurrences in the Eastern Rhodopi Mts have intensively been exploited since prehistoric times up to the present.

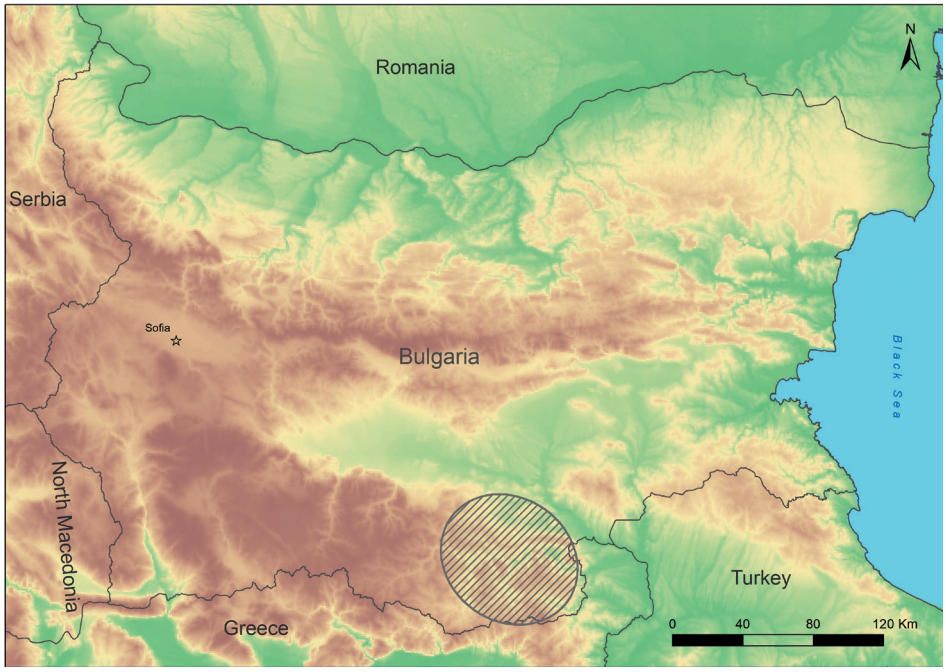


Fig. 1. Location of the area investigated.

The study area belongs to the Continental-Mediterranean climatic region (Velev 2002). The mean January temperature is –3 °C – +4 °C and the mean July temperature is 16–24 °C. The annual precipitation is 500–900 mm, which is among the largest ones in the country for the lowland and the middle mountain belt, with a winter (November–January) maximum and summer-autumn (July–September) minimum (Yordanova *et al.* 2002). The altitude is 200–1000 m (mostly 200–600 m). From a phytogeographical point of view, the Eastern Rhodopi Mts belong to the Illyric (Balkan) province of the European deciduous forest region with the predominance of xerothermic oak forests and scrublands (Bondev 2002). The study area has been inhabited by humans at least since the Neolithic and the landscape and vegetation are strongly affected by human activities.

Sampling sites

Sampling sites were selected in areas of metallogenic ore fields. Within each site, we attempted to cover the diversity of microhabitats and substrates as much as possible. Most of the study sites (with the exception of sites 12 and 13) belong to the Natura 2000 SCI site BG0001032 Rodopi – Iztochni (Rhodopi – Eastern).

1. W of Spahievo village, on the E slopes of peak Aida, andesite outcrop with heavy metals at rivulet Erikdere, 41° 53’ 55.3” N, 25° 18’ 41.0” E, 510 m, 12.06.2019.

2. W of the town of Madzharovo, by River Arda, andesite bedrock, by an old lead mine, 41° 38’ 16.3” N, 25° 51’ 02.1” E, 162 m, 13.06.2019.

3. W of the town of Madzharovo, by River Arda, andesite bedrock, by old lead mines, 41° 38’ 26.8” N, 25° 50’ 46.1” E, 143 m, 13.06.2019.

4. E of village Studen Kladenets, andesitobasaltic bedrock, 41° 36’ 33.5” N, 25° 39’ 14.9” E, 183 m, 13.06.2019.

5. S of Golyamo Kamenyane village, abandoned mine area, metaserpentine bedrock, 41° 24’ 10.4” N, 25° 42’ 22.4” E, 440 m, 14.06.2019.

5x. S of Golyamo Kamenyane village, abandoned mine area, metaserpentine bedrock, rocky dry grassland, rivulet, 41° 24’ 10.4” N, 25° 42’ 22.4” E, 440 m, 15.06.2019.

6. By River Avrenska between Arven and Devesilovo villages, metaserpentine bedrock, 41° 20’ 33.5” N, 25° 41’ 14.9” E, 380 m, 14.06.2019.

7. E of Kazak village, in serpentine grassland, 41° 24’ 43.4” N, 25° 53’ 03.7” E, 405 m, 15.06.2019.

8. Along the road from Kazak to Chernichevo, E of Chernichevo village, metaserpentine bedrock, 41° 21’ 29.1” N, 25° 48’ 34,2” E, 635 m, 15.06.2019.

8x. Along the road from Kazak to Chernichevo, E of Chernichevo village, metaserpentine bedrock, 41° 21’ 29.1” N, 25° 48’ 34.2” E, 635 m, 18.06.2019.

9. N of Sentse village, below old lead mines, stream with shaded basaltic and andesite rocks, 41° 27’ 24.1” N, 25° 28’ 21.7” E, 565 m, 16.06.2019.

10. N of Sentse village, basaltic and andesite bedrock, 41° 27' 36.3" N, 25° 28' 09.9" E, 535 m, 16.06.2019.

11. At mine Zvezdel, N slopes of peak Kalabak, acidic tufa bedrock, along a stream valley, 41° 27' 17.2" N, 25° 30' 25.4" E, 485 m, 16.06.2019.

12. SW of Gorna Yakovica village, dry grassland by a lead mine, on metaserpentine bedrock, 41° 18' 35.3" N, 25° 15' 30.4" E, 765 m, 17.06.2019.

13. E of Dzherovo village, along River Arabadzhiiska, sandstone bedrock, 41° 18' 52.1" N, 25° 18' 55.4" E, 375 m, 17.06.2019.

14. At Studen Kladenets village, just below the wall of Studen Kladenets Dam, loc. Sheitan dere, andesitobasaltic rocks at the river, 41° 36' 47.0" N, 25° 38' 23.9" E, 162 m, 19.06.2019.

Methods

The materials were collected in June 2019. Herbarium materials are deposited in the Herbarium of the Hungarian Natural History Museum, Budapest (BP) and in the Herbarium of the Institute of Biodiversity and Ecosystem Research, Sofia (SOM).

The nomenclature follows Hodgetts *et al.* (2020). The selection of species of conservation interest is based on the European red list (Hodgetts *et al.* 2019), the Bulgarian red list (Natcheva *et al.* 2006), and the Serbian red lists of hornworts and liverworts (Sabovljević *et al*. 2024*a*), and mosses (Sabovljević *et al*. 2024*b*). The recent red lists of Serbia, which is a neighbouring country of Bulgaria, give a very good overview of the threat status of the species in the region. Therefore, it was very useful to consider them. In some cases the red list of the neighbouring Romania was also considered (Ştefănuţ 2012). Abbreviations of red list categories are as follows: CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, DD = data deficient. The European distribution (floristical element categorisation) of species is given according to Düll (1983) for liverworts and Düll (1984, 1985) for mosses, while country distributions in Europe and red list status in countries according to Hodgetts and Lockhart (2020), with updates where relevant.

RESULTS AND DISCUSSION

During this study, we identified a total of 183 bryophyte taxa, i.e. one hornwort (Anthocerotophyta), 33 liverworts (Marchantiophyta), and 149 mosses (Bryophyta). The list of species is presented in Appendix. Nine taxa (two liverworts and 7 mosses) are reported for the first time from Bulgaria, and 130 species are new to the Eastern Rhodopi Mts. Two species are included in the European

bryophyte red list in the NT and DD category, respectively (Hodgetts *et al.* 2019). Twenty-seven species (6 liverworts and 21 mosses) have conservation importance based on the recent knowledge on their distribution and threats affecting them in Bulgaria (Natcheva *et al.* 2006) and the neighbouring countries (Sabovljević *et al*. 2024*a*, *b*, Ştefănuţ 2012).

New additions to the Bulgarian bryophyte flora

Liverworts

Riccia michelii – It is a Mediterranean, sub-Atlantic liverwort. In the Western Mediterranean it is known from Portugal, Spain, France, and Italy, where it is red listed in the NT category. It also occurs in Switzerland, where it is VU. It is regionally extinct (RE) in Germany. In SE Europe it has records from Albania, Bosnia-Herzegovina, Croatia, Greece, and Montenegro. In the Eastern Rhodopi Mts it was collected in several dry grasslands near Studen Kladenets, Golyamo Kamenyane, Kazak, and Sentse villages.

Targionia lorbeeriana – It is a Mediterranean, sub-Atlantic liverwort. It is widely distributed in the Western Mediterranean, but CR in Italy. In SE Europe it is known from Croatia, Greece, and Montenegro. Considering the distribution of the species, the Bulgarian populations are at the northern edge of its range. In the Eastern Rhodopi Mts it was collected in a dry grassland near Kazak village.

Mosses

Didymodon nicholsonii – It is an Atlantic, sub-Mediterranean species living on rocks in streams and rivers, often below flood level (Smith 2004). It has a sporadic distribution from the Atlantic coast to Eastern Europe; known from Great Britain, Ireland, Balearic Islands, Canary Islands, Portugal, Spain, France, Italy, Belgium, the Netherlands, Germany, and Luxembourg, where it is red listed as VU. In SE Europe it has records from Albania, Greece, Montenegro, Serbia, and Slovenia. It is included in the recent red list of Serbia as VU due to its restricted area of occupancy and number of locations. In the Eastern Rhodopi Mts it was found in two sites by River Avrenska and at Studen Kladenets Dam.

Didymodon tophaceus subsp. ***erosus*** – This taxon has recently been described as *Didymodon erosus* from northwestern Spain by Jiménez *et al.* (2004). Later on, studies on the *Didymodon tophaceus* complex by Kučera *et al.* (2018) reduced *Didymodon erosus* to the subspecies level. The taxon is known from the following countries so far: France, Portugal, Spain, Austria, Germany, Luxembourg, and Hungary. From SE Europe it has been reported from Albania. It does not seem to be rare in the Eastern Rhodopi Mts evidenced by collections from four localities.

Epipterygium tozeri – It is a sub-Atlantic, Mediterranean species widely distributed in the Western Mediterranean. It also has records from Great Britain and Ireland. It is also known from Switzerland, where it is red listed as VU. In SE Europe it has records from Greece, Montenegro, and the European part of Turkey. In the Eastern Rhodopi Mts it was found on soil at a streambank near Chernichevo village.

Lewinskya acuminata – It is a sub-Mediterranean, montane epiphyte. It is widely distributed in the Western Mediterranean region, and it is known from Great Britain, where it is red listed as VU. It has records from Belgium, the Netherlands, Switzerland, and Germany, where it is extremely rare. In SE Europe it occurs in Albania, Bosnia-Herzegovina, Croatia, Greece, Montenegro, and Slovenia. In the Eastern Rhodopi Mts it was found on the bark of a *Quercus pubescens* tree at mine Zvezdel.

Orthotrichum schimperi – It is an epiphyte species which was previously treated as a synonym of *Orthotrichum pumilum* Sw. in many flora works (Frey *et al*. 1995, Schäfer-Verwimp 2001), therefore it has not received adequate attention in many regions. It has a wide distribution in Europe; however, it is red listed in Portugal as CR, in Great Britain as VU, and in Sicily as NT. In Finland and Switzerland, it is in the DD category. In SE Europe it was known from almost all SE European countries except Bulgaria, the European part of Turkey, and North Macedonia. Later on, it has also been reported from the latter country (Papp *et al.* 2024*a*). In the Eastern Rhodopi Mts it was collected at two sites from *Salix* and *Quercus* barks.

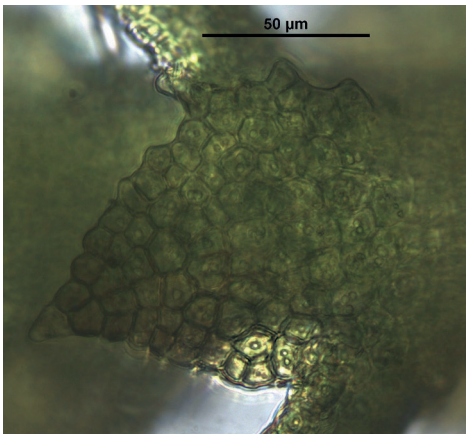
Schistidium dupretii – It has a wide, but sporadic distribution in Europe, but probably it is still under-recoded. In SE Europe it is known from almost all countries except Bosnia-Herzegovina, Bulgaria, and the European part of Turkey. It is included in the recent red list of Serbia as VU due to its restricted area of occupancy and number of locations. In the Eastern Rhodopi Mts several patches were collected at Spahievo village on an andesite outcrop.

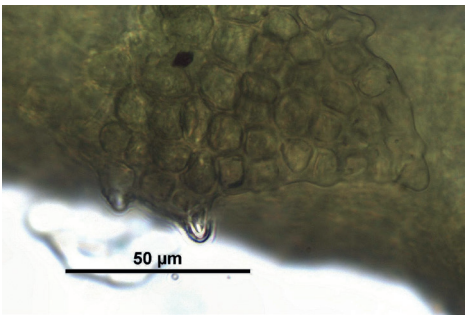
Scorpiurium sendtneri – It is a sub-Mediterranean species. It has a sporadic distribution. In the Western Mediterranean it is known from Portugal, France, Italy, and Spain, where it is in the DD category. In SE Europe it occurs in Albania, Croatia, Greece, Montenegro, and Slovenia, where it is red listed as EN. In the Eastern Rhodopi Mts it was found on andesite rocks by River Arda near Madzharovo.

Taxonomically noteworthy records

Cephaloziella divaricata var. ***scabra*** – It is a sub-Atlantic taxon. It is distinguished from var. *divaricata* by having strongly dentate leaves, verruculose cuticle, and frequently large conical outgrowths on the back part of the leaves below the

sinus (Damsholt 2002). It lives on exposed, dry acidic cliffs, ledges, and sandy heaths in Scandinavia (Damsholt 2002). In Great Britain and Austria it intergrades with more typical forms and according to Smith (1990) and Köckinger (2017) it cannot be maintained even at varietal rank. The specimens collected in many localities in the Eastern Rhodopi Mts contain a lot of shoots matching with the description of this taxon.





Figs 2–3. Leaf lobe of *Cephaloziella divaricata* var. *scabra* (loc. 2).

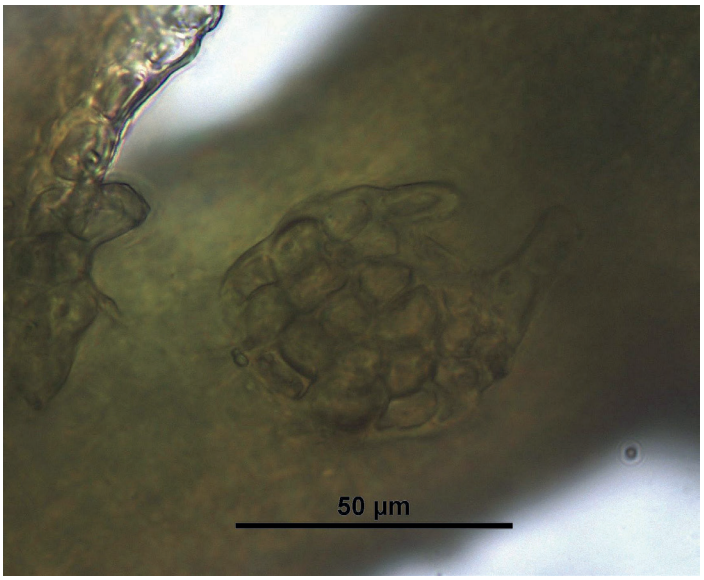


Fig. 4. An underleaf of *Cephaloziella divaricata* var. *scabra* (loc. 2).

Lewinskya fastigiata – It is an epiphyte species of the temperate zones of Europe. Its previous name, *Orthotrichum fastigiatum* Bruch ex Brid., was treated as a synonym of *Orthotrichum affine* Schrad. ex Brid. in many widely used checklists (Hill *et al.* 2006, Ros *et al.* 2013). *Lewinskya fastigiata* was reinstated by Vigalondo *et al.* (2019), on the basis of integrative taxonomic analyses on the *Lewinskya affinis* complex. Therefore, the distribution of this taxon should be reinvestigated. In Bulgaria it was known from the Central Rhodopi Mts (Ganeva and Düll 1999). In the Eastern Rhodopi Mts it does not seem to be rare, several patches were collected at four localities.

Species of conservation interest

Liverworts

Cephaloziella hampeana – This is a northern sub-Atlantic liverwort, which is known in Bulgaria from Rila (Stefanoff and Petrov 1962) and the Vitosha Mts (Dimitrov *et al.* 2015). It is included in the Bulgarian red list as CR.

Clevea hyalina – So far, it is known from the Pirin (Petrov 1962, Meinunger 1975), Rila, and the Western Rhodopi Mts (Šmarda 1970). Despite being a subarctic-subalpine species according to Düll (1983), in Bulgaria it has been found at fairly low elevation under sub-Mediterranean climates, e.g. 400 m in this study and 850 m in the Southern Pirin Mts, as well as at 2,500 m in the central part of the Pirin Mts. It has a wide, but scattered distribution in Europe. It is red listed in many countries where it occurs. It is known from Finland (EN), Norway, Svalbard, Sweden, Great Britain (CR), Andorra, Balearic Islands, France, Italy (CR), Spain, Austria (VU), Hungary, (EN), Germany (EN), Poland (VU), Slovakia (VU), and Switzerland (VU). In SE Europe it occurs in almost all countries except Bosnia-Herzegovina, Serbia, and the European part of Turkey. It is also red listed in Montenegro as CR and in Slovenia as VU. Towards east it is known from the Caucasus, Crimea, Ukraine, and NE and NW Russia. It is red listed as VU in Bulgaria.

Corsinia coriandrina – This species is known from the Black Sea coast (Petkoff 1908), the Strandzha Mts (Petrov 1963), and the Valley of River Struma (Natcheva 2024). Despite the fact that this sub-Atlantic, Mediterranean species is red listed as EN in Bulgaria, recent data suggest that it is more widespread in areas with sub-Mediterranean climate.

Scapania compacta – This is the second report and the first recent record of this species in Bulgaria. It has been found only at two localities in the Strandzha Mts (Petrov 1963). It is a sub-Atlantic, sub-Mediterranean element. It is EN according to the Bulgarian bryophyte red list. It is also included in the bryophyte red list of Romania, in the DD category.

Mannia androgyna – It has only one published record in Bulgaria, from the Southern Pirin Mts (Petrov 1962). It is a Mediterranean liverwort; hence these populations are at the northern edge of its distribution range. It is red listed as CR in Bulgaria.

Riccia crozalsii – This Atlantic, Mediterranean liverwort has recently been reported as new for the Bulgarian bryophyte flora partly based on the collections in 2019 in the Eastern Rhodopi (Ellis *et al.* 2024). Beside the Eastern Rhodopi Mts, it is known from the Struma valley (Western Bulgaria).

Mosses

Atrichum angustatum – In Bulgaria it is known from Eastern Stara Planina (Stefanoff and Petrov 1962), Strandzha (Papp *et al.* 2011), and the Forebalkan Mts (Natcheva and Gyosheva 2016). It is a sub-Mediterranean species being in DD category according to the Bulgarian red list. It is NT in Serbia due to its restricted area of occupancy and number of locations.

Bartramia aprica – It has only one locality in Bulgaria in the Valley of River Struma (Lüth 2007). This sub-Atlantic, Mediterranean species is in the DD category in Serbia.

Bryum gemmiparum – It is the first recent record of the species in Bulgaria. Until now, it has been reported only from the Vitosha Mts (Podpéra 1911). This sub-Atlantic, sub-Mediterranean species is red listed as VU in Bulgaria. It is also VU in Serbia due to restricted and declining area of occupancy and number of locations and CR in Romania for similar reasons.

Cheilothela chloropus – It is the first documented report of this species in Bulgaria. It has been mentioned by Velenovsky (1902), however the voucher specimen in Velenovsky's collection at PR was revised to *Ditrichum flexicaule*. Therefore, the species was excluded from the bryophyte flora of Bulgaria (Natcheva and Ganeva 2018). This Atlantic, Mediterranean species is included in the Bulgarian red list as VU. In the Serbian red list it is placed in the DD category.

Coscinodon cribrosus – It is known from the western and central part of the Stara Planina Mts (Ganeva 2002, Natcheva 2003). This is a boreal-temperate species living on acidic rocks (Smith 2004). It is red listed as VU in Bulgaria. Its sporadic distribution in the region is the consequence of the predominance of calcareous bedrocks in the Balkans. It is NT in Romania.

Dicranella cerviculata – It is the first recent and documented report of the species in Bulgaria. It is known only from the Vitosha Mts (Stefanoff and Petrov 1962). It is a boreal species living on damp acidic or gravelly soil (Smith 2004). It has a pioneer character (Sauer 2000). In Hungary, it occurs in a single known location, on the aluminium-containing soil of an abandoned mining area (Erzberger and Papp 2004). It is in the DD category in Bulgaria.

Dicranella howei – This species has recently been added to the bryophyte flora of Bulgaria from the Strandzha Mts (Papp *et al.* 2011), and this is the second report for the country. This Atlantic, Mediterranean species is red listed as NT in Serbia due to restricted and declining area of occupancy and number of locations. In spite of its Mediterranean character, it is also present in many Central European countries, e.g. Austria, Hungary, Germany, Luxemburg, and Switzerland, where it is VU. In Hungary it occurs in arid habitats like saline grassland and loess cliffs.

Fissidens viridulus – In Bulgaria it is known from the Central Rhodopi Mts, North Black Sea coast, and the Forebalkan (BP and SOM herbarium data). This sub-Mediterranean species is probably under-recorded due to its minute size. It is red listed as VU in Serbia due to restricted and declining area of occupancy and number of locations. It is NT in Romania.

Grimmia longirostris – This is the second known locality of the species in Bulgaria, the first being in the Rila Mts (Ganeva and Düll 1999). It is a boreal, montane species and red listed as VU in Bulgaria.

Grimmia muehlenbeckii – This species is known so far only from Rila (Lüth 2007), Western Stara planina (Ganeva *et al.* 2008), and the Central Rhodopi Mts (Blockeel 1994). This is a species of the temperate zones of Europe living on exposed acidic rocks (Smith 2004) and red listed as VU in Bulgaria. It is also VU in Romania due to restricted and declining area of occupancy and number of locations. Its sporadic distribution in the region is the consequence of the predominance of calcareous bedrocks in the Balkans.

Gyroweisia tenuis – The specimen collected in the Eastern Rhodopi is the first valid record of this species in Bulgaria. It had been reported for the first time from Bulgaria from the Strandzha Mts (Papp *et al.* 2011), then later it had a record from the northern Black Sea coast (Papp *et al.* 2018), however these specimens deposited in the BP herbarium have been revised to *Gymnostomum calcareum*. Both turned out to be small forms of *G. calcareum*. It is a sub-Mediterranean and sub-Atlantic montane element. It is widely distributed in Europe, but red listed in many countries, e. g. Finland (CR), Ireland (VU), Norway (NT), Sweden (VU), Portugal (CR), Spain (DD), Austria (Risk assumed), Czech Republic (VU), Germany (NT), Slovakia (VU), Hungary (NT), Latvia (Rare), and Lithuania (VU). In SE Europe it is known from all countries except Bosnia-Herzegovina, however red listed as VU in Romania and EN in Slovenia. There are many reports from the Balkan countries, but these should be carefully checked because many specimens are misidentified (Papp *et al.* 2023, 2024*b*). Guerra *et al.* (2006) also mention that this species is rarer in the Iberian Peninsula than it seems on the basis of literature data, because it is frequently mistaken for *Gymnostomum* species. In the Eastern Rhodopi Mts it was found in a cave entrance on metaserpentine rock near Gorna Yakovica village and on sandstone rock by River Arabadzhiiska near Dzherovo village.

Philonotis calcarea – This subboreal element of wetlands is NT in Europe, because its habitat extent and quality are continuously decreasing in Europe (Sabovljević *et al*. 2019). It is also VU in Serbia due to restricted and declining area of occupancy, number of locations, and number of mature individuals. It is in the group of medium conservation priority in Europe according to the Priority Scores for conservation (Bisang *et al*. 2025). In Bulgaria it is relatively widespread but until now it has not been reported from the Eastern Rhodopi Mts (Natcheva and Ganeva 2005).

Philonotis capillaris – Until now, it has been reported from two localities (Petrov 1963, Papp *et al*. 2011). This northern sub-Atlantic species is vulnerable (VU) in Bulgaria. It is also red listed in Serbia as EN due to restricted and declining area of occupancy and number of locations, and also EN in Romania for similar reasons.

Philonotis marchica – Known from four floristic regions in Bulgaria (Natcheva and Ganeva 2005) This sub-Mediterranean species is endangered (EN) in Bulgaria. It is also red listed in Serbia as VU due to restricted and declining area of occupancy, number of locations, and number of mature individuals. It is NT in Romania.

Rhynchostegiella curviseta – This species is a relatively new addition to the bryophyte flora of Bulgaria and it is known from the Western Stara Planina (Papp *et al.* 2006), the Strandzha Mts (Papp *et al*. 2011), and the Northern Black Sea coast (Papp *et al*. 2018). This sub-Mediterranean, sub-Atlantic element is in DD category in Serbia and in Romania.

Rhynchostegium confertum – In Bulgaria it is known form three localities (Petrov 1962, Mickiewicz *et al.* 1966, Natcheva and Ganeva 2022). This sub-Mediterranean, Atlantic element is red listed as NT in Bulgaria. However, this species is widespread in the Balkans, which is evidenced by several recent collections even from the neighbouring countries, like Serbia (Papp *et al.* 2016, 2019), Northern Macedonia (Papp *et al.* 2020), and Greece (Papp and Tsakiri 2011).

Schistidium papillosum – Until now, this species has been known only from the Pirin Mts (Lüth 2007). It is a boreo-arctic, montane species (Smith 2004). It does not seem to be rare in the Balkans, where acidic bedrocks occur. It has several records from the neighbouring Serbia (Papp and Erzberger 2007, Papp *et al.* 2012, 2016), Northern Macedonia (Papp and Erzberger 2012, Papp *et al*. 2024*c*), and Greece (Papp and Tsakiri 2017).

Scorpiurium circinatum – This Atlantic, Mediterranean species is red listed as EN in Bulgaria and it is in DD category in the Serbian red list. In Bulgaria it is known from several localities in the eastern part of the country (Natcheva and Ganeva 2005, Papp *et al.* 2011, 2018). Considering the distribution of the species, the Bulgarian populations are at the northern edge of its range.

Syntrichia latifolia – This is a species of the temperate zones of Europe living on tree barks near larger watercourses (Ahrens and Nebel 2000). There is only one old report of this species in Bulgaria (Stefanoff and Petrov 1962). Therefore, it is red listed as CR in Bulgaria. It is VU in Romania due to restricted and declining area of occupancy and number of locations.

Syntrichia princeps – This Atlantic, sub-Mediterranean species is red listed in Bulgaria as VU and it is known from only one floristical region – Pirin (Simon and Vajda 1959). It is in DD category in Serbia, and CR in Romania.

Syntrichia subpapillosissima – It is on the European red list as DD. It is treated as an Atlantic, Mediterranean species by Düll (1984). Being similar in the field to the common *Syntrichia ruralis* it is under-recorded, and its distribution is still not well known. There is only one location in Bulgaria (Papp *et al.* 2018). It is VU in Serbia due to restricted and declining area of occupancy and number of locations.

Some other red-listed species in Bulgaria collected in the Eastern Rhodopi like *Fissidens crassipes* (VU), *Marsupella funckii* (VU), *Microeurhynchium pumilum* (EN), *Oxyrrhynchium schleicheri* (CR), *Scleropodium touretii* (EN), *Syntrichia papillosa* (EN), *Trichodon cylindricus* (VU), and *Trichostomum brachydontium* (VU) turned out to be not rare or threatened in the country based on investigations after the publication of the Bulgarian red list (Natcheva *et al*. 2006).

Bryophyte vegetation

The region is rich in dry grasslands and dry rocky places (Figs 5, 6, 7), which maintain high bryophyte diversity; 51.6% of the species collected live in these habitats. In the bryophyte assemblages of these dry habitat types sub-Atlantic-sub-Mediterranean and Atlantic-Mediterranean species have the highest proportion (47.8%). The species of the temperate zones of Europe are also important constituents (32.6%). The proportion of boreal, subboreal species is 19.6%. They occupy and are sporadically found mostly in more shaded, humid microhabitats, like rocks crevices. Among the most frequent species of Mediterranean character several thalloid liverworts can be mentioned, like *Mannia androgyna*, *Oxymitra incrassata*, *Riccia ciliata*, *R. ciliifera*, *R. crozalsii*, *R. nigrella*, *R. michelii*, *Reboulia hemisphaerica*, and *Targionia hypophylla*. The most frequent sub-Atlantic-sub-Mediterranean, and Atlantic-Mediterranean species are the following: *Cynodontium bruntonii*, *Encalypta vulgaris*, *Dialytrichia mucronata*, *Didymodon luridus*, *Didymodon insulanus*, *Grimmia laevigata*, *G. tergestina*, *Pleuridium subulatum*, *Scleropodium touretii*, *Syntrichia princeps*, *S. subpapillosissima*, *Tortella squarrosa*, *Trichostomum brachydontium*. *Barbula unguiculata*, *Brachytheciastrum*

Fig. 5. Dry andesite rocky outcrop by River Arda near Madzharovo (loc. 3).

Fig. 6. Dry serpentine grassland near Kazak (loc. 7).

Fig. 7. Acidic tufa rocky slopes at mine Zvezdel (loc. 11).

velutinum, *Cephaloziella divaricata*, *Ceratodon purpureus*, *Grimmia muehlenbeckii*, *G. pulvinata*, *Homalothecium lutescens*, *Hypnum cupressiforme* var. *lacunosum*, *Orthotrichum anomalum*, *Polytrichum juniperinum*, *P. piliferum*, *Ptychostomum capillare*, *P. imbricatulum*, *Riccia sorocarpa*, *Syntrichia ruralis*, *Tortula muralis*, *Trichostomum crispulum*, *Weissia controversa* are the most frequently found species of the temperate zones of Europe. Only two boreal (*Coscinodon cribrosus*, *Racomitrium canescens*) and a subboreal species (*Grimmia ovalis*) can be mentioned as common in these habitats.

On the shaded rocks and on acidic soil in forests, among the frequent, characteristic species we can find species of the temperate zones of Europe and sub-Atlantic, sub-Mediterranean species almost in the same number. *Dicranella heteromalla*, *Fissidens bryoides*, *Fissidens dubius*, *F. taxifolius*, *Plagiomnium affine*, *P. undulatum*, and *Pseudoscleropodium purum* are the most frequent temperate species, while *Cirriphyllum crassinervium*, *Lejeunea cavifolia*, *Microeurhynchium pumilum*, *Oxyrrhynchium schleicheri*, *Rhynchostegium confertum*, and *Tortula schimperi* are frequently found sub-Atlantic, sub-Mediterranean elements. In these habitat types a few boreal (e.g. *Mnium stellare* and *Plagiothecium cavifolium*) and subboreal (*Dicranum scoparium*, *Plagiochila porelloides*, and *Tortula subulata*) species are also characteristic.

In the species composition of the aquatic-riparian bryophyte vegetation formed at rivers, streams, and rivulets (Figs 8, 9) species of the temperate zones of Europe and sub-Atlantic, sub-Mediterranean, and Mediterranean elements also take part almost in the same proportion. *Apopellia endiviifolia*, *Cratoneuron filicinum*, *Hygroamblystegium tenax*, *Pohlia melanodon*, *Ptychostomum pseudotriquetrum*, and *Rhynchostegium riparioides* are the most frequent temperate species, while *Bryum gemmiparum*, *Cinclidotus fontinaloides*, *Didymodon nicholsonii*, *D. sinuosus*, *Imbribryum alpinum*, *Lunularia cruciata*, and *Orthotrichum cupulatum* var. *riparium* can be mentioned as frequent sub-Mediterranean, Mediterranean species. Only two species of northern distribution are common in the region in this habitat; the boreal, montane *Philonotis tomentella* and the subboreal *Brachythecium rivulare*.

The epiphyte flora mainly consists of species of the temperate zones of Europe, like *Frullania dilatata*, *Radula complanata*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Leucodon sciuroides*, *Lewinskya affinis*, *L. fastigiata*, *Orthotrichum pumilum*, *O. schimperi*, *Syntrichia latifolia*, and *S. papillosa*, but species with sub-Atlantic, sub-Mediterranean character also frequently appear in this habitat, too, e.g. *Lewinskya acuminata*, *L. striata*, *Orthotrichum stramineum*, *O. tenellum*, *Pulvigera lyellii*, and *Zygodon rupestris*.

Fig. 8. River Avrenska between Arven and Devesilovo villages (loc. 6).

CONCLUSIONS

Fig. 9. Below the wall of the Studen Kladenets Dam, loc. Sheitan dere, andesitobasaltic rocks by the river (loc. 14).

A bryological investigation in special habitats formed on metal-rich igneous bedrock in the Eastern Rhodope Mountains has revealed several new national records and data on species of conservation interest. Most of the new additions to the Bulgarian bryophyte flora are species with sub-Mediterranean, Mediterranean, and sub-Atlantic distribution. Similar conclusions can be drawn about the species of conservation interest. The results suggest that the study area maintains high bryophyte diversity and species of Mediterranean character play an important role in the species composition of each habitat type. This very valuable bryophyte flora has developed in many cases in areas under high anthropogenic influence and pressure (e.g. at or nearby mining areas). Finally, we have to highlight the necessity of further research and adequate protection of these diverse bryophyte assemblages.

* * *

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Összefoglaló: „A Fémkötő kriptogámok – egy alig ismert csoport nagy természetvédelmi értéke" című 2019–2021 között folyó kétoldalú akadémiai kutatási projekt keretében, 2019-ben a Kelet-Rodope hegység ércben gazdag lelőhelyein, felhagyott bányák és meddőhányók térségében, valamint szerpentinit és homokkő alapkőzetű területeken vizsgáltuk a mohaflórát. Összesen 183 taxont (egy becősmohát, 33 májmohát és 149 lombosmohát) gyűjtöttünk. Kilenc mohát (két májmohát és 7 lombosmohát) először mutattunk ki Bulgária területéről, amelyek a következők: *Riccia michelii*, *Targionia lorbeeriana, Didymodon nicholsonii, D. tophaceus* subsp. *erosus, Epipterygium tozeri, Orthotrichum schimperi, Lewinskya acuminata*, *Schistidium dupretii* és *Scorpiurium sendtneri.* Két faj (*Philonotis calcarea* és *Syntrichia subpapillosissima*) szerepelnek a 2019-ben publikált IUCN Európai Moha Vörös Listán a veszélyeztetettséghez közeli (NT), illetve az adathiányos (DD) kategóriában. Természetvédelmi szempontból 27 faj (6 májmoha és 21 lombosmoha) rendkívül fontosnak tekinthető, elsősorban bulgáriai és balkáni szórványos elterjedésük, illetve az őket veszélyeztető tényezők alapján.

REFERENCES

Ahrens, M. and Nebel, M. (2000): *Pottiaceae, Pottmoose.* – In: Nebel, M. and Philippi, G. (eds): Die Moose Baden-Württembergs. Band 1. Ulmer, Stuttgart, pp. 230–369.

Bisang, I., Schyder, N., Schröck, C., Hodgetts, N., Lockhart, N. and Bergamini, A. (2025): Priority ranking for conservation of all European bryophytes. – *Biol. Conserv.* **309**: 111297. https://doi.org/10.2139/ssrn.5166317

Blockeel, T. (1994): Some bryophytes new to Bulgaria. – *J. Bryol.* **18**: 199–200. https://doi.org/10.1179/jbr.1994.18.1.199

Bondev, I. (2002): *Geographsko raionirane.* [Geobotanic regioning]. – In: Kopralev, I. (ed.): Geography of Bulgaria, physical geography, socio-economic geography. Publishing House ForCom., Sofia (Bulgaria), pp. 336–352.

Damsholt, K. (2002): *Illustrated flora of Nordic liverworts and hornworts.* – Nord. Bryol. Soc., Lund, 837 pp.

Dimitrov, M., Natcheva, R., Ganeva, A. and Gyurova, D. (2015): Plant biodiversity of Sphagnum-dominated mires in Vitosha Nature Park. – *Forest review*, Skopje **46**: 15–29.

Düll, R. (1983): Distribution of the European and Macaronesian liverworts (Hepaticophytina). – *Bryol. Beiträge* **2**: 1–115.

Düll, R. (1984): Distribution of the European and Macaronesian mosses (Bryophytina) I. – *Bryol. Beiträge* **4**: 1–109.

Düll, R. (1985): Distribution of the European and Macaronesian mosses (Bryophytina) II. – *Bryol. Beiträge* **5**: 110–232.

Ellis, L. T., Adjie, B., Alvarez, D. J., Ardiles, V., Asthana, A. K., Atwood, J. J., Bakalin, V. A., Bednarek-Ochyra, H., Boiko, M., Budke, J. M., Cedrés-Perdomo, R. D., Cerrato, M. D., Csiky, J., Espinoza-Prieto, B., Gabriel, R., Gey, S., Gil, L., Graulich, A., Hylander, K., Kiebacher, T., Konstantinova, N. A., Kučera, J., Kunev, G., Larraín, J., Lönnell, N., Maciel-Silva, A. S., Mamontov, Yu. S., Mattos, G. H. R., Mir-Rosselló, P. M., Nadhifah, A., Natcheva, R., O'Leary, S. V., Oliveira, M. F., Opisso, J., Papp, B., Peñaloza-Bojacá, G. F., Polaino-Martín, C., Rawat, K. K., Ribas-Serra, A., Rosadziński, S., Sahu, V., Sipos, A., Staniaszek-Kik, M., Starzomski, B. M., Suárez, G. M., Tucker, D. B. L., Verma, A. and Zagorodniuk, N. (2024): New national and regional bryophyte records, 77. – *J. Bryol.* **46**(2): 139–155. https://doi.org/10.1080/03736687.2024.2388418

Erzberger, P. and Papp, B. (2004): Annotated checklist of Hungarian bryophytes. – *Studia bot. hung.* **35**: 91–150.

Frey, W., Frahm, J.-P., Fischer, E. and Lobin, W. (1995): *Die Moos- und Farnpflanzen Europas. Kleine Kryptogamenflora Bd. IV.* – G. Fischer, Stuttgart, Jena, New York, 426 pp.

Ganeva, A. (2002): New data on the distribution of bryophytes in Bulgaria. – *Phytol. Balcan.* **8**(2): 191–195.

Ganeva, A. and Düll, R. (1999): *A contribution to the Bulgarian bryoflora. Checklist of Bulgarian bryophytes.* – In: Düll, R., Ganeva, A., Martinčič, A. and Pavletić, Z. (eds): Contributions to the bryoflora of former Yugoslavia and Bulgaria. 1 Auflage. IDH-Verlag, Bad Münstereifel, pp. 111–199.

Ganeva, A., Papp, B. and Natcheva, R. (2008): Contribution to the bryophyte flora of the NW Bulgaria. – *Phytol. Balcan.* **14**(3): 327–333.

Georgiev, V. (2012): *Metallogeny of the Eastern Rhodope.* – Prof. Marin Drinov Academic Publishing House, Sofia.

Gospodinov, G. and Natcheva, R. (2022): An updated checklist of liverworts and hornworts of Bulgaria. – *Herzogia* **35**(1): 138–154. https://doi.org/10.13158/heia.35.1.2022.138

Guerra, J., Cano, M. J. and Ros, R. M. (2006): *Flora Briofítica Ibérica.* Vol. III. – Universidad de Murcia, Sociedad Espaňola de Briología, 42 pp.

Hill, M. O., Bell, N., Bruggeman-Nannenga, M. A., Brugués, M., Cano, M. J., Enroth, J., Flatberg, K. I., Frahm, J.-P., Gallego, M. T., Garilleti, R., Guerra, J., Hedenäs, L., Holyoak, D. T., Hyvönen, J., Ignatov, M. S., Lara, F., Mazimpaka, V., Muñoz, J. and Söderström, L. (2006): An annotated checklist of the mosses of Europe and Macaronesia. – *J. Bryol.* **28**(3): 198–267. https://doi.org/10.1179/174328206X119998

Hodgetts, N. and Lockhart, N. (2020): *Checklist and country status of European bryophytes – update 2020.* – Irish Wildlife Manuals, No. 123. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Hodgetts, N. G., Söderström, L., Blockeel, T. L., Caspari, S., Ignatov, M. S., Konstantinova, N. A., Lockhart, N., Papp, B., Schröck, C., Sim-Sim, M., Bell, D., Bell, N. E., Blom, H. H., Bruggeman-Nannenga, M. A., Brugués, M., Enroth, J., Flatberg, K. I., Garilleti, R., Hedenäs, L., Holyoak, D. T., Hugonnot, V., Kariyawasam, I., Köckinger, H., Kučera, J., Lara, F. and Porley, R. D. (2020): An annotated checklist of bryophytes of Europe, Macaronesia and Cyprus. – *J. Bryol.* **42**(1): 1–116. https://doi.org/10.1080/03736687.2019.1694329

Hodgetts, N., Cálix, M., Englefield, E., Fettes, N., García Criado, M., Patin, L., Nieto, A., Bergamini, A., Bisang, I., Baisheva, E., Campisi, P., Cogoni, A., Hallingbäck, T., Konstantinova, N., Lockhart, N., Sabovljević, M., Schnyder, N., Schröck, C., Sérgio, C., Sim Sim, M., Vrba, J., Ferreira, C. C., Afonina, O., Blockeel, T., Blom, H., Caspari, S., Gabriel, R., Garcia, C., Garilleti, R., González Mancebo, J., Goldberg, I., Hedenäs, L., Holyoak, D., Hugonnot, V., Huttunen, S., Ignatov, M., Ignatova, E., Infante, M., Juutinen, R., Kiebacher, T., Köckinger, H., Kučera, J., Lönnell, N., Lüth, M., Martins, A., Maslovsky, O., Papp, B., Porley, R., Rothero, G., Söderström, L., Ştefănuţ, S., Syrjänen, K., Untereiner, A., Váňa, J. †, Vanderpoorten, A., Vellak, K., Aleffi, M., Bates, J., Bell, N., Brugués, M., Cronberg, N., Denyer, J., Duckett, J., During, H. J., Enroth, J., Fedosov, V., Flatberg, K.-I., Ganeva, A., Gorski, P., Gunnarsson, U., Hassel, K., Hespanhol, H., Hill, M., Hodd, R., Hylander, K., Ingerpuu, N., Laaka-Lindberg, S., Lara, F., Mazimpaka, V., Mežaka, A., Müller, F., Orgaz, J. D., Patiño, J., Pilkington, S., Puche, F., Ros, R. M., Rumsey, F., Segarra-Moragues, J. G., Seneca, A., Stebel, A., Virtanen, R., Weibull, H., Wilbraham, J. and Żarnowiec, J. (2019): *A miniature world in decline: European red list of mosses, liverworts and hornworts.* – IUCN, Brussels, Belgium.

Jiménez, J. A., Guerra, J., Cano, M. J. and Ros, R. M. (2004): Didymodon erosus sp. nov. (Musci, Pottiaceae) from the Iberian Peninsula. – *Nova Hedwigia* **78**: 501–506.

Köckinger, H. (2017): *Die Horn- und Lebermoose Österreichs (Anthocerotophyta und Marchantiophyta)*. – Catalogus Florae Austriae. II(2), pp. 1–382.

Kučera, J., Blockeel, T. L., Erzberger, P., Papp, B., Soldán, Z., Vellak, K., Werner, O. and Ros, R. M. (2018): Didymodon tophaceus complex (Pottiaceae, Bryophyta) revisited: new data support the subspecific rank of currently recognized species – *Cryptogamie, Bryol.* **39**(2): 241–257. https://doi.org/10.7872/cryb/v39.iss2.2018.241

Lüth, M. (2007): Additions to the bryophyte flora of Bulgaria. – *Cryptogamie, Bryol.* **28**(3): 237–241.

Meinunger, L. (1975): Kleiner Beitrag zur Moosflora Bulgariens. – *Herzogia* **3**: 209–212.

Mickiewicz, J., Rejment-Grochowska, I. and Sobotka, D. (1966): Résultats des recherches bryologiques en Bulgarie. – *Acta Soc. Bot. Poloniae* **35**(1): 111–127.

Natcheva, R. (2003): The bryophyte flora of Mt. Golema Planina, Western Balkan Range. – *Phytol. Balcan.* **9**(1): 9–18.

Natcheva, R. (2024): New localities of some rare bryophyte species in Bulgaria. – *Phytol. Balcan.* **30**(1): 9–14. https://doi.org/10.7546/PhB.30.1.2024.2

Natcheva, R. and Ganeva, A. (2005): Check-list of the bryophytes of Bulgaria II. Musci. – *Cryptogamie, Bryol.* **26**(2): 209–232.

Natcheva, R. and Ganeva, A. (2018): On the identity and distribution of some elusive bryophyte species in the Bulgarian flora. – *Phytol. Balcan.* **24**(2): 201–204.

Natcheva, R. and Ganeva, A. (2022): New data on the bryophyte flora of the Bulgarka Nature Park. – *Phytol. Balcan.* **28**(3): 305–310. https://doi.org/10.7546/PhB.28.3.2022.2

Natcheva, R. and Gospodinov, G. (2024): A supplement to the checklist of the liverwort flora of Bulgaria. – *Phytol. Balcan.* **30**(3): 283–288. https://doi.org/10.7546/PhB.30.3.2024.2

Natcheva, R. and Gyosheva M. (2016): Contribution to the bryophyte flora and mycota of Bulgaria: I. Bryophytes and larger fungi from Uchilishtna Gora Managed Reserve. – *Phytol. Balcan.* **22**(3): 323–330.

Natcheva, R., Ganeva, A. and Spiridonov, G. (2006): Red list of the bryophytes in Bulgaria. – *Phytol. Balcan.* **12**(1): 55–62.

Papp, B. and Erzberger, P. (2007): Contribution to the bryophyte flora of Western Stara Planina Mts (E. Serbia). – *Studia bot. hung.* **38**: 95-123.

Papp, B. and Erzberger, P. (2012): Contribution to the bryophyte flora of the Former Yugoslav Republic of Macedonia (FYROM). – *Polish Bot. J.* **57**(1): 205–221.

Papp, B. and Tsakiri, E. (2011): Contribution to the bryophyte flora of the Skra-Koupa waterfalls area (Mt Paiko, Central Macedonia, North Greece). – *Studia bot. hung.* **42**: 41–50.

Papp, B. and Tsakiri, E. (2017): Contribution to the bryophyte flora of the Paiko, Tzena and Pinovo Mts in Greece. – *Studia bot. hung.* **48**(1): 33–49. https://doi.org/10.17110/StudBot.2017.48.1.33

Papp, B., Erzberger, P. and Dragićević, S. (2023): Revision of bryophyte specimens from Montenegro. – *Acta Biol. Plant. Agriensis* **11**: 283–301. https://doi.org/10.21406/abpa.2023.11.1.283

Papp, B., Ganeva, A. and Natcheva, R. (2006): Bryophyte vegetation of Iskur River and its main tributaries. – *Phytol. Balcan.* **12**(2): 181–189.

Papp, B., Natcheva, R. and Ganeva, A. (2011): The bryophyte flora of Northern Mt Strandzha. – *Phytol. Balcan.* **17**(1): 21–32.

Papp, B., Natcheva, R. and Ganeva, A. (2018): Bryophyte diversity along the Northern Black Sea Coast in Bulgaria. – *Phytol. Balcan.* **24**(1): 25–33.

Papp, B., Pantović, J., Nikolić, N. and Sabovljević, M. S. (2019): Contribution to the bryophyte flora of Serbia: Ovčar, Kablar and Vujan Mts. – *Studia bot. hung.* **50**(2): 333–348. https://doi.org/10.17110/StudBot.2019.50.2.331

Papp, B., Pantović, J. P., Szurdoki, E. and Sabovljević, M. S. (2024*a*): Three moss novelties in the flora of North Macedonia. – *Hacquetia* **23**(2): 199–202. https://doi.org/10.2478/hacq-2023-0012

Papp, B., Pantović, J. P. and Sabovljević, M. S. (2024*b*): Revision of bryophyte specimens from Serbia deposited in the Bryophyte Collection of the Hungarian Natural History Museum, Budapest. – *Studia bot. hung.* **55**(2): 223–243. https://doi.org/10.17110/StudBot.2024.55.2.223

Papp, B., Pantović, J. P., Szurdoki, E. and Sabovljević, M. S. (2024*c*): Contribution to the bryophyte flora of Jablanica Mts, North Macedonia. – *Studia bot. hung.* **55**(2): 245–265. https://doi.org/10.17110/StudBot.2024.55.2.245

Papp, B., Sabovljević, M. S. and Pantović, J. (2020): A contribution to the exploration of the bryophyte flora of Galičica National Park (the Republic of North Macedonia) with special attention to the species of conservation interest. – *Nova Hedwigia, Beih.* **150**: 117–132. https://doi.org/10.1127/nova-suppl/2020/117

Papp, B., Szurdoki, E. and Sabovljević, M. (2012): Bryophyte flora of the Vlasina lake and its surrounding (SE Serbia). – *Studia bot. hung.* **43**: 27–45.

Papp, B., Szurdoki, E., Pantović, J. and Sabovljević, M. (2016): An insight into the bryophyte flora of the Ibar gorge and its surroundings (Central and SW Seria). – *Acta Bot. Hung.* **58**(3–4): 411–423. https://doi.org/10.1556/ABot.58.2016.3-4.10

Petkoff, S. (1908): Contribution à l'étude des Hépatiques de Bulgarie. – *Period. Spis. Bulg. Knizh. Druzh.* **68**: 115–123.

Petrov, S. (1962): Contribution à la flore bryologique de la Bulgarie. Bryophytes des montagnes du Pirin et de Slavianka. – *Izv. Bot. Inst.* **10**: 131–144.

Petrov, S. (1963): Neue Beirag zur Kenntnis der Moosflora Bulgariens. – *Izv. Bot. Inst. (Sofia)* **11**: 167–187.

Podpéra, J. (1911): Ein Beitrag zu der Kryptogamenflora der bulgarischen Hochgebirge. – *Beih. Bot. Centralbl.* **28**(2): 173–224.

Ros, R. M., Mazimpaka, V., Abou-Salama, U., Aleffi, M., Blockeel, T. L., Brugués, M., Cros, R. M., Dia, M. G., Dirkse, G. M., Draper, I., El Saadawi, W., Erdağ, A., Ganeva, A., Gabriel, R., González-Mancebo, J. M., Granger, C., Herrnstadt, I., Hugonnot, V., Khalil, K., Kürschner, H., Losada-Lima, A., Luís, L., Mifsud, S., Privitera. M., Puglisi, M., Sabovljević, M., Sérgio, C., Shabbara, H. M., Sim-Sim, M., Sotiaux, A., Tacchi, R., Vanderpoorten, A. and Werner, O. (2013): Mosses of the Mediterranean, an annotated checklist. – *Cryptogamie, Bryol.* **34**(2): 99–283. https://doi.org/10.782/cryb.v34.iss2.2013.99

Sabovljević, M. S., Pantović, J. P., Širka, P., Vujičić, M. M., Sabovljević, A. D. and Papp, B. (2024*a*): Red-list of liverwort and hornwort species of Serbia: 2024 assessment. – *Bot. Serbica* **48**(1): 1–6. https://doi.org/10.2298/BOTSERB2401001S

Sabovljević, M. S., Pantović, J. P., Širka, P., Vujičić, M. M., Sabovljević, A. D. and Papp, B. (2024*b*): Red-list of moss species of Serbia: 2024 assessment. – *Bot. Serbica* **48**(2): 207–222. https://doi.org/10.2298/BOTSERB2402207S

Sabovljević, M., Papp, B., Blockeel, T., Ignatov, M., Hallingbäck, T. and Söderström, L. (2019): *Philonotis calcarea (Europe assessment)*. – The IUCN Red List of Threatened Species 2019: e.T83659958A87777565 (accessed on 06 October 2025)

Sauer, M. (2000): *Dicranaceae, Gabelzahnmoose*. – In: Nebel, M. and Philippi, G. (eds): Die Moose Baden-Württembergs. Band 1. Ulmer, Stuttgart, pp. 129–219.

Schäfer-Verwimp, A. (2001): *Orthotrichum.* – In: Nebel, M. and Philippi, G. (eds): Die Moose Baden-Württembergs. Band 2. Ulmer, Stuttgart, pp. 170–197.

Simon, T. and Vajda, L. (1959): Beiträge zur Moosflora Bulgariens. – *Ann. Univ. Sci. Budapest. Rolando Eötvös, Sect. Biol.* **2**: 259–272.

Šmarda, J. (1970): Complements à la flore muscinale de la Bulgarie. – *Rev. Bryol. Lichénol.* **37**(1): 33–46.

Smith, A. J. E. (1990): *The liverworts of Britain and Ireland.* – Cambridge University Press, Cambridge.

Smith, A. J. E. (2004): *The moss flora of Britain and Ireland.* (2nd ed). – Cambridge University Press, Cambridge.

Stefanoff, B. and Petrov, S. (1962): Über die Moose und die Moosflora Bulgariens. – *Bull. de l'Inst. des forêts* **11**: 5–38.

Ştefănuţ, S. (2012): Checklist and red list of bryophytes of Romania. – *Nova Hedwigia* **95**(1–2): 59–104. https://doi.org/10.1127/0029-5035/2012/0044

Velenovsky, J. (1902): Neuter Nachtrag zur Flora von Bulgarien. – *Österr. bot. Zeitschr.* **52**(3): 115–121.

Velev, S. (2002): *Klimatichesko raionirane.* [Climatic regioning]. – In: Kopralev, I. (ed.): Geography of Bulgaria, physical geography. socio-economic geography. Publishing House ForCom., Sofia (Bulgaria), pp. 155–157.

Vigalondo, B., Garilleti, R., Vanderpoorten, A., Patiño, J., Draper, I., Calleja, J. A., Mazimpaka, V. and Lara, F. (2019): Do mosses really exhibit so large distribution ranges? Insights from the integrative taxonomic study of the Lewinskya affinis complex (Orthotrichaceae, Bryopsida). – *Mol. Phyl. Evol.* **140**: 106598. https://doi.org/10.1016/j.ympev.2019.106598

Yordanova, M., Velev, S. and Drenovski, I. (2002): *Charakteristika na fisikogeographskite oblasti.* [Characteristic features of the physical geographical regions]. – In: Kopralev, I. (ed.): Geography of Bulgaria, physical geography, socio-economic geography. Publishing House ForCom., Sofia (Bulgaria), pp. 391–409.

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Appendix – Complete list of bryophyte records. The numerals following the species names refer to the collection sites described above.

Liverworts

Apopellia endiviifolia (Dicks.) Nebel et D. Quandt – 5, 6, 9 – siliceous rock.
Barbilophozia barbata (Schmidel ex Schreb.) Loeske – 1, 4 – siliceous rock.
Barbilophozia sudetica (Nees ex Huebener) L. Söderstr., De Roo et Hedd. – 1 – siliceous rock.
Cephaloziella divaricata (Sm.) Schiffn. var. ***divaricata*** – 5, 8x, 10, 12 – siliceous rock.
Cephaloziella divaricata (Sm.) Schiffn. var. ***scabra*** (M. Howe) Haynes – 1, 2, 12 – siliceous rock.
Cephaloziella hampeana (Nees) Schiffn. ex Loeske – 8x – soil.
Clevea hyalina (Sommerf.) Lindb. – 5 – soil.
Conocephalum conicum (L.) Dumort. – 6 – siliceous rock.

Corsinia coriandrina (Spreng.) Lindb. – 10 – soil.
Frullania dilatata (L.) Dumort. – 1, 3, 6, 7, 8x, 9, 11, 12 – bark of *Alnus*, *Quercus*, *Acer monspessulanum*, rocks.
Frullania tamarisci (L.) Dumort. – 2, 5 – siliceous rock.
Lejeunea cavifolia (Ehrh.) Lindb. – 3, 9 – siliceous rock.
Lophocolea heterophylla (Schrad.) Dumort. – 8, 8x, 9 – soil, rock.
Lophoziopsis excisa (Dicks.) Konstant. et Vilnet – 1 – siliceous rock.
Lunularia cruciata (L.) Dumort. ex Lindb. – 3, 8x, 14 – siliceous rock, soil.
Mannia androgyna (L.) A. Evans – 3, 10 – siliceous rock.
Marsupella funckii (F. Weber et D. Mohr) Dumort. – 2 – siliceous rock.
Marsupella sphacelata (Giesecke ex Lindenb.) Dumort. – 2 – siliceous rock.
Oxymitra incrassata (Brot.) Sérgio et Sim-Sim – 4, 5x, 7 – siliceous rock, soil.
Phaeoceros carolinianus (Michx.) Prosk. – 8 – soil.
Plagiochila porelloides (Torr. ex Nees) Lindenb. – 1, 9 – siliceous rock.
Porella cordaeana (Huebener) Moore – 9 – siliceous rock.
Radula complanata (L.) Dumort. – 3, 9 – siliceous rock, *Quercus* bark.
Reboulia hemisphaerica (L.) Raddi – 2, 3, 4, 5, 7, 8x, 10, 12 – siliceous rock, soil.
Riccia ciliata Hoffm. – 5x, 7, 10 – soil.
Riccia ciliifera Link ex Lindenb. – 4, 5x, 7, 10 – siliceous rock, soil.
Riccia crozalsii Levier – 7, 10 – soil.
Riccia michelii Raddi – 4, 5x, 7, 10 – siliceous rock, soil.
Riccia nigrella DC. – 5x, 7 – soil.
Riccia sorocarpa Bisch. – 3, 9, 10 – siliceous rock.
Scapania compacta (Roth) Dumort. – 1, 2 – siliceous rock.
Solenostoma hyalinum (Lyell ex Hook.) Mitt. – 8x – soil.
Targionia hypophylla L. – 3, 4 – siliceous rock.
Targionia lorbeeriana Müll. Frib. – 7 – soil.

Mosses

Alleniella complanata (Hedw.) S. Olsson, Enroth et D. Quandt – 9 – siliceous rock.
Amblystegium serpens (Hedw.) Schimp. – 9 – siliceous rock.
Atrichum angustatum (Brid.) Bruch et Schimp. – 12 – bank of an artificial lake.
Atrichum undulatum (Hedw.) P. Beauv. – 8x – soil.
Barbula unguiculata Hedw. – 2, 4, 9, 11, 12 – siliceous rock.
Bartramia aprica Müll. Hal. – 10 – soil.
Bartramia pomiformis Hedw. – 2 – siliceous rock.
Brachytheciastrum velutinum (Hedw.) Ignatov et Huttunen – 2, 3, 9, 12 – siliceous rock.
Brachythecium albicans (Hedw.) Schimp. – 1 – siliceous rock.
Brachythecium rivulare Schimp. – 8, 9, 13 – rock.

Brachythecium rutabulum (Hedw.) Schimp. – 5 – siliceous rock.
Bryum gemmiparum De Not. – 4, 6, 14 – siliceous rock.
Calliergonella cuspidata (Hedw.) Loeske – 8, 8x – rock.
Campyliadelphus chrysophyllus (Brid.) R. S. Chopra – 12 – siliceous rock.
Ceratodon purpureus (Hedw.) Brid. – 1, 2, 5, 7, 8x, 9, 10, 11, 12, 13 – siliceous rock, soil.
Cheilothela chloropus (Brid.) Broth. – 5 – siliceous rock.
Cinclidotus fontinaloides (Hedw.) P. Beauv. – 4, 6 – siliceous rock.
Cinclidotus riparius (Host ex Brid.) Arn. – 4 – siliceous rock.
Cirriphyllum crassinervium (Taylor) Loeske et M. Fleisch. – 3, 4 – siliceous rock.
Coscinodon cribrosus (Hedw.) Spruce – 1, 2, 3, 11 – siliceous rock.
Cratoneuron filicinum (Hedw.) Spruce – 4, 5, 6, 9, 12, 14 – siliceous rock.
Cynodontium bruntonii (Sm.) Bruch et Schimp. – 1, 2, 3 – siliceous rock.
Dialytrichia mucronata (Brid.) Broth. – 4, 5, 14 – siliceous rock.
Dicranella cerviculata (Hedw.) Schimp. – 1 – soil.
Dicranella heteromalla (Hedw.) Schimp. – 1, 2, 8 – soil, siliceous rock.
Dicranella howei Renauld et Cardot – 11 – siliceous rock.
Dicranella schreberiana (Hedw.) Dixon – 12 – bank of an artificial lake.
Dicranella varia (Hedw.) Schimp. – 12 – bank of an artificial lake.
Dicranoweisia cirrata (Hedw.) Lindb. – 1 – siliceous rock.
Dicranum scoparium Hedw. – 1, 2, 8, 8x, 9, 12 – siliceous rock, soil.
Didymodon acutus (Brid.) K. Saito – 7 – soil.
Didymodon insulanus (De Not.) M. O. Hill – 2, 3, 4, 5x, 6, 8, 8x, 9 – siliceous rock, soil.
Didymodon luridus Hornsch. – 6, 12, 13 – siliceous rock.
Didymodon nicholsonii Culm. – 6, 14 – siliceous rock.
Didymodon sinuosus (Mitt.) Delogne – 1, 14 – siliceous rock.
Didymodon spadiceus (Mitt.) Limpr. – 6 – siliceous rock.
Didymodon tophaceus (Brid.) Lisa subsp. ***tophaceus*** – 5 – siliceous rock.
Didymodon tophaceus subsp. ***erosus*** (J. A. Jiménez et J. Guerra) Jan Kučera – 5, 6, 12, 14 – siliceous rock.
Didymodon vinealis (Brid.) R. H. Zander – 9 – siliceous rock.
Ditrichum pusillum (Hedw.) Hampe – 2, 8x – soil.
Encalypta vulgaris Hedw. – 5, 11 – siliceous rock, lime containing schistose rock.
Epipterygium tozeri (Grev.) Lindb. – 8x – soil.
Eucladium verticillatum (With.) Bruch et Schimp. – 14 – siliceous rock.
Eurhynchiastrum pulchellum (Hedw.) Ignatov et Huttunen – 3 – siliceous rock.
Fissidens bryoides Hedw. – 3, 8x, 9 – siliceous rock.
Fissidens crassipes Wilson ex Bruch et Schimp. – 14 – siliceous rock.
Fissidens dubius P. Beauv. var. ***dubius*** – 5, 12 – siliceous rock.

Fissidens dubius var. ***mucronatus*** (Limpr.) Kartt., Hedenäs et L. Söderstr. – 7 – soil.
Fissidens taxifolius Hedw. – 8x, 9 – soil.
Fissidens viridulus (Sw. ex anon.) Wahlenb. – 7 – soil.
Fontinalis antipyretica Hedw. – 8 – rock.
Funaria hygrometrica Hedw. – 5 – siliceous rock.
Grimmia laevigata (Brid.) Brid. – 1, 3, 4, 5, 7, 11, 13, 14 – siliceous rock.
Grimmia lisae De Not. – 1, 3, 4, 5, 7, 13, 14 – siliceous rock.
Grimmia longirostris Hook. – 14 – siliceous rock.
Grimmia muehlenbeckii Schimp. – 1, 2, 3, 11, 12 – siliceous rock.
Grimmia ovalis (Hedw.) Lindb. – 1, 3, 5, 7, 11, 12, 13 – siliceous rock.
Grimmia pulvinata (Hedw.) Sm. – 2, 4, 5, 9, 11, 13 – siliceous rock.
Grimmia tergestina Tomm. ex Bruch et Schimp. – 11, 13 – siliceous rock.
Grimmia trichophylla Grev. – 11 – siliceous rock.
Gyroweisia tenuis (Hedw.) Schimp. – 12, 13 – siliceous rock.
Hedwigia ciliata (Hedw.) P. Beauv. – 11 – rock.
Hedwigia emodica Hampe ex Müll. Hal. – 3, 10, 13 – siliceous rock.
Homalothecium aureum (Spruce) H. Rob. – 4 – siliceous rock.
Homalothecium lutescens (Hedw.) H. Rob. – 2, 5, 9, 11 – siliceous rock.
Homalothecium sericeum (Hedw.) Schimp. – 1, 3, 8x, 9, 11 – *Quercus* bark, rock.
Hygroamblystegium tenax (Hedw.) Jenn. – 6, 9 – siliceous rock.
Hygrohypnum luridum (Hedw.) Jenn. – 13 – siliceous rock.
Hypnum cupressiforme Hedw. var. ***cupressiforme*** – 1, 3, 5, 6, 7, 8, 9, 10, 11, 13, 14 – siliceous rock, bark of *Alnus, Quercus, Acer monspessulanum*, soil.
Hypnum cupressiforme var. ***lacunosum*** Brid. – 2, 4, 7, 11, 12 – siliceous rock.
Imbribryum alpinum (Huds. ex With.) N. Pedersen – 4, 5, 8x, 10, 11, 12, 13 – siliceous rock.
Isothecium alopecuroides (Lam. ex Dubois) Isov. – 9 – siliceous rock.
Kindbergia praelonga (Hedw.) Ochyra – 8x – soil.
Leptodictyum riparium (Hedw.) Warnst. – 14 – siliceous rock.
Leucodon sciuroides (Hedw.) Schwägr. – 1, 3, 7, 8x – bark of *Quercus, Acer monspessulanum*.
Lewinskya acuminata (H. Philib.) F. Lara, Garilleti et Goffinet – 11 – *Quercus* bark.
Lewinskya affinis (Schrad. ex Brid.) F. Lara, Garilleti et Goffinet – 3, 6 – bark of *Alnus, Salix*.
Lewinskya fastigiata (Bruch ex Brid.) Vigalondo, F. Lara et Garilleti – 3, 8x, 11, 12 – *Quercus*, rock.
Lewinskya rupestris (Schleich. ex Schwägr.) F. Lara, Garilleti et Goffinet – 8x, 12 – rock, *Quercus* bark.
Lewinskya striata (Hedw.) F. Lara, Garilleti et Goffinet – 3, 6, 8x, 11 – bark of *Salix, Quercus, Alnus*.

Microeurhynchium pumilum (Wilson) Ignatov et Vanderp. – 3, 8x – siliceous rock, soil.
Mnium stellare Hedw. – 8x, 9 – soil, rock.
Nogopterium gracile (Hedw.) Crosby et W. R. Buck – 3 – siliceous rock.
Orthotrichum anomalum Hedw. – 3, 6, 14 – siliceous rock.
Orthotrichum cupulatum Hoffm. ex Brid. var. ***cupulatum*** – 9 – siliceous rock.
Orthotrichum cupulatum Hoffm. ex Brid. var. ***riparium*** Huebener – 5, 6, 14 – siliceous rock.
Orthotrichum pumilum Sw. ex anon. – 7, 8x, 11 – *Quercus* bark.
Orthotrichum schimperi Hammar – 3, 11 – *Salix* bark.
Orthotrichum stramineum Hornsch. ex Brid. – 6 – *Alnus* bark.
Orthotrichum tenellum Bruch ex Brid. – 6, 7 – bark of *Alnus, Quercus*.
Oxyrrhynchium hians (Hedw.) Loeske – 5, 6, 14 – siliceous rock.
Oxyrrhynchium schleicheri (R. Hedw.) Röll – 8x, 9 – soil.
Philonotis calcarea (Bruch et Schimp.) Schimp. – 13 – siliceous rock.
Philonotis capillaris Lindb. – 2, 8x, 9 – siliceous rock.
Philonotis fontana (Hedw.) Brid. – 4 – siliceous rock.
Philonotis marchica (Hedw.) Brid. – 14 – siliceous rock.
Philonotis tomentella Molendo – 8, 8x, 9, 10 – rock.
Plagiomnium affine (Blandow ex Funck) T. J. Kop. – 3, 8x – siliceous rock.
Plagiomnium undulatum (Hedw.) T. J. Kop. – 8x, 9 – soil, rock.
Plagiothecium cavifolium (Brid.) Z. Iwats. – 8x, 9 – soil.
Pleuridium subulatum (Hedw.) Rabenh. – 4, 5, 8x, 12 – siliceous rock.
Pogonatum aloides (Hedw.) P. Beauv. – 8 – soil.
Pohlia melanodon (Brid.) A. J. Shaw – 5, 9, 14 – siliceous rock.
Pohlia nutans (Hedw.) Lindb. – 1 – siliceous rock, soil.
Polytrichum juniperinum Hedw. – 1, 4, 7, 10, 12 – siliceous rock.
Polytrichum piliferum Hedw. – 1, 2, 8, 8x – siliceous rock, soil.
Pseudocrossidium hornschuchianum (Schultz) R. H. Zander – 7 – soil.
Pseudoscleropodium purum (Hedw.) M. Fleisch. – 9, 11, 12 – siliceous rock.
Pterigynandrum filiforme Hedw. – 9 – siliceous rock.
Ptychostomum capillare (Hedw.) Holyoak et N. Pedersen – 1, 2, 3, 5, 9, 11, 12, 13, 14 – siliceous rock.
Ptychostomum imbricatulum (Müll. Hal.) Holyoak et N. Pedersen – 5, 7, 11, 12 – siliceous rock.
Ptychostomum pseudotriquetrum (Hedw.) J. R. Spence et H. P. Ramsay var. ***pseudotriquetrum*** – 6, 8, 8x, 10 – siliceous rock.
Ptychostomum pseudotriquetrum var. ***bimum*** (Schreb.) Holyoak et N. Pedersen – 6 – siliceous rock.

Pulvigera lyellii (Hook. et Taylor) Plášek, Sawicki et Ochyra – 6, 11 – bark of *Alnus, Quercus*.
Racomitrium canescens (Hedw.) Brid. – 1, 4, 5x, 10, 13 – siliceous rock.
Racomitrium elongatum Ehrh. ex Frisvoll – 8x – soil.
Racomitrium lanuginosum (Hedw.) Brid. – 3 – siliceous rock.
Racomitrium sudeticum (Funck) Bruch et Schimp. – 2 – siliceous rock.
Rhizomnium punctatum (Hedw.) T. J. Kop. – 8x, 9 – soil, rock.
Rhynchostegiella curviseta (Brid.) Limpr. – 14 – siliceous rock.
Rhynchostegium confertum (Dicks.) Schimp. – 1, 9, 14 – siliceous rock.
Rhynchostegium megapolitanum (Blandow ex F. Weber et D. Mohr) Schimp. – 12 – siliceous rock.
Rhynchostegium riparioides (Hedw.) Cardot – 4, 5, 6, 8, 9, 14 – siliceous rock.
Schistidium apocarpum (Hedw.) Bruch et Schimp. – 8x, 9 – rock.
Schistidium crassipilum H. H. Blom – 5,6 – siliceous rock.
Schistidium duprettii (Thér.) W. A. Weber – 1 – siliceous rock.
Schistidium papillosum Culm. – 1 – siliceous rock.
Scleropodium touretii (Brid.) L. F. Koch – 2, 3 – siliceous rock.
Scorpiurium circinatum (Bruch) M. Fleisch. et Loeske – 3 – siliceous rock.
Scorpiurium sendtneri (Schimp.) M. Fleisch. – 3 – siliceous rock.
Syntrichia calcicola J. J. Amann – 11 – lime containing schistose rock.
Syntrichia latifolia (Bruch ex Hartm.) Huebener – 3 – *Salix* bark.
Syntrichia montana Nees – 11 – siliceous rock.
Syntrichia papillosa (Wilson) Jur. – 3 – *Salix* bark.
Syntrichia princeps (De Not.) Mitt. – 2, 3, 5, 9 – siliceous rock.
Syntrichia ruralis (Hedw.) F. Weber et D. Mohr – 1, 2, 5, 7, 11 – *Quercus* bark.
Syntrichia subpapillosissima (Bizot et R. B. Pierrot ex W. A. Kramer) M. T. Gallego et J. Guerra – 5, 11, 13 – siliceous rock.
Thuidium recognitum (Hedw.) Lindb. – 9 – siliceous rock.
Tortella squarrosa (Brid.) Limpr. – 2, 4, 5, 7, 10, 11, 13 – siliceous rock.
Tortula inermis (Brid.) Mont. – 11 – lime containing schistose rock.
Tortula muralis Hedw. – 6, 11, 14 – siliceous rock.
Tortula schimperi M. J. Cano, O. Werner et J. Guerra – 2, 9 – siliceous rock.
Tortula subulata Hedw. – 2, 3, 8x, 9, 11, 12 – siliceous rock, *Quercus* bark.
Trichodon cylindricus (Hedw.) Schimp. – 12 – bank of an artificial lake.
Trichostomum brachydontium Bruch – 4, 5, 6, 7, 12 – siliceous rock.
Trichostomum crispulum Bruch – 6, 11, 12 – siliceous rock.
Weissia brachycarpa (Nees et Hornsch.) Jur. – 3, 12 – siliceous rock.
Weissia controversa Hedw. – 3, 5, 10, 12 – siliceous rock.
Zygodon rupestris Schimp. ex Lorentz – 8x – siliceous rock.

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CHAENOTHECA SPECIES IN THE BAKONY MOUNTAINS AND THE BALATON UPLANDS (HUNGARY)

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Abstract: The occurrences of *Chaenotheca* species in the Bakony Mts and the Balaton Uplands are mostly controlled by exposure, host species, and trunk height. Over the past decade, data on six *Chaenotheca* species (*Ch. chrysocephala*, *Ch. ferruginea*, *Ch. furfuracea*, *Ch. phaeocephala*, *Ch. stemonea*, and *Ch. trichialis*) were accumulated from 28 settlements in the study area. Among them *Chaenotheca chrysocephala* proved to be the most common and most spectacular. All the six lichen species predominantly prefer E, NE, and SE exposure of old oak trees, primarily *Quercus cerris* and *Qu. petraea*, with microhabitats where adequate microclimatic conditions are ensured.

Key words: Balaton Uplands, Bakony Mts, calicioid lichens, *Chaenotheca* species, exposure, height, Hungary, lichen floristics, microhabitat, new occurrences, old trees, pin lichens

INTRODUCTION

Calicioid lichens have ephemeral asci that disintegrate before the ascospores mature, forming a mazaedium (Tibell 1975, 1992, 1999). This group of lichens is often referred to as "pin lichens" because of their small, needle-like fruiting bodies (Paquette *et al.* 2019, Selva 2003). Most of them occur mainly on tree bark and decaying wood. They usually prefer the base of trunks and cracks of rough bark or hanging roots in cavities being protected from rain, as well as decaying wood being hard, acidic, and dry (with low water content) in relatively shady and humid habitats of stable microclimatic conditions, with low atmospheric humidity and diffuse light (Barkman 1958, Holien 1996). Low-light-requiring calicioid lichen species usually prefer deep bark crevices of north exposure, where their occurrence is also limited by the competition with bryophytes and macrolichens (Rydberg 1997, Sinigla and Lőkös 2015). Due to their unique morphology and special habitats, these species have received increasing attention in conservation biology research, particularly because of their role as indicator species (Coppins and Coppins 2002, Selva 2003).

In many countries, the characterisation and evaluation of old-growth forests is also based on calicioid species (Bell-Doyon 2021). Most of them are sensitive to changes in the forest environment, to air pollution and to fire, and generally indicate long-term ecological continuity (Dort and Horvers 2021, Hoffmann and Van Landuyt 1997, Selva 1994, 1996, 2002).

Chaenotheca species are rather tiny lichens that typically colonize decaying wood or bark in old, natural forests (Tibell 1980). The presence of *Chaenotheca* species in a forest is closely related to the forest structure, the proportion of old trees, and the amount of decaying or dead wood, making them excellent bioindicators of natural or semi-natural forest ecosystems (Lõhmus and Lõhmus 2011, Rikkinen 2003).

In Hungary the calicioid lichens and fungi are represented by *ca* 45 species (30 lichen-forming and 15 non-lichenized (parasitic or saprophytic) species). Among them 10 *Chaenotheca* species have been recognised up to now. These calicioid species were studied quite thoroughly in Hungary at the beginning of the last century, but with no records from the Bakony Mts (Szatala 1926, 1927). The first specimen (*Chaenotheca stemonea*) was collected by Ödön Szatala at the Zirc Arboretum (Szatala 1930). Later, the number of records decreased, and only a few occurrences were published from the Bakony Mts (Verseghy 1973).

The recent distribution and ecological role of *Chaenotheca* species in Hungary is relatively poorly known. The species *Chaenotheca phaeocephala*, *C. stemonea*, and *C. trichialis* are most commonly found on trees in Hungarian wooded pastures (Sinigla and Lőkös 2015). *Chaenotheca phaeocephala* occurred in sunnier locations than other species within the genus. In general, south-facing trunks are colonised by more lichen species (Ranius *et al.* 2008).

Our aim was to register as many occurrences of *Chaenotheca* species as possible in the Bakony Mts and in the Balaton Uplands and to study their habitat preferences according to the new collections.

MATERIAL AND METHODS

A total of 107 specimens of six *Chaenotheca* species (*Ch. chrysocephala* (Ach.) Th. Fr. 1860*, Ch. ferruginea* (Turner ex Sm.) Lettau 1912*, Ch. furfuracea* L.) Tibell 1984*, Ch. phaeocephala* (Turner) Th. Fr. 1861*, Ch. stemonea* (Ach.) Müll. Arg. 1862*,* and *Ch. trichialis* (Ach.) Th. Fr. 1860) collected between 2015 and 2024 around 28 settlements in the Bakony Mts and the Balaton Uplands were deposited in the HNHM Bakony Natural History Museum (HNHM-BMCRY). Coordinates of localities were recorded by GPS devices (Garmin eTrex 20, Garmin GPSMAP 65sA) in HD72/EOV (Hungarian Unified National Projection). During the field trips all observed exposures of the given

lichen species on the phorophyte trunks have been registered and included in the habitat analysis. The phytosociological names follow the work of Kevey (2008).

The specimens were examined and identified using standard microscopic techniques (Olympus SZX-7, Olympus CX-41, Nikon 6012867, and Zeiss Amplival). Nomenclature of the lichen species follows Index Fungorum (IFP 2025) and MycoBank (Robert *et al.* 2018).

RESULTS

Altogether 107 specimens of six *Chaenotheca* species (*Ch. chrysocephala*, *Ch. ferruginea*, *Ch. furfuracea*, *Ch. phaeocephala*, *Ch. stemonea*, and *Ch. trichialis*) collected around 28 settlements as new records for the Bakony Mts and the Balaton Uplands in the past decade, were studied in relation to their environmental traits, like exposure, host tree species, and collecting height on the trunks. Specimen information together with differences in habitat and substrate preferences is presented in detail in each species.

Chaenotheca chrysocephala
(Figs 1–2)

The 35 specimens of the conspicuous *Chaenotheca chrysocephala* have mainly been found on *Quercus cerris* trunks (28), but it also occurred on *Alnus glutinosa*, *Qu. petraea*, *Qu. pubescens*, and *Tilia platyphyllos*. They were localized at heights between 40 cm and 200 cm on the tree trunks, mostly on the eastern side (18 specimens) (Fig. 1), but southeastern exposure was also preferred (Fig. 2).

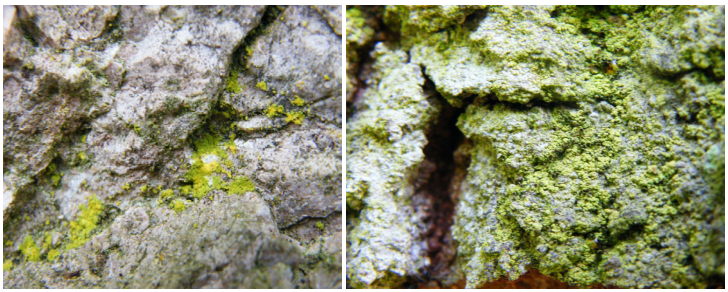

Fig. 1. Conspicuous bright yellow thalli of *Chaenotheca chrysocephala*.

Comit. Győr-Moson-Sopron, in loci “Alsó-Cuha-szurdok”, “Kenyeri-hegy”, prope pag. Bakonyszentlászló, in *Quercetum cerris*, ad corticem *Qu. cerris*. (x-y): 226085-558092, alt. cca. 260 m.s.m. Leg.: Sinigla, M., 12.03.2016 (HNHM-

BMCRY 002334). – Comit. Veszprém , in valle "Hajagos-völgy" prope pag. Balatonszőlős, in cacuminum *Quercetum*, ad corticem *Qu.s cerris,* (x-y): 183534-556310, alt. cca. 323 m.s.m. Leg.: Sinigla, M.,23.04.2015 (HNHM-BMCRY 001556). – Comit. Veszprém, ad margines viam vallis "Malom-völgy", prope

Fig. 2. Proportions of exposures of *Chaenotheca chrysocephala* occurrences.

pag. Felsőörs, ad corticem *Qu. cerris,* (x-y): 187111-565067, alt. cca. 247 m.s.m. Leg.: Sinigla, M.,07.05.2015 (HNHM-BMCRY 001557). – Comit. Veszprém, ad margines viam vallis "Malom-völgy", prope pag. Felsőörs, ad corticem *Qu. cerris,* (x-y): 187001-565232, alt. cca. 230 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 001558). – Comit. Veszprém, in vallem "Malom-völgy", prope pag. Felsőörs, in *Quercetum petraeae-cerridis*, ad corticem *Qu. cerris,* (x-y): 186973-565259, alt. cca. 232 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002119). – Comit Veszprém, in loci "pécselyi Felső-erdő", prope pag. Pécsely, in *Carpinetis Quercetum*, ad corticem *Qu. petraea,* (x-y): 180100-551392, alt. cca. 321 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002120). – Comit. Veszprém, in loci "Felső-erdő", prope pag. Balatonfüred, in *Quercetum petraeae-cerridis*, ad corticem *Qu.s petraea,* (x-y): 559038-184332, alt. cca. 388 m.s.m. Leg.: Sinigla, M., 13.05.2015 (HNHM-BMCRY 002121). – Comit. Veszprém, in cacumine "Koloska-tető", prope opp. Balatonfüred, in *Quercetum cerris pubescentis*, ad corticem *Qu.s cerris,* (x-y): 184012-561300, alt. cca. 262 m.s.m. Leg.: Sinigla, M., 13.05.2015 (HNHM-BMCRY 002122). – Comit. Veszprém, in loci "Koloska-felső", prope opp. Balatonfüred, in *Quercetum petraeae-cerridis*, ad corticem *Qu. cerris,* (x-y): 185064-560983, alt. cca. 291 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002123). – Comit. Veszprém, in

loci "Káptalani-erdő", prope pag. Csopak, in *Quercetum cerris-Pinetum* vallis, ad corticem *Qu. cerris,* (x-y): 185064-560983, alt. cca. 269 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002124). – Comit. Veszprém, in loci "Fajszi-fás-legelő", prope pag. Veszprémfajsz, ad margines viam, in *Quercetum cerris pubescentis*, ad corticem *Qu.s cerris,* (x-y): 185673-562394, alt. cca. 290 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002125). – Comit. Veszprém, in valle "Evetes-völgy" prope pag. Balatonszőlős, in *Quercetum petraeae-Carpinetum*, ad corticem *Qu. petraea,* (x-y): 182547-557967, alt. cca. 264 m.s.m. Leg.: Sinigla, M., 02.06.2015 (HNHM-BMCRY 002126). – Comit. Veszprém, in valle "Evetes-völgy", prope pag. Balatonszőlős, prope rivuli, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 182426-557999, alt. cca. 253 m.s.m. Leg.: Sinigla, M., 02.06.2015 (HNHM-BMCRY 002127). – Comit. Veszprém, in valle "Evetes-völgy", prope pag. Balatonszőlős, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 182222-558080, alt. cca. 258 m.s.m. Leg.: Sinigla, M., 02.06.2015 (HNHM-BMCRY 002128). – Comit. Veszprém, in loci "Halomi-erdő", prope pag. Mencshely, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177766-548355, alt. cca. 267 m.s.m. Leg.: Sinigla, M., 04.06.2015 (HNHM-BMCRY 002129). – Comit. Veszprém, in loci "Koloska-felső", prope opp. Balatonfüred, in *Quercetum petraeae-cerris*, ad corticem *Qu. cerris,* (x-y): 185045-560985, alt. cca. 297 m.s.m. Leg.: Sinigla, M., 05.06.2015 (HNHM-BMCRY 002130). – Comit. Veszprém, in loci "Paloznaki-erdő", prope pag. Paloznak, in *Quercetum petraeae-cerridis*, ad corticem *Quercus cerris,* (x-y): 185439-564553, alt. cca. 267 m.s.m. Leg.: Sinigla, M., 08.06.2015 (HNHM-BMCRY 002131). – Comit. Veszprém, in monte "Paloznaki-hegy", prope pag. Paloznak, in cacumine montis *Quercetum pubescentis*, ad corticem *Qu. pubescens,* (x-y): 183868-565434, alt. cca. 256 m.s.m. Leg.: Sinigla, M., 05.06.2015 (HNHM-BMCRY 002132). – Comit. Veszprém, in loci "Hideg-kúti-séd", prope pag. Balatonszőlős, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 183565-557958, alt. cca. 292 m.s.m. Leg.: Sinigla, M., 25.06.2015 (HNHM-BMCRY 002133). – Comit. Veszprém, in loci "Ragonya", prope pag. Vöröstó, in *Quercetum petraeae*, ad corticem *Qu. pubescens,* (x-y): 180236-549959, alt. cca. 366 m.s.m. Leg.: Sinigla, M., 01.07.2015 (HNHM-BMCRY 002134). – Comit. Veszprém, supra rivuli, in valle "Malom-völgy", prope locum "Kopasz-tető" prope pag. Felsőörs, in saxa Tiliaceum, ad corticem *Qu. cerris,* (x-y): 186547-565721, alt. cca. 240 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002135). – Comit. Veszprém, in valle "Malom-völgy", prope locum "Kopasz-tető" prope pag. Felsőörs, in saxa Tiliaceum, ad corticem *Tilia platyphyllos,* (x-y): 186762-565376, alt. cca. 239 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002136). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in saxa Tiliaceum, ad corticem *Qu. cerris,* (x-y): 186785-565370,

alt. cca. 240 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002137). – Comit. Győr-Moson-Sopron, in loci "ősfenyves", prope pag. Fenyőfő, in *Pineti*, ad corticem *Qu. cerris,* (x-y): 554107-224660, alt. cca. 272 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 003624). – Comit. Zala, in valle "Vári-völgy", prope pag. Vállus, in siccis graminosis, ad corticem *Qu. cerris,* (x-y): 514536-166459, alt. cca. 229 m.s.m. Leg.: Sinigla, M., 16.08.2022 (HNHM-BMCRY 003587). – Comit. Veszprém, in cacumine "Nagy-vár-tető", prope pag. Vászoly, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177219-553190, alt. cca. 298 m.s.m. Leg.: Sinigla, M., 08.07.2015 (BTM 002138). – Comit. Veszprém, in loci "fás legelő, Alsó-erdő", prope pag. Veszprémfajsz, ad corticem *Qu. cerris,* (x-y): 562665-187757, alt. cca. 320 m.s.m. Leg.: Sinigla, M., 28.12.2019 (HNHM-BMCRY 003858). – Comit. Zala, in loci "Tátika", prope pag. Zalaszántó, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 513499-174375, alt. cca. 321 m.s.m. Leg.: Sinigla, M., 17.08.2022 (HNHM-BMCRY 003588). – Comit. Veszprém, in loci "Balázs-tető", prope pag. Dörgicse, in *Quercetum petraeae-cerris*, ad corticem *Qu. cerris,* (x-y): 175248-547248, alt. cca. 296 m.s.m. Leg.: Sinigla, M., 26.06.2015 (HNHM-BMCRY 002139). – Comit. Veszprém, in loci "Megye-hegy", prope opp. Balatonalmádi, in *Carpinetis Quercetum* vallis, ad corticem *Qu. cerris,* (x-y): 192255-571272, alt. cca. 200 m.s.m. Leg.: Sinigla, M., 21.07.2015 (HNHM-BMCRY 002140). – Comit. Veszprém, in valle "Füredi Malom-völgy", prope pag. Balatonszőlős, in *Quercetum petraeae-cerris*, ad corticem *Qu. cerris,* (x-y): 179967-557899, alt. cca. 172 m.s.m. Leg.: Sinigla, M., 07.08.2015 (HNHM-BMCRY 002141). – Comit. Veszprém, in valle "Malom-völgy", prope opp. Balatonfüred, prope rivuli *Carpinetis*, ad corticem *Qu. cerris,* (x-y): 558089-179869, alt. cca. 188 m.s.m. Leg.: Sinigla, M., 07.08.2015 (HNHM-BMCRY 002142). – Comit. Veszprém, in loci "Istvándi-erdő", prope pag. Uzsa, in alnetis, ad corticem *Alnus glutinosa*, (x-y): 518559-175887, alt. cca. 200 m.s.m. Leg.: Sinigla, M., 16.08.2022 (HNHM-BMCRY 003331). – Comit. Veszprém, in loci "fás legelő", prope pag. Veszprémfajsz, ad corticem *Qu. cerris,* (x-y): 562116-186739, alt. cca. 188 m.s.m. Leg.: Sinigla, M., 20.01.2024 (HNHM-BMCRY 003820). – Comit. Veszprém, in loci "fás legelő", prope pag. Veszprémfajsz, ad corticem *Qu. cerris,* (x-y): 563414-185772, alt. cca. 300 m.s.m. Leg.: Sinigla, M., 20.01.2024 (HNHM-BMCRY 003821).

Chaenotheca ferruginea
(Figs 3–4)

The 28 specimens of *Chaenotheca ferruginea* have been found mainly on *Quercus cerris* (16), *Qu. petraea* (5) and *Pinus sylvestris* (6) trunks typically at heights of

100–120 cm mainly in eastern (E) exposure (13 specimens), as well as in south-southeastern (SSE) exposure (9 specimens).

Fig. 3. Dull greenish-yellowish orange thalli of *Chaenotheca ferruginea.*

Comit. Veszprém, in *Quercetum*, prope pag. Bakonyszentkirály, ad corticem *Quercus cerris,* (x-y): 562627-227209, alt. cca. 260 m.s.m. Leg.: Sinigla, M., 10.05.2020 (HNHM-BMCRY 003750). – Comit. Győr-Moson-Sopron, in loci "Alsó-Cuha-szurdok", "Kenyeri-hegy", prope pag. Bakonyszentlászló, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 226085-558092, alt. cca. 260 m.s.m. Leg.: Sinigla, M., 12.03.2016 (HNHM-BMCRY 002335). – Comit. Veszprém, in monte "Megye-hegy", prope opp. Balatonalmádi, in *Carpinetis Quercetum*, ad corticem *Qu. cerris,* (x-y): 192255-571272, alt. cca. 200 m.s.m. Leg.: Sinigla, M., 21.07.2015 (HNHM-BMCRY 002158). – Comit. Veszprém, in monte "Péter-hegy", prope opp. Balatonfüred, in *Carpinetis* fossis, ad corticem *Pinus sylvestris*, (x-y): 182420-562028, alt. cca. 201 m.s.m. Leg.: Sinigla, M., 22.04.2015 (HNHM-BMCRY 002143). – Comit. Veszprém, in valle "Füredi Malom-völgy", prope pag. Balatonszőlős, in *Quercetum petraeae-cerris*, ad corticem *Qu. cerris,* (x-y): 179967-557899, alt. cca. 172 m.s.m. Leg.: Sinigla, M., 07.08.2015 (HNHM-BMCRY 002161). – Comit. Veszprém, in valle "Evetes-völgy" prope pag. Balatonszőlős, in *Carpinetis-Quercetum petraea*, ad corticem *Qu. petraea,* (x-y): 182547-557967, alt. cca. 264 m.s.m. Leg.: Sinigla, M., 02.06.2015 (HNHM-BMCRY 002153). – Comit. Veszprém, in loci "Hidegkúti-séd", prope pag. Balatonszőlős, prope rivuli, in *Carpinetis*, ad corticem *Qu. cerris,* (x-y): 183463-558035, alt. cca. 284 m.s.m. Leg.: Sinigla, M., 04.08.2015

(HNHM-BMCRY 002160). – Comit. Veszprém, in loci "Káptalani-erdő", prope pag. Csopak, in *Carpinetis Quercetum cerris*, ad corticem *Quercus petraea,* (x-y): 185121-562708, alt. cca. 264 m.s.m. Leg.: Sinigla, M., 14.06.2015 (HNHM-BMCRY 002151). – Comit. Veszprém, in cacumine "Balázs-tető", prope pag.

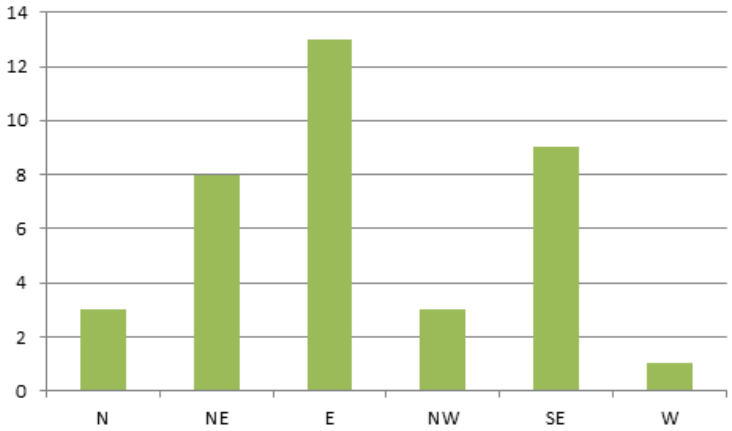

Fig. 4. Proportions of exposures of *Chaenotheca ferruginea* occurrences.

Dörgicse, in *Quercetumpetraeae-cerris*, ad corticem *Qu. petraea,* (x-y): 175103-547516, alt. cca. 321 m.s.m. Leg.: Sinigla, M., 04.06.2015 (HNHM-BMCRY 002154). – Comit. Veszprém, in valle "Horog-völgy", prope pag. Dörgicse, in Pineti, ad corticem *Pinus sylvestris,* (x-y): 174127-552019, alt. cca. 266 m.s.m. Leg.: Sinigla, M., 02.07.2015 (HNHM-BMCRY 002156). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in *Quercetum cerris*, ad corticem *Pinus sylvestris,* (x-y 186930-565259, alt. cca. 226 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002145). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in *Quercetum cerris pubescentis*, ad corticem *Pinus sylvestris,* (x-y 186930-565259, alt. cca. 226 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002146). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in *Quercetum cerris Pinetum*, ad corticem *Pinus sylvestris,* (x-y 565259-186930, alt. cca. 226 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002147). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in *Pinetum*, ad corticem *Qu. cerris,* (x-y 187140-565096, alt. cca. 234 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002979). – Comit. Veszprém, in "Malom-völgy", prope pag. Felsőörs, in *Quercetum cerris pubescentis*, ad corticem *Pinus sylvestris,* (x-y 565294-186872, alt. cca. 255 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002157). – Comit. Győr-Moson-Sopron, in loci "ősfenyves", prope pag. Fenyőfő, in *Pineti*, ad corticem *Qu. cerris,* (x-y 553771-225226)

alt. cca. 261 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 003625). – Comit. Veszprém, in loci "Zádor-vár", prope pag. Pécsely, prope murus arcis, ad corticem *Qu. cerris,* (x-y 181783-552960, alt. cca. 328 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 001559). – Comit. Veszprém, in loci "Zádor-vár", prope pag. Pécsely, prope murus arcis, ad corticem *Qu. petraea,* (x-y: 181783-552960, alt. cca. 328 m.s.m. Leg.: Sinigla, M., 05.05.2015 (HNHM-BMCRY 002144). – Comit. Veszprém, in loci "Zádor-vár", prope pag. Pécsely, in valle *Faginetis*, ad corticem *Qu. cerris,* (x-y 181864-552944) alt. cca. 286 m.s.m. Leg.: Sinigla, M., 22.07.2015 (HNHM-BMCRY 002159). – Comit. Veszprém, in monte "Sátorma-hegy", prope pag. Szentbékkálla, in *Quercetum petraeae-cerridis*, ad corticem *Qu. petraea,* (x-y): 173875-535346, alt. cca. 321 m.s.m. Leg.: Sinigla, M., 17.05.2016 (HNHM-BMCRY 002573). – Comit. Veszprém, in loci "Öreg-Futóné", prope pag. Tés, in saxis Tiliaceum, ad cortex *Tilia,* (x-y): 574216-209350, alt. cca. 482 m.s.m. Leg.: Sinigla, M., 13.03.2021 (HNHM-BMCRY 003388). – Comit. Veszprém, in cacumine "Nagy-vár-tető", prope pag. Vászoly, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177245-553054) alt. cca. 283 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 001560). – Comit. Veszprém, in cacumine "Nagy-vár-tető", prope pag. Vászoly, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177245-553054) alt. cca. 283 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002148). – Comit. Veszprém, in *Quercetum cerris pubescentis*, loci "Nagy-vár-tető", prope pag. Vászoly, ad corticem *Qu. cerris,* (x-y): 177203-553068 alt. cca. 286 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002149). – Comit. Veszprém, in loci "Fajszi-fás-legelő", prope pag. Veszprémfajsz, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 185702-562092) alt. cca. 287 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002152). – Comit. Veszprém, in loci "Fajszi-fás-legelő", prope pag. Veszprémfajsz, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 186276-561848) alt. cca. 298 m.s.m. Leg.: Sinigla, M., 07.05.2015 (HNHM-BMCRY 002155). – Comit. Veszprém, in loci "Nagy-vár-tető", prope pag. Vászoly, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 562116-186739, alt. cca. 286 m.s.m. Leg.: Sinigla, M., 20.01.2024 (HNHM-BMCRY 003822). – Comit Veszprém, in loci "Vöröstói fás legelő", prope pag. Vöröstó, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 181072-556122) alt. cca. 344 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002150).

Chaenotheca furfuracea
(Figs 5–6)

Only three occurrences have been detected on rather old *Pinus sylvestris* and *Tilia platyphyllos* trunks at eastern (E) and northeastern (NE) exposures at the base of the trunks, as well as on the soil.

Fig. 5. Dull greenish-yellowish thalli of *Chaenotheca furfuracea.*

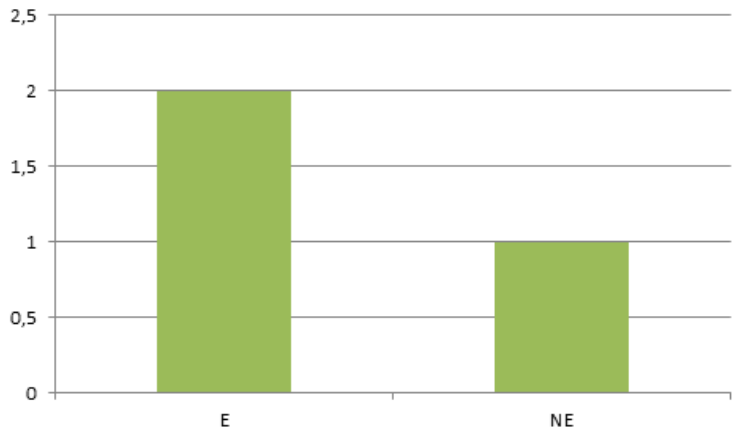

Fig. 6. Proportions of exposures of *Chaenotheca furfuracea* occurrences.

Comit. Veszprém, supra Bittva, prope pag. Farkasgyepű, in *Faginetis*, ad terram, (x-y): 206282-540902, alt. cca. 315 m.s.m. Leg.: Sinigla, M., 05.10.2018 (HNHM-BMCRY 002922). – Comit. Veszprém, in cacumine "Kopasztető", prope pag. Felsőörs, in saxa Tiliaceum, ad corticem *Tilia platyphyllos,* (x-y): 565778-186537, alt. cca. 232 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002167). – Comit. Győr-Moson-Sopron, in loci "Hangos-Fenyves", prope pag. Fenyőfő, in arenosis sylvestris, ad corticem *Pinus sylvestris,*

(x-y): 225199-553923, alt. cca. 271 m.s.m. Leg.: Sinigla, M., 26.07.2016 (HNHM-BMCRY 003033).

Chaenotheca phaeocephala
(Figs 7–8)

Altogether 16 occurrences have been recorded from *Pyrus pyraster* (2), *Quercus cerris* (5), *Qu. petraea* (5), and *Qu. pubescens* (4) trunks up to a height of 180 cm. Most of the specimens (10) have been located in E exposure, while 4 specimens were in SE exposure (mainly on *Quercus petraea* trunks).

Fig. 7. Inconspicuous thalli of *Chaenotheca phaeocephala*.

Fig. 8. Proportions of exposures of *Chaenotheca phaeocephala* occurrences.

Comit. Veszprém, in loci "Káptalani-erdő", prope pag. Csopak, in *Quercetum cerris-Pinetum*, ad corticem *Quercus cerris,* (x-y): 185135-562716, alt. cca. 269 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002173). – Comit. Veszprém, in monte "Bádi-hegy", prope pag. Óbudavár, ad margines viam, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177522-546625,

alt. cca. 266 m.s.m. Leg.: Sinigla, M., 26.06.2015 (HNHM-BMCRY 002175). – Comit. Veszprém, in monte "Bádi-hegy", prope pag. Óbudavár, ad margines viam, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 177522-546625, alt. cca. 266 m.s.m. Leg.: Sinigla, M., 26.06.2015 (HNHM-BMCRY 002176). – Comit. Veszprém, in monte "Csengő-hegy", prope pag. Olaszfalu-Alsópere, in saxis *Quercetum*, ad corticem *Qu.s cerris,* (x-y): 568791-211617, alt. cca. 470 m.s.m. Leg.: Sinigla, M., 07.11.2021 (HNHM-BMCRY 003389). – Comit. Veszprém, in monte "Csengő-hegy", prope pag. Olaszfalu-Alsópere, in *Quercetum*, ad corticem *Qu. petraea,* (x-y): 569740-210580, alt. cca. 409 m.s.m. Leg.: Sinigla, M., 07.01.2023 (HNHM-BMCRY 003645). – Comit. Veszprém, in "Örvényesi-fás-legelő", prope pag. Örvényes, in fruticetis, ad corticem *Qu. pubescens,* (x-y): 555094-176225, alt. cca. 166 m.s.m. Leg.: Sinigla, M., 30.06.2015 (HNHM-BMCRY 002177). – Comit. Zala, in loci "Rezi-vár", prope pag. Rezi, in *Quercetum pubescentis*, ad corticem *Qu. pubescens,* (x-y): 512299-170552, alt. cca. 422 m.s.m. Leg.: Sinigla, M., 30.06.2015 (HNHM-BMCRY 003213). – Comit. Zala, in loci "Büdös-kút", prope pag. Vállus, in pascuis, ad corticem *Pyrus pyraster,* (x-y): 518504-164464, alt. cca. 348 m.s.m. Leg.: Sinigla, M., 07.06.2022 (HNHM-BMCRY 003423). – Comit. Zala, in loci "Büdöskút", prope pag. Vállus, in *Quercetum cerris pubescentis*, ad corticem *Pyrus pyraster,* (x-y): 518545-164408, alt. cca. 348 m.s.m. Leg.: Sinigla, M., 16.08.2022 (HNHM-BMCRY 003589). – Comit. Veszprém, in loci "Fajszi-erdő", prope pag. Veszprémfajsz, ad margines viam, in *Quercetum cerris pubescentis*, ad corticem *Qu. pubescens,* (x-y): 185755-562497, alt. cca. 287 m.s.m. Leg.: Sinigla, M., 14.04.2015 (HNHM-BMCRY 002168). – Comit. Veszprém, in loci "Fajszi-erdő" prope pag. Veszprémfajsz, ad viam antiquus pascuis *Quercetum cerris*, ad corticem *Qu.s pubescens,* (x-y): 185755-562501, alt. cca. 283 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002174). – Comit. Veszprém, in loci "Vöröstói fás legelő (Lapály-dűlő)", prope pag. Vöröstó, in *Quercetum cerris pubescentis*, ad corticem *Qu.s petraea,* (x-y): 181072-550160, alt. cca. 349 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002169). – Comit. Veszprém, in loci "Vöröstói fás legelő (Lapály-dűlő)", prope pag. Vöröstó, in *Quercetum cerris pubescentis*, ad corticem *Qu. petraea,* (x-y): 181072-550160, alt. cca. 349 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002170). – Comit. Veszprém, in loci "Vöröstói fás legelő", prope pag. Vöröstó, in *Quercetum petraeae-cerridis*, ad corticem *Qu. petraea,* (x-y): 550160-181072, alt. cca. 349 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002171). – Comit. Veszprém, in loci "Vöröstói fás legelő", prope pag. Vöröstó, in *Quercetum petraeae-cerris*, ad corticem *Qu. petraea,* (x-y): 550160-181072, alt. cca. 349 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002172). – Comit. Veszprém, in loci "Vöröstói fás legelő (Lapály-dűlő)", prope pag. Vöröstó, in *Aceretum*, ad

corticem *Qu. cerris,* (x-y): 181111-550141, alt. cca. 348 m.s.m. Leg.: Sinigla, M., 01.07.2015 (HNHM-BMCRY 002178).

Chaenotheca stemonea
(Figs 9–10)

The 14 specimens have been found on nine host tree species (*Pinus sylvestris*, *Pyrus pyraster*, *Quercus cerris*, *Qu. petraea*, *Qu. pubescens*, *Robinia pseudoacacia*, *Salix alba*, *S. fragilis*, and *Tilia cordata*), occasionally also on decaying wood. The specimens have been collected in eastern (E), northern (N), and northeastern (NE) exposures of the tree trunks at height of around 180 cm.

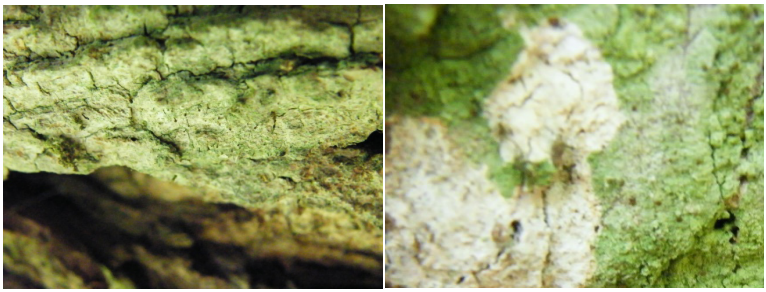

Fig. 9. Greenish leprarioid thalli of *Chaenotheca stemonea*.

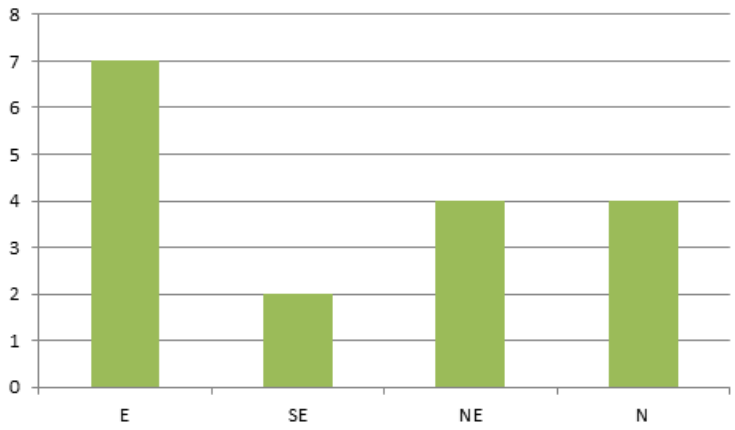

Fig. 10. Proportions of exposures of *Chaenotheca stemonea* occurrences.

Comit. Veszprém, supra "Koloska-forrás", in cacumine "Koloska-tető", prope opp. Balatonfüred, in saxa *Quercetum cerris*, ad corticem *Pinus sylvestris,*

(x-y): 183594-561606, alt. cca. 269 m.s.m. Leg.: Sinigla, M., 03.07.2015 (HNHM-BMCRY 002180). – Comit. Veszprém, supra vallem "Koloska-völgy", in cacumine "Koloska-tető", prope opp. Balatonfüred, ad saxa dolomit., in *Quercetum petraeae-cerridis*, ad corticem *Qu. pubescens,* (x-y): 183682-561468, alt. cca. 271 m.s.m. Leg.: Sinigla, M., 03.07.2015 (HNHM-BMCRY 002184). – Comit. Veszprém, supra vallem "Koloska-völgy", in cacumine "Koloska-tető", prope opp. Balatonfüred, ad saxa dolomit., in *Quercetum petraeae-cerridis*, ad corticem *Pinus sylvestris,* (x-y): 183594-561606, alt. cca. 269 m.s.m. Leg.: Sinigla, M., 03.07.2015 (HNHM-BMCRY 002185). – Comit. Veszprém, in loci "Hideg-Kúti-Séd", prope pag. Balatonszőlős, in *Salicetum*, ad corticem *Salix alba,* (x-y): 183594-561606, alt. cca. 279 m.s.m. Leg.: Sinigla, M., 23.04.2015 (HNHM-BMCRY 002948). – Comit. Veszprém, in valle Evetes-völgy". Balatonszőlős, in *Quercetum Carpinetis*, ad corticem *Robinia pseudoacacia,* (x-y): 182424-558012, alt. cca. 258 m.s.m. Leg.: Sinigla, M., 25.06.2015 (HNHM-BMCRY 002181). – Comit. Veszprém, in loci "Káptalani-erdő" prope pag. Csopak, in cacumine *Quercetum*, ad corticem *Qu. cerris,* (x-y): 185269-562618, alt. cca. 276 m.s.m. Leg.: Sinigla, M., 08.06.2015 (HNHM-BMCRY 002182). – Comit. Veszprém, in cacumine "Kopasz-tető", prope pag. Felsőörs, in *Quercetum Carpinetis*, ad corticem *Qu. cerris,* (x-y): 186436-565950, alt. cca. 214 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002186). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in saxa Tiliaceum, ad corticem lignum, (x-y): 186718-565406, alt. cca. 248 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002187). – Comit. Veszprém, in valle "Király-kúti-völgy", prope pag. Lovas, in *Carpinetis* vallis, ad corticem *Quercus cerris,* (x-y): 186031-565280, alt. cca. 244 m.s.m. Leg.: Sinigla, M., 10.05.2015 (HNHM-BMCRY 002183). – Comit. Veszprém, ad viam lacum, prope "Séd", prope pag. Márkó, ad corticem *Tilia cordata,* (x-y): 197056-557066, alt. cca. 262 m.s.m. Leg.: Sinigla, M., 25.09.2018 (HNHM-BMCRY 002828). – Comit. Zala, in loci "Büdöskút", prope pag. Vállus, in *Quercetum cerris pubescentis*, ad corticem *Pyrus pyraster,* (x-y): 518545-164408, alt. cca. 348 m.s.m. Leg.: Sinigla, M., 16.08.2022 (HNHM-BMCRY 003590). – Comit. Veszprém, in cacumine "Nagy-vár-tető", prope pag. Vászoly, in *Faginetis*, ad corticem *Salix fragilis,* (x-y): 177432-553149, alt. cca. 231 m.s.m. Leg.: Sinigla, M., 22.07.2015 (HNHM-BMCRY 002188). – Comit. Veszprém, in loci "Vöröstói fás legelő", prope pag. Vöröstó, in *Quercetum petraeae-cerridis*, ad corticem *Qu. petraea,* (x-y): 550085-180994, alt. cca. 350 m.s.m. Leg.: Sinigla, M., 01.07.2015 (HNHM-BMCRY 002179). – Comit. Zala, in loci "Tátika", prope pag. Zalaszántó, in saxis Tiliaceum, ad corticem *Tilia cordata,* (x-y): 513325-175342, alt. cca. 312 m.s.m. Leg.: Sinigla, M., 17.08.2022 (HNHM-BMCRY 003332).

Chaenotheca trichialis
(Figs 11–12)

A total of 11 occurrences have been detected on six host tree species (*Quercus cerris*, *Qu. petraea*, *Robinia pseudoacacia*, *Tilia cordata*, *T. platyphyllos*, and *Ulmus laevigata*). Northeastern (NE) (5) and eastern (E) (4) exposures have been dominant, in most cases at heights between 100 and 160 cm.

Fig. 11. Inconspicuous greyish-greenish thalli of *Chaenotheca trichialis*.

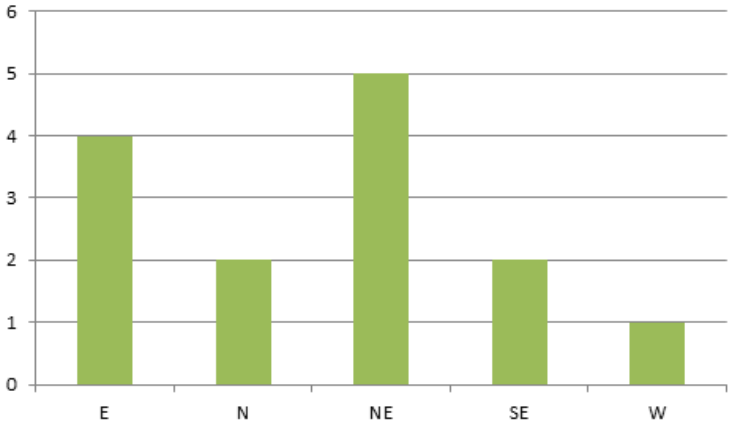

Fig. 12. Proportions of exposures of *Chaenotheca trichialis* occurrences.

Comit. Veszprém, in loci "Káptalani-erdő", prope opp. Csopak, in *Quercetum*, ad corticem *Quercus cerris,* (x-y): 185135-562716, alt. cca. 269 m.s.m. Leg.: Sinigla, M., 14.05.2015 (HNHM-BMCRY 002949). – Comit. Veszprém, in monte "Tobán-hegy", prope pag. Eplény, in saxis *Quercus pubescentis*, ad corticem *Tilia cordata*, (x-y): 566965-207008, alt. cca. 378 m.s.m. Leg.: Sinigla, M., 28.03.2016 (HNHM-BMCRY 003390). – Comit. Veszprém, in loci "Vöröstói fás legelő", prope pag. Vöröstó,

in *Quercetum petraeae-cerridis*, ad corticem *Qu. petraea*, (x-y): 180950-550043, alt. cca. 340 m.s.m. Leg.: Sinigla, M., 12.05.2015 (HNHM-BMCRY 002162). – Comit. Veszprém, in loci "Hideg-kúti-séd", prope pag. Balatonszőlős, prope rivuli, in *Aceretum*, ad corticem *Robinia pseudoacacia,* (x-y): 183482-558029, alt. cca. 286 m.s.m. Leg.: Sinigla, M., 25.06.2015 (HNHM-BMCRY 002163). – Comit. Veszprém, in cacumine "Kopasz-tető", prope pag. Felsőörs, in *Quercetum pubescentis*, ad corticem *Tilia platyphyllos*, (x-y): 186537-565778, alt. cca. 232 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002164). – Comit. Veszprém, in valle "Malom-völgy", prope locum "Kopasz-tető" prope pag. Felsőörs, in saxa Tiliaceum, supra rivuli, ad corticem *Tilia platyphyllos*, (x-y): 186507-565813, alt. cca. 231 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002165). – Comit. Veszprém, in valle "Malom-völgy", prope pag. Felsőörs, in *Quercetum cerris pubescentis*, ad corticem *Qu. cerris,* (x-y): 186781-565380, alt. cca. 234 m.s.m. Leg.: Sinigla, M., 06.07.2015 (HNHM-BMCRY 002166). – Comit. Veszprém, prope "Séd", prope pag. Márkó, ad viam lacum, ad corticem *Tilia cordata,* (x-y): 197056-557066, alt. cca. 262 m.s.m. Leg.: Sinigla, M., 25.09.2018 (HNHM-BMCRY 002829). – Comit. Veszprém, prope "Séd", prope pag. Márkó, ad viam lacum, ad corticem *Ulmus laevigata,* (x-y): 97056-557066, alt. cca. 262 m.s.m. Leg.: Sinigla, M., 25.09.2018 (HNHM-BMCRY 002830). – Comit. Zala, in loci "Rezi-vár", prope pag. Rezi, in saxa sylvis, ad corticem *Qu. petraea,* (x-y): 512299-170552, alt. cca. 422 m.s.m. Leg.: Sinigla, M., 17.08.2022 (HNHM-BMCRY 003492). – Comit. Veszprém, in monte "Sátorma-hegy", prope pag. Szentbékkálla, in *Quercetum petraeae-cerridis*, corticem *Q. petraea,* (x-y): 174010-535140, alt. cca. 274 m.s.m. Leg.: Sinigla, M., 17.05.2016 (HNHM-BMCRY 002567).

DISCUSSION

In the last decades, habitats and the species composition have changed here significantly as a result of shading (shrub encroachment, afforestation). Generally, the number of species decreased with the shading of trees and shrubs growing around old oaks, which can be explained by moderate or weak wind movement and by competition with bryophytes. On the other hand, these changes favoured and enhanced the appearance of those species that prefer shady, moist, deep bark crevices and cooler microhabitats (Sinigla and Lőkös 2015), like in the case of *Chaenotheca trichialis* and *C. stemonea*, also discussed by previous studies (Ranius *et al.* 2008). Diaspores of these species are continuously washed away by rainwater in these deep bark crevices, favouring their spread also by ants marching primarily in deeper crevices (Paltto *et al.* 2011).

A total of 107 occurrences of six *Chaenotheca* species (*Ch. chrysocephala*, *Ch. ferruginea*, *Ch. furfuracea*, *Ch. phaeocephala*, *Ch. stemonea*, and *Ch. trichialis*) registered around 28 settlements in the Bakony Mts and the Balaton Uplands (Fig. 13) in the past decade proved to be influenced mainly by exposure, host tree species, and collecting height on the trunks.

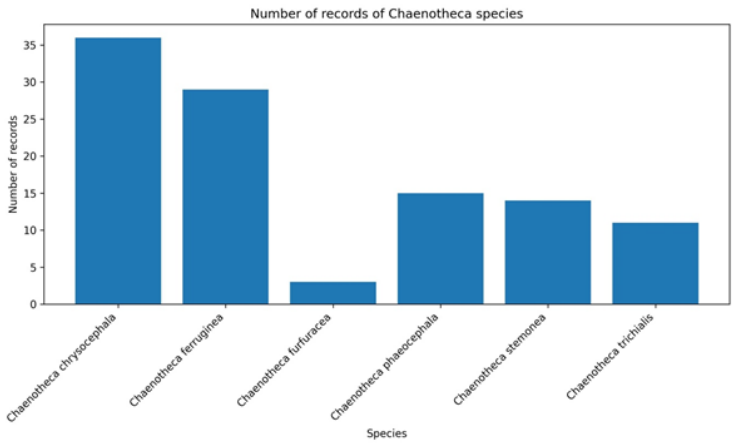

Fig. 13. Abundance of *Chaenotheca* species in the Bakony Mts and the Balaton Uplands.

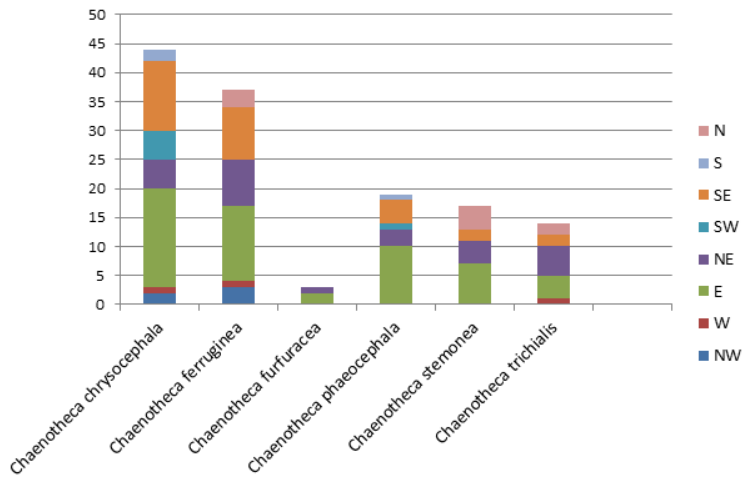

Fig. 14. Favoured exposures for the studied *Chaenotheca* species.

Chaenotheca chrysocephala (35 localities) and *Ch. ferruginea* (28 localities) have been the most frequent of the six species. In the studied area the eastern side of the trunks is clearly favourable for all species, however *Chaenotheca ferruginea*

and *Ch. phaeocephala* also prefer SW exposure, *Ch. stemonea* and *Ch. trichialis* N/NE exposures (Fig. 14).

Host tree biodiversity has been quite high, altogether 12 phorophytes (*Alnus glutinosa*, *Pinus sylvestris*, *Pyrus pyraster*, *Quercus cerris*, *Qu. petraea*, *Qu. pubescens*, *Robinia pseudoacacia*, *Salix alba*, *S. fragilis*, *Tilia cordata*, *T. platyphyllos*, and *Ulmus laevigata*) have been identified. Old oak trees, with their microhabitats of adequate microclimatic conditions, served as the most suitable hosts for the *Chaenotheca* species, i.e. *Quercus cerris* (5 species), *Qu. petraea* (5 species), and *Qu. pubescens* (4 species). The highest number of phorophytes has been colonised by *Chaenotheca stemonea* (9 species) and *Ch. trichialis* (6 species).

Chaenotheca furfuracea is predominantly located at the lowest parts of the trunks (0–50 cm), *Ch. ferruginea* and *Ch. trichialis* at middle range (100–150 cm), while *Ch. chrysocephala*, *Ch. phaeocephala*, and *Ch. stemonea* can spread between 30 and 200 cm.

* * *

Összefoglaló: A *Chaenotheca* fajok előfordulását a Bakony hegységben és a Balaton-felvidéken elsősorban az égtáj, a fafaj és a fatörzseken elfoglalt vertikális pozíció befolyásolják. Az utóbbi évtizedben hat *Chaenotheca* faj (*Ch. chrysocephala*, *Ch. ferruginea*, *Ch. furfuracea*, *Ch. phaeocephala*, *Ch. stemonea*, and *Ch. trichialis*) adatait sikerült begyűjteni a tanulmányozott terület 28 településének környékéről. Ezek között a leggyakoribb faj a *Chaenotheca chrysocephala* volt. Mind a hat zuzmófaj az idős tölgyek, elsősorban *Quercus cerris* és *Qu. petraea*, keleti, északkeleti és délkeleti kitettségű részeit preferálja, ahol az élőhely megfelelő mikroklímája biztosított.

REFERENCES

Barkman, J. J. (1958): *Phytosociology and ecology of cryptogamic epiphytes*. – Koninklijke Van Gorcum B.V., Assen. 628 pp. + 628, maps 49, tables 71, photographs 16.

Bell-Doyon, P., Selva, S. B. and McMullin, R. T. (2021): Calicioid fungi and lichens from an unprotected intact forest ecosystem in Québec. – *Écoscience* **28**(2): 127–136. https://doi.org/10.1080/11956860.2021.1885804

Coppins, B. J. and Coppins, A. M. (2002): *Indications of ecological continuity: lichens and bryophytes*. – British Lichen Society, London.

Dort, K. van and Horvers, B. (2021): *Coniocarps. Rain shadow specialists*. – KNNV-Afdeling, Tilburg, ISBN 978-90-8261-57-4-6, 192pp

Hoffmann, M. and Van Landuyt, W. (1997): Lichenized Caliciales with stalked apothecia in Flanders (northern Belgium): rare or poorly known? – *Belgian J. Bot.* **130**(1): 25–37.

Holien, H. (1996): Influence of site and stand factors on the distribution of crustose lichens of the Caliciales in a suboceanic spruce forest area in central Norway. – *Lichenologist* **28**(4): 315–330. https://doi.org/10.1006/lich.1996.0029

IFP (Index Fungorum Partnership) (2025): *Index Fungorum*. – http://www.indexfungorum.org [accessed on 2 June 2025]

Kevey B. (2008): *Magyarország erdőtársulásai*. [Forest associations of Hungary] – *Tilia* **14**: 1–488, Lővérprint, Sopron, ISBN – 978-963-9883-22-2

Lõhmus, P. and Lõhmus, A. (2011): Old-growth indicator species and their habitat preferences in boreal forests in Estonia. – *Ann. Zool. Fenn.* **48**(1): 1–18. https://doi.org/10.5735/086.048.0101

Paltto, H., Nordberg, A., Nordén, B. and Snäll, T. (2011): Development of secondary woodland in oak wood pastures reduces the richness of rare epiphytic lichens. – *PLoS ONE* **6**(9): e24675. https://doi.org/10.1371/journal.pone.0024675

Paquette, A. H., Miltenburg van, B. N., Selva, B. S. and McMullin, T. (2019): The Calicioids of Forillon National Park, Quebec, Canada – *Opusc. Philolich.* **18**: 58–73. https://doi.org/10.5962/p.388260

Ranius, T., Johansson, P., Berg, N. and Niklasson, M. (2008): The influence of tree age and microhabitat quality on the occurrence of crustose lichens associated with old oaks. – *J. Veg. Sci.* **19**: 653–662. https://doi.org/10.3170/2008-8-18433

Rikkinen, J. (2003): Calicioid lichens and fungi in the boreal zone and at the forest limit in northern Fennoscandia. – *Acta Bot. Fenn.* **175**: 1–41.

Robert, V., Stalpers, J. and Stegehuis, G. (2018): *MycoBank, the fungal website*. – http://www.mycobank.org/DefaultPage.aspx [accessed on 2 June 2025]

Rydberg, H. (1997): Caliciales lichens on old oaks in Södermanland. – *Svensk Bot. Tidskr.* **91**: 39–57.

Selva, S. B. (1994): Lichen diversity and stand continuity in the northern hardwoods and spruce-fir forests of northern New England and western New Brunswick. – *The Bryologist* **94**: 424–428. https://doi.org/10.2307/3243911

Selva, S. B. (1996): *Using lichens to assess ecological continuity in northeastern forests*. – In: Davis, M. B. (ed.): Eastern old-growth forests. Island Press, Washington, DC, USA, pp. 35–48.

Selva, S. B. (2002): *Indicator species – restricted taxa approach in coniferous and hardwood forests of northeastern America*. – In: Nimis, P. L., Scheidegger, C. and Wolseley, P. (eds): Monitoring lichens. Kluwer, NATO Science Series, Earth and Environmental Sciences, Ser. **7**: 349–357.

Selva, S. B. (2003): Using calicioid lichens and fungi to assess ecological continuity in the Acadian forest ecoregion of the Canadian Maritimes. – *Forestry Chronicle* **79**(3): 550–558. https://doi.org/10.5558/tfc79550-3

Sinigla, M. and Lőkös, L. (2015): *Az örvényesi és a vöröstói fás legelő idős tölgyein előforduló zuzmófajok összehasonlítása*. [The comparison of lichen species colonising old oaks in the Örvényesi and Vöröstói wooded pastures]. – *In*: Szűcs, P. and Kónya, E. (eds): III. Aktuális eredmények a kriptogám növények kutatásában. Eszterházy Károly Főiskola, Eger, p. 46.

Szatala, Ö. (1926): A magyarországi Coniocarpeae-k kritikai feldolgozása. (Revisio critica Coniocarpinearum Hungariae). – *Ann. Mus. Nat. Hung.* **24**: 99–135.

Szatala, Ö. (1927): Lichenes Hungariae. Magyarország zuzmóflórája. I. Pyrenocarpeae – Gymnocarpeae (Coniocarpineae). – *Folia Cryptog.* **1**(5): 337–434.

Szatala, Ö. (1930): Adatok Magyarország zuzmóflórájának ismeretéhez. IV. [Data on the lichen flora of Hungary]. – *Magyar Bot. Lapok* **28**: 68–99.

Tibell, L. (1975): The caliciales of boreal North America. – *Symb. Bot. Upsal.* **21**(2): 1–128.

Tibell, L. (1980): The lichen genus *Chaenotheca* in the northern hemisphere. – *Symb. Bot. Upsal.* **23**(1): 1–65.

Tibell, L. (1992): Crustose lichens as indicators of forest continuity in boreal coniferous forests. – *Nord. J. Bot.* **12**: 427–450. https://doi.org/10.1111/j.1756-1051.1992.tb01325.x

Tibell, L., (1999): *Calicioid lichens and fungi*. – *In*: Ahti, T., Jørgensen, P. M., Kristiansson, H., Moberg, R., Søchting, U. and Thor, G. (eds): Nordic Lichen Flora, 1. Bohuslän '5, Uddevalla, pp. 20–94.

Verseghy, K. (1973): Az Északi- és a Keleti-Bakony zuzmóvegetációja. [The lichen vegetation of the northern and eastern Bakony Mts]. – *A Veszprém Megy. Múz. Közlem.* **12**: 169–181.

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THE IMPACT OF ACADEMIC EXCHANGE PROGRAMS ON RESEARCH AND COLLECTION DEVELOPMENT IN THE HNHM BRYOPHYTE COLLECTION

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Abstract: The paper summarises the results of the author's twenty-eight trips, carried out with the help of exchange programs and thematic research programs between academies. The Bryophyte Collection of the Hungarian Natural History Museum (HNHM) was enriched with about 2,500 Asian and nearly 4,000 Balkan bryophyte specimens. Conference participations of the early trips were important in shaping scientific careers and building relationships between colleagues, and also profoundly influenced the development of the HNHM Bryophyte Collection. Several foreign colleagues visited the HNHM within the framework of exchange programs and carried out taxonomic revisions, which also increased the value of the collection. The 27 published articles and 22 conference abstracts also prove the success of the trips and the inter-academic scientific programs.

Key words: bryophyte specimens, collecting trips, international relations, joint research

INTRODUCTION

The Hungarian Natural History Museum participated in inter-academic exchange programs and thematic research programs primarily as expedition opportunities to collect scientific material serving as the basis for scientific work. Thanks to the support of the Hungarian Academy of Sciences, these collecting trips yielded a huge amount of zoological and botanical material deposited in the collections of the Museum (Mészáros & Zombori 1995, Mahunka *et al.* 2002, Papp *et al.* 2002a, Papp 2013, Csorba *et al.* 2004, 2006). The author has been working for the Hungarian Natural History Museum since 1989, immediately after graduating from university and then became the curator of the Bryophyte Collection in 1990. Her professional career was intertwined with the Bryophyte Collection, and the research conducted in the collection is practically the imprint of her scientific career. In this paper, she summarizes

the importance of exchange programs between academies, which directly or indirectly influenced the development of the Bryophyte Collection of HNHM (Herbarium BP).

MATERIAL AND METHODS

The author's trips, which will be presented in detail, can be found in Tab. 1.

Table 1. The author's trips are listed in chronological order with the hosts and projects.

Year	Host academy	Host institute	Project
1990	Ukrainian Academy of Sciences	Institute of Botany of UAS	visit the Institute of Botany of UAS, Kyiv
1991	Armenian Academy of Sciences	Institute of Botany of AAS	collecting trip in Armenia
1993	Spanish National Research Council (CSIC)	Autonomous University of Barcelona; Complutense University of Madrid; University of León	The role of bryophytes as bioindicators of water quality in running water
1994	National Academy of Sciences of the Democratic People's Republic of Korea		collecting trip in North Korea
1994	Bulgarian Academy of Sciences	Institute of Botany of BAS	The role of bryophytes as bioindicators of water quality in running water
1995	Bulgarian Academy of Sciences	Institute of Botany of BAS	The role of bryophytes as bioindicators of water quality in running water
1996	Bulgarian Academy of Sciences	Institute of Botany of BAS	The role of bryophytes as bioindicators of water quality in running water
1997	Chinese Academy of Sciences	Institute of Botany of CAS	Conference of the International Association of Bryologists, Beijing and a collecting trip
1997	Vietnam Academy of Science and Technology	Institute of Ecology and Biological Resources	visit the Institute in Hanoi and a collecting trip

Year	Host academy	Host institute	Project
1998	Norwegian Academy of Science	Norwegian University of Science and Technology	3rd Conference of the European Committee for the Conservation of Bryophytes
1999	Chinese Academy of Sciences	Institute of Botany of CAS; Shenyang University	collecting trip in China
2002	Indian National Science Academy	National Botanical Research Institute (NBRI), Lucknow	Conference of the International Association of Bryologists
2002	Korean Academy of Science and Technology	Kangwon National University, Chuncheon	First KAST/HAS Bilateral Symposium on Biodiversity Research in the Korean Peninsula
2005	Korean Academy of Science and Technology	Sunchon National University	collecting trip in South Korea
2005	Chinese Academy of Sciences	Nanjing Normal University	International Bryological Symposium for Prof. Pan-Chieh Chen's Centennial Birthday and a collecting trip
2006	Bulgarian Academy of Sciences	Institute of Botany of BAS	4th Balkan Botanical Congress, Sofia and a collecting trip
2006	Chinese Academy of Sciences	Institute of Botany of CAS	collecting trip in China
2007	Korean Academy of Science and Technology	Sunchon National University	collecting trip in South Korea
2007	Bulgarian Academy of Sciences	Institute of Botany of BAS	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2008	Bulgarian Academy of Sciences	Institute of Botany of BAS	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2009	Bulgarian Academy of Sciences	Institute of Botany of BAS	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species

Year	Host academy	Host institute	Project
2009	Serbian Academy of Sciences and Arts	Faculty of Biology, University of Belgrade	5th Balkan Botanical Congress, Belgrade
2010	Serbian Academy of Sciences and Arts	Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2011	Serbian Academy of Sciences and Arts	Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2012	Serbian Academy of Sciences and Arts	Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2013 two trips	Serbian Academy of Sciences and Arts	Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade	Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species
2019	Bulgarian Academy of Sciences	Institute of Biodiversity and Ecosystem Research of BAS	Metallophilic cryptogams - a little-known but high conservation value group

RESULTS AND DISCUSSION

First trips

The story begins in 1990, when the author travelled to Lapland, the Kola Peninsula, with Miklós Rajczy, a bryologist working at the museum, for the 7th Meeting of the Central and East European Bryological Working Group. This was the author's first foreign conference, which is a starting point in the life of any researcher, and of course had a great impact on her work. In addition to numerous foreign colleagues, she also met with bryologists from Eger, Hungary, who

said that they were able to attend the conference through an exchange program between the Hungarian and Russian academies; this covered their travel and stay. The author was very interested in this opportunity, and right at the conference, she and Miklós Rajczy began planning their trip for next year, which was a collecting trip to Armenia. The plan seemed even more feasible, because the Armenian bryologist, Vrez Manakyan, was also present at the conference, and he approved the plan and assured them of his willingness to receive them. But first, still in the same year, in September 1990, the author visited with Miklós Rajczy and Éva Ács (algologist at that time at the HNHM) the Institute of Botany in Kyiv (Ukraine) through an inter-academic exchange program. Here she was able to gain insight into the taxonomic work of Vitalij Virchenko, bryologist, who was working at that time on the *Bryum erythrocarpum* complex (rhizoid gemmae bearing *Bryum* species). She also had the opportunity to become familiar with the herbarium work processes and management of another institute. Then, in June 1991, a two-week collecting trip to Armenia was realised through an exchange program between academies. Despite the political problems, shortage of gasoline and curfew at that time, the Armenian colleagues at the Institute of Botany of the Armenian Academy of Sciences did everything to make this trip a success and took them to many interesting places in Armenia, where they conducted joint collections (Fig. 1, 2). The collecting trip included the following localities: Marmarik Artavan (Marmarik River Valley), Lake Sevan, the area around Garni Temple, the area around Geghard Monastery, the Yeranos Mts near Dvin, and the 4090 m high Mt. Aragats. A total of 125 samples of bryophytes were collected.

Fig. 1. With Vrez Manakyan in the Yeranos Mts (Armenia) in June 1991.

Fig. 2. Miklós Rajczy and Vrez Manakyan in Mt. Aragats (Armenia) in June 1991.

As a continuation of the author's PhD thesis "Bioindication of karst water level changes in a mountainous area of Hungary", defended in 1993, which still dealt with streamside higher plant vegetation, she began investigating the role of bryophytes as bioindicators of water quality in running water; in streams of Hungarian mountains, in the Danube, and in the Szigetköz branch system of the Danube. To expand on this topic, in the autumn of 1993, through an exchange program between the Hungarian Academy of Sciences and the Spanish National Research Council (CSIC), she spent a month in Spain, establishing contacts with bryologists of the Autonomous University of Barcelona, the Complutense University of Madrid, and the hydrobiology research group of the University of León. The good relationships developed with Spanish bryologists accompanied the author throughout her career and also influenced the Bryophyte Collection, e.g. through herbarium loans, materials from the Bryophyte Collection of the HNHM help Spanish researchers in numerous taxonomic works, such as the Flora Briofítica Iberica series (Brugués & Guerra 2015, Guerra *et al.* 2006, 2010, 2014, 2018). In 2005, the author was invited to give a lecture at the 20th meeting of the Spanish Society of Bryology (Sociedad Espaňola de Briología) in the Canary Islands, La Gomera island, Garajonay National Park, famous for its laurel forests (laurisilva) rich in bryophytes. The meeting also included several field trips, during which the bryophyte specimens collected enriched the Bryophyte Collection of the HNHM, including species that were not yet in the collection. The investigation on the bioindication role of bryophytes in running waters was successfully extended to Bulgaria within the framework of a thematic research program between academies from 1994 to 1996. In 1994, the author and Anna Ganeva, the bryologist at the Institute of Botany of the Bulgarian Academy of Sciences, conducted field trips and collections in the streams of the Vitosha, Rila,

Pirin, and Rhodope Mts. Then, the following year, the Iskur River was selected, and the bryophyte vegetation of the upper reaches, the Beli and Cerni Iskur and their tributaries in the Rila and Vitosha Mts, and then the lower reaches flowing through the Stara Planina Mts, were examined. In 1996, Miklós Rajczy and Lilyana Yurukova (ecologist at the Botanical Institute of the Bulgarian Academy of Sciences) joined them, and the team explored the bryophyte vegetation of the lower reaches of the Iskur River and followed the river further until it joins the Danube. The results of this research were presented at the 1st Balkan Botanical Congress in Thessaloniki, Greece, in 1997 (Papp *et al.* 1997) and published in a paper (Papp *et al.* 2006a), according to which the main results are the following: Eighty-four bryophyte species were found. Three species were recorded for the first time in Bulgaria (Fig. 3). Based on the bryophyte vegetation, two large groups could be distinguished: 1) the upper reaches of Iskur River and its tributaries taking their source from the Vitosha and Stara Planina Mts, and 2) the lower sections of Iskur River. The bryophyte assemblages of the source area at Lakatnik and the sites situated in the upper course of Iskur River in the Rila Mts were very different from those of the other sampling sites. Furthermore, from this 3-year project, 378 specimens were added to the Bryophyte Collection of the HNHM.

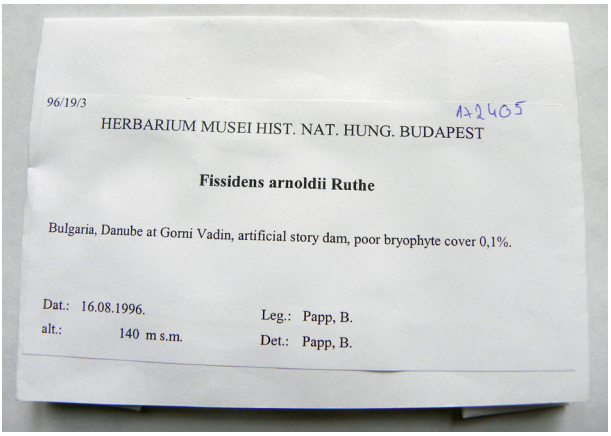

Fig. 3. Voucher specimen of *Fissidens arnoldii* R. Ruthe, a moss recorded for the first time in Bul garia.

Asian trips

In 1994, a series of East Asian bryological collecting trips began. Within the framework of exchange programs between the Hungarian Academy of Sciences and the National Academy of Sciences of the Democratic People's Republic of

Korea, eleven scientists of the Botanical Department of the HNHM made five collecting trips to North Korea between 1987 and 1994. A wide range of experts visited the country, and almost all groups of plants were examined and collected during the field trips. The author participated in the last expedition with Krisztina Buczkó, algologist, László Lőkös, lichenologist, Miklós Rajczy, bryologist, and Tibor Szerdahelyi, pteridologist, during which they visited the following sites: the surroundings of Mangjongdae, Mt. Taesong, Mt. Ryongak, and spent a week in the Myohyang Mts (Fig. 4). A total of approximately 800 samples of bryophytes were collected, of which more than 300 specimens were later fully processed and inventoried to the Bryophyte Collection of the HNHM (Fig. 5). Besides the collecting trips, the delegation visited the Botanical Institute and the Botanical Garden of the Academy of Sciences of DPRK, and the author met with Hoang Ho Dzun, bryologist, and saw some materials deposited in the herbarium of the institute.

Fig. 4. The team in the Myohyang Mts (North Korea) in September 1994. From left to right: László Lőkös, North Korean guide, Krisztina Buczkó, Miklós Rajczy, North Korean interpreter, Tibor Szerdahelyi.

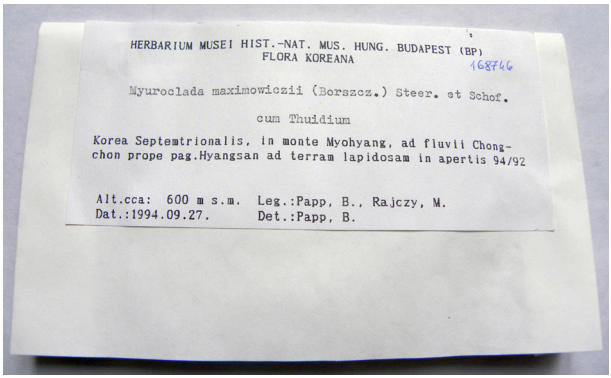

Fig. 5. Specimen of an Asian moss species, *Myuroclada maximowiczii* (G.G. Borshch.) Steere & W.B. Schofield collected in the Myohyang Mts (North Korea).

A few years later, South Korean colleagues became interested in the materials collected in North Korea, and in 2002, as part of the scientific exchange program between the Korean Academy of Science and Technology and the Hungarian Academy of Sciences, a symposium was organized at Kangwon National University in Chuncheon, where the author participated as a botanical expert together with zoologists of the HNHM. For the symposium, a summary of expeditions and research conducted in North Korea by the scientists of the Botanical Department of the HMHM was published (Papp *et al.* 2002a).

After the symposium, the South Korean colleagues organized a 2-week tour for the Hungarian colleagues, during which they gave lectures at universities in the southern part of the country and had the opportunity for smaller collections. Later, in 2005 and 2007, the author made two more collecting trips to South Korea through exchange programs between academies together with her lichenologist colleague, László Lőkös. Their host was Jae-Seoun Hur at Sunchon National University. They managed to collect in several nature reserves of the southern part of South Korea (e.g. Mt. Jogye and Mt. Nanbongsan at Suncheon city, Mt. Cheon-gwansan at Gwansan city, Mt. Baegasan at Hwasun city, Mt. Taebek at Taebek city, Mt. Juwang National Park at Cheongsong city, Jirisan National Park between Gurye and Hamyang, etc.), and even they visited the iconic Jeju Island (Fig. 6, 7, 8). In total, more than 800 samples of bryophytes were collected in South Korea, and a paper on the bryophyte flora of Mt. Taebek was published (Papp 2008). During their visit in 2007, they also participated in the Symposium of the Lichen Bioresources Center of Sunchon University, where they gave a presentation entitled „Biodiversity research on lichens and bryophytes in North Korea" (Lőkös & Papp 2007).

Fig. 6. With László Lőkös at a peak of Mt. Taebek (South Korea), in October 2005.

Fig. 7. On the ferry to Jeju Island (South Korea) in October 2005. To the left side of Beáta Papp is Jae-Seoun Hur.

Fig. 8. In the Yeomiji Botanical Garden in Jeju Island (South Korea), with a famous Korean painter on the right side of Beáta Papp in October 2005.

Another part of the East Asian trips led to China, which began in 1997, when the author was able to attend the IAB (International Association of Bryologists) conference held in Beijing through the exchange program between the Hungarian Academy of Sciences and the Chinese Academy of Sciences (Fig. 9). At this major international world conference, she reported on her studies of bryophyte vegetation in running water (Papp & Rajczy 1997), but was inspired by lectures given by foreign colleagues and conversations with them. A milestone in her career was reached, with her interest turning to rare, endan-

gered bryophyte species and their protection, which further defined her research and influenced the development of the Bryophyte Collection of the HNHM, e.g. establishment of a herbarium database of rare and threatened species and digitalization of the field diaries of Ádám Boros. After the conference, she participated in a conference excursion led by Professor Cao Tong, a Chinese bryologist, to the Changbai Mts at the border between China and North Korea (Fig. 10).

Fig. 9. With Trấn Ninh, a Vietnamese bryologist at the Great Wall in the IAB (International Association of Bryologists) conference in Beijing in 1997.

Fig. 10. Conference excursion in the Changbai Mts (China) in June 1997.
Left side Professor Cao Tong.

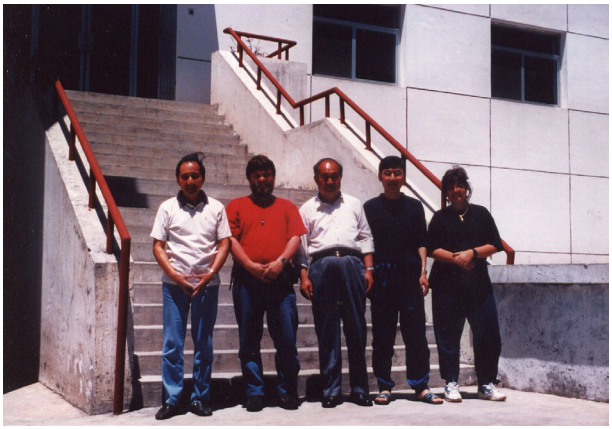

Fig. 11. In front of the Ecological Institute in Mt. Lingshan (China) in June 1999. On the left side, Professor Wu Pengcheng.

Fig. 12. In front of the directorate of the Baishilazi National Park (China) in June 1999. To the right of Beáta Papp are László Lőkös and Professor Cao Tong.

During this conference, she also managed to establish good relations with Chinese colleagues, and later, further trips took place, also through exchange programs between academies. She participated with László Lőkös, lichenologist, in two collecting trips. In 1999, their host were Wu Pengcheng at the Institute of Botany of the Chinese Academy of Sciences in Beijing and Cao Tong at Shenyang University. They had the opportunity to collect on Mt. Lingshan near Beijing (Fig. 11), in Baishilazi Nature Reserve (Fig. 12), and in the Yiwulü Mts in Manchuria. In 2006, they visited the Wulingshan Nature Reserve with Professor Wu Pengcheng and again Mt. Lingshan near Beijing.

Fig. 13. With Chinese colleagues at the International Bryological Symposium for Prof. Pan-Chieh Chen's Centennial Birthday in Nanjing (China) in October 2005. To the right side of Beáta Papp is Professor Cao Tong.

Fig. 14. With Professor Wu Pengcheng in the Herbarium of the Nanjing Botanical Garden (China) in October 2005.

In 2005, the author was invited to give a lecture at the International Bryological Symposium for Prof. Pan-Chieh Chen's Centennial Birthday, at Nanjing (Papp *et al.* 2005a, 2010). This symposium was a great opportunity to meet again with many Chinese bryologists (Fig. 13, 14) and many experts on Asian bryophyte flora from other countries, like Michael Ignatov from Russia (Fig. 15) and Timo Koponen from Finland.

Fig. 15. With Dolgor Tubanova (Institute of General and Experimental Biology, Ulan-Ude) and Michael Ignatov (Lomonosov Moscow State University) at the International Bryological Symposium for Prof. Pan-Chieh Chen's Centennial Birthday in Nanjing (China) in October 2005.

Fig. 16. Conference excursion in the Tian Tang Zhai National Park in Anhui Province (China) in October 2005. To the left side of Beáta Papp is Professor Wu Pengcheng.

After the symposium, she participated in the conference excursion to the Tian Tang Zhai National Park in Anhui Province (Fig. 16). During Chinese trips, in total, more than 600 samples of bryophytes were collected.

Among the Asian trips, a 2-week trip to Vietnam in 1997 with Krisztina Buczkó, algologist, should also be mentioned, which was organized with the help of the exchange program between the Vietnam Academy of Science and Technology and the Hungarian Academy of Sciences.

Fig. 17. With Krisztina Buczkó in the Hoang-Liem Mts (Vietnam) in 1997.

They were guests of the Institute of Ecology and Biological Resources in Hanoi and visited the Hoang-Liem Mts in Lao Cai Province with Professor Mai, where they made small collections (about 130 samples of bryophytes) (Fig. 17). They also met with Trấn Ninh, a bryologist at the Department of Botany at the University of Hanoi, who graduated in Hungary at Eszterházy Károly Teacher Training College in Eger, supervised by Professor Tamás Pócs.

The author's participation in the IAB (International Association of Bryologists) conference held in the National Botanical Research Institute (NBRI), Lucknow, India, in 2002 can also be considered one of her Asian trips, which was realized through the exchange program between the Indian National Science Academy and the Hungarian Academy of Sciences. Here she was able to meet again with the world's leading bryologists and gave a lecture on the monitoring of bryophyte species included in the Bern Convention (Papp *et al.* 2002b). This lecture was a presentation of the methods of the then-initiated Hungarian National Biodiversity Monitoring System. This topic has already been linked to the research of rare and endangered bryophyte species and the topic of bryophyte conservation. The methods and protocols of the Hungarian National Biodiversity Monitoring System later received great international attention, and as a result, further studies were published about them (Papp *et al.* 2005b, Vanderpoorten *et al.* 2010).

Trips and cooperations related to bryophyte conservation

In 1998, through the exchange programme between the Norwegian Academy of Science and Letters and the Hungarian Academy of Sciences, she managed to participate in the 3rd ECCB (European Committee for the Conservation of Bryophytes) meeting held in Trondheim, Norway.

Fig. 18. With Bulgarian and Turkish bryologists in the 4th Balkan Botanical Congress, Sofia. From left to right: Rayna Natcheva (Bulgaria), Gökhan Abay (Turkey), Beáta Papp, Güray Uyar (Turkey), Anna Ganeva (Bulgaria).

Participation in this conference was already in line with her recently started activities in the field of bryophyte protection, and the lecture she gave was about threatened bryophyte species and their habitats (Papp & Rajczy 1998). From then on, her career was permanently intertwined with the ECCB. In 2004, she had been invited to the Board of the ECCB, then, served as the chair of the ECCB from 2012 to 2016 and as the vice-chair since 2016. Her activities in the field of bryophyte conservation also had a great impact on the development of the Bryophyte Collection of the HNHM, e.g. she enriched it with more than 12000 specimens collected in Hungary, among them voucher specimens of the populations of rare and threatened species. The specimens were collected during fieldworks, aimed to confirm existing populations and search for new populations of rarities by visiting special habitats and habitats rich in bryophytes. It must be mentioned here that recent specimens are very important and provide a solid basis for the red-listing process of threatened species. Later, her research on rare and endangered bryophyte species and the topic of bryophyte conservation was extended to the Balkans, which was among the bryologically less-explored regions in Europe (Sabovljević *et al.* 2001). In line with this theme, Bulgarian trips started again through inter-academic exchange programs. In 2006, the author, accompanied by László Lőkös, lichenologist and Zoltán Barina and Dániel Pifkó, higher plant specialists, participated in the 4th Balkan Botanical Congress held in Sofia (Fig. 18). She gave a lecture on the results of her collecting trips conducted in Serbia from 2000 (Papp *et al.*

2006b), which was later published in the Proceedings of the Congress (Papp *et al.* 2009). After the congress, they made a short field trip to the Western Stara Planina Mts with Bulgarian colleagues, Anna Ganeva and Rayna Natcheva, bryologists, and Siikia Nikolova, lichenologist. Bryological results were published in Phytologia Balcanica (Papp *et al.* 2008). During the field trip a total of 252 species (48 liverworts and 204 mosses) were recorded. Three species were new to Bulgaria and 46 were new to the floristic regions of the Western Balkan Range and the West Forebalkan. Twenty-five of the species were red listed in Bulgaria. In addition, the 2006 collecting trip enriched the Bryophyte Collection of the HNHM with more than 400 specimens.

Fig. 19. The team in the Palace and Botanical Gardens of Balchik (Northern Black Sea Coast, Bulgaria) in April 2007. From left to right: László Lőkös, Rayna Natcheva, Jae-Seoun Hur, Anna Ganeva.

Fig. 20. With Daniela Ivanova and László Lőkös in the Strandzha Mts (Bulgaria) on the celebration of Nestinarka folk tradition in Bulgari village in June 2009.

From 2007 to 2009, a thematic research programme between the Bulgarian and Hungarian Academies started, entitled "Investigations of cryptogram flora (bryophytes, lichens) and biodiversity in Bulgaria and Hungary, especially in the habitats of rare species". The project aimed to explore the lichen and bryophyte flora of less-researched areas. In 2007, the author visited the northern part of the Bulgarian Black Sea Coast with a large team consisting of Anna Ganeva and Rayna Natcheva, bryologists, Siika Nikolova, lichenologist, László Lőkös, and his South Korean lichenologist colleague, Jae-Seoun Hur (Fig. 19). Then, in 2008, they continued their work with László Lőkös, Rayna Natcheva, and Siika Nikolova in the southern part of the Black Sea Coast. In 2009, they collected in the Strandzha Mts with László Lőkös and Daniela Ivanova, a Bulgarian pteridologist (Fig. 20). Bryological results were published in three papers (Papp *et al.* 2011, 2012a, 2018). As a summary, in the Black Sea Coast, 153 species were recorded. Five species were new to the bryophyte flora of Bulgaria, and 116 species were new to the Black Sea Coast floristic region. Eighteen species were red-listed at the national level, and 10 species were European red-list candidates (Papp *et al.* 2018). In the Strandzha Mts, 206 species were found, among them 13 species and one subspecies were new to the country. Eighty-nine mosses and 20 liverworts were reported for the first time for the Strandzha Mts. Twenty-four species were red-listed in Bulgaria (Papp *et al.* 2011). The surveys highlighted the importance of the studied regions for conservation of the bryophyte diversity in Bulgaria.

Fig. 21. The team in the Eastern Rhodopi Mts near Chernichevo village (Bulgaria) in June 2019. From left to right: Nóra Varga, Beáta Papp, László Lőkös, Veselin Shivarov, Galin Gospodinov.

Fig. 22. Bryologists from the Balkans in the 5th Balkan Botanical Congress in Belgrade, in 2009. From left to right: Evdoxia Tsakiri (Greece), Snežana Dragićević (Montenegro), Marko Sabovljević (Serbia), Beáta Papp.

Furthermore, due to this 3-year project, more than 1200 Bulgarian specimens have been added to the Bryophyte Collection of the HNHM. Then, after a break, in 2019, a 3-year research project started between the Bulgarian and Hungarian Academies, led by lichenologist Edit Farkas (Institute of Ecology and Botany, Ecological Research Centre of the Hungarian Academy of Sciences) on the Hungarian side, to explore the lichen and bryophyte vegetation of special habitats entitled "Metallophilic cryptogams - a little-known but high conservation value group". In addition to the author, other participants were László Lőkös, Nóra Varga, and Veselin Shivarov, lichenologists, and Rayna Natcheva and Galin Gospodinov, bryologists. In 2019, they visited metalliferous areas of the Eastern Rhodopi Mts (Fig. 21). The bryological results were presented at a conference (Papp *et al.* 2021) and published in two papers (Ellis *et al.* 2024, Papp *et al.* 2026). As a summary 183 bryophyte taxa (one hornwort, 33 liverworts, and 149 mosses) were recorded. Nine taxa (two liverworts and 7 mosses) have been reported for the first time from Bulgaria. Two species were included in the European bryophyte red list. Twenty-seven species (6 liverworts and 21 mosses) have conservation importance based on recent knowledge of their distribution and threats affecting them in Bulgaria and the neighbouring countries. Due to this collecting trip, approximately 450 specimens enriched the Bryophyte Collection of the HNHM. Unfortunately, the Covid19 pandemic that broke out in the meantime interrupted this project, and we were unable to organize further collecting trips in 2020 and 2021.

Fig. 23. With Erzsébet Szurdoki on the peak of Mt Čemernik near Lake Vlasina (Serbia), in June 2011.

Among the trips related to the bryophyte conservation in the Balkans, the Serbian collecting trips are very important. From 2000, a series of fieldworks have been conducted in the country in cooperation with Serbian colleagues (Papp 2013, Papp *et al.* 2006b, 2019). At the same time, a database of the bryophyte specimens collected in the Balkans was established in the Bryophyte Collection of the HNHM. In 2009, through the exchange program between the Serbian Academy of Sciences and Arts and the Hungarian Academy of Science, the author, accompanied by Zoltán Barina and Dániel Pifkó, higher plant specialists, participated in the 5th Balkan Botanical Congress held in Belgrade, where she gave a lecture on the historical specimens from the Balkans deposited at the Bryophyte Collection of the HNHM (Papp & Sabovljević 2009). At the same congress, the results of their research conducted in Montenegro were also presented (Dragićević *et al.* 2009). This conference provided a great opportunity to meet with numerous colleagues from the Balkans (Fig. 22).

Then, from 2010, a 3-year thematic research program started between the Serbian Academy of Sciences and Arts and the Hungarian Academy of Sciences, entitled "Investigations on cryptogam flora (bryophytes, lichens) and biodiversity in Serbia and Hungary, especially in the habitats of rare species". Within the framework of this program, the author participated with Erzsébet Szurdoki, bryologist, and László Lőkös, lichenologist, in the 10th Symposium on the Flora of Southeastern Serbia and Neighbouring Regions held at Lake Vlasina, where she presented her results on the bryophyte flora of a mountain area of Serbia (Papp & Erzberger 2010). After the conference, they made collections in the surroundings of the lake, and continued this work in 2011, too (Fig. 23).

The bryological results were published in several papers (Ellis *et al.* 2012a, 2012b, Papp *et al.* 2012b, 2013a). As a summary, 216 bryophyte taxa (38 liverworts and 178 mosses) were collected during these field trips at Lake Vlasina. Four species were found for the first time in Serbia (Fig. 24), and six species were red-listed in Europe (Papp *et al.* 2012b). Furthermore, the Bryophyte Collection of the HNHM was enriched with 745 Serbian specimens. In the last year of this 3-year project, the Hungarian team, together with Marko Sabovljević (Institute of Botany and Botanical Garden, Faculty of Biology, University of Belgrade) visited the Pešter plateau in Southern Serbia. This was also a fruitful collecting trip, as evidenced by four published papers (Ellis *et al.* 2014, Papp *et al.* 2014a, 2014b, 2014c). The results were as follows: 211 bryophytes (37 liverworts and 174 mosses) were collected. Five species were new additions to the bryophyte flora of Serbia. Four species were red-listed in Europe. An additional 19 taxa were regarded as rare in the Balkans. Due to the trip to the Pešter plateau, 442 specimens were added to the Bryophyte Collection of the HNHM (Papp *et al.* 2014c).

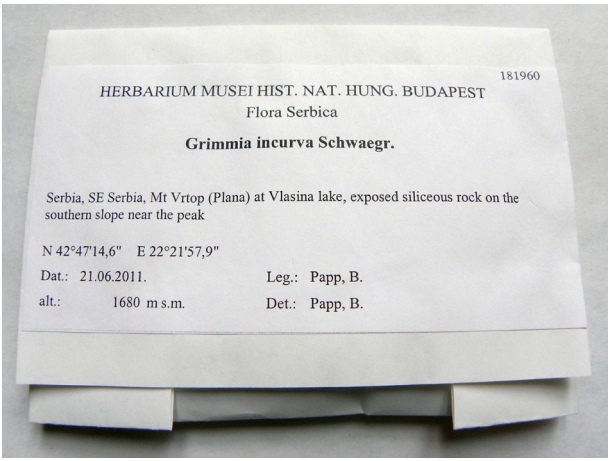

Fig. 24. Voucher specimen of *Grimmia incurva* Schwägr., a moss recorded for the first time in Serbia.

Then, as a continuation of the previous project, from 2013, another 3-year thematic research program started between the Serbian and Hungarian Academies with the same title and aims. Participants were the same, but it was led by a bryologist, Péter Ódor (Institute of Ecology and Botany, Ecological Research Centre of the Hungarian Academy of Sciences), on the Hungarian side, and the Serbian team was expanded with a young bryologist, Jovana Pantović. In April 2013, they visited the Ibar gorge (Fig. 25) and in June participated again in the 11th Symposium on the Flora of Southeastern Serbia and the Neighbouring

Regions held at Lake Vlasina, where the author gave a lecture on the bryophyte flora of Lake Vlasina (Papp *et al.* 2013b). After the symposium, smaller collections were also made, during which a liverwort new to Serbia was found (Papp *et al.* 2014b). The collecting trip to the Ibar gorge was also successful. The bryological results were published in three papers (Ellis *et al.* 2015, Papp *et al.* 2016a, 2016b). As a summary, 126 bryophyte taxa (12 liverworts and 114 mosses) were collected in the Ibar gorge and its surroundings. Four moss species were recorded for the first time in Serbia. Several rare species in Serbia and in the Balkans were found. One species was included in the Bern Convention and the European Union Habitats and Species Directives. The Ibar gorge maintains a unique bryophyte assemblage due to the serpentine bedrock and continental, Mediterranean climatic influence, which are the main characteristics of the region (Papp *et al.* 2016b). From the collecting trips conducted in 2013, 262 specimens were added to the Bryophyte Collection of the HNHM. Later, the results of these two 3-year Hungarian-Serbian inter-academic projects were summarised and presented at numerous conferences (Papp *et al.* 2015, 2016c, 2019).

Fig. 25. The team in the Ibar gorge (Serbia) in April 2013. From left to right: Marko Sabovljević, Erzsébet Szurdoki, Beáta Papp, Jovana Pantović, László Lőkös.

There was another theme related to the bryophyte conservation that participants kept in mind during their fieldwork in these projects, the *ex situ* conservation of nationally red-listed and internationally valuable bryophyte species. Species-specific biotechnological approaches in establishing axenic culture of selected red-listed, rare, nationally or internationally significant bryophyte species were performed. Various species were targeted in axenic cultivation, and axenic collection of the Bryophyte Biology Group at the Institute of Botany and

Botanical Garden, Faculty of Biology, University of Belgrade. Accession from the Bryophyte Collection of the HNHM, as well as adequate field collections during these projects were of the highest value for achievement of materials for reviving or establishing targeted *ex situ* bryophyte collection (Sabovljević *et al.* 2015). Hungarian fieldwork in the framework of Hungarian-Serbian inter-academic projects carried out with Marko Sabovljević, Aneta Sabovljević, and Jovana Pantović, contributed to the successes achieved in this research field, evidenced by several presentations in conferences (Jadranin *et al.* 2023, Papp *et al.* 2022, Sabovljević *et al.* 2013, 2015, 2016, Vujičić 2013a, 2013b) and joint publications (Ćosić 2022, Jadranin *et al.* 2024, 2025, Sabovljević *et al.* 2012a, 2012b, 2018).

SUMMARY

The author carried out twenty-eight trips with the help of exchange programs and thematic research programs between academies. Among them, the most important were the collecting trips, which contributed significantly to the development of the Bryophyte Collection of the HNHM. All recent (collected in the last 35 years) Asian material in the Bryophyte Collection, derived from inter-academic exchange projects, counts approximately 2500 samples of bryophytes. The recent Balkan collection is an important part of the Bryophyte Collection and reaches more than 27500 specimens, from which 76% (almost 21000 specimens) were collected in the last 35 years. More than one-sixth, 16.7%, of the recent collections is Bulgarian material (2547 specimens). All of them were collected during exchange programs and thematic research programs between the Bulgarian and Hungarian Academy of Sciences. More than a quarter, 25.5%, of the recent Balkan collection is Serbian material (5347 specimens), of which 27 % (1449 specimens) were collected during exchange programs and thematic research programs between the Serbian Academy of Sciences and Arts and the Hungarian Academy of Sciences. In addition to the collecting trips, which directly influenced the Bryophyte Collection of the HNHM by the acquisition of Asian and Balkan specimens, conference participations also contributed to the author's scientific career and indirectly influenced the collection. It should also be mentioned that many foreign colleagues visited the Bryophyte Collection of the HNHM within the framework of exchange programs between academies and carried out taxonomic revisions, which also increased the value of the collection. The 27 published articles and 22 conference abstracts also prove the success of the trips and, through them, the inter-academic exchange programs and thematic research programs.

* * *

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Összefoglaló: A tanulmány a szerző huszonnyolc tanulmányi- és gyűjtőútját mutatja be, melyeket akadémiák közötti csereprogramok és tematikus kutatási programok segítségével bonyolított le. A gyűjtőutak eredményeként az MNMKK MTM Mohagyűjteménye mintegy 2500 ázsiai mohamintával, valamint közel 4000 bulgáriai és szerbiai mohapéldánnyal gyarapodott. A korai utak konferencia részvételei fontosak voltak a szerző pályafutásának alakításában és számos külföldi kollégával való kapcsolatépítésében. E kapcsolatok közül sok végigkísérte a szerzőt pályafutása során, és hatott a Mohagyűjtemény fejlődésére is. Ezen kívül számos külföldi kolléga látogatta meg az MNMKK MTM Mohagyűjteményét akadémiák közötti csereprogramok keretében, és végzett taxonómiai revíziós munkát, ami szintén növelte a gyűjtemény értékét. A 27 publikált cikk és a 22 konferencia kivonat is bizonyítja az utak, és ezeken keresztül az akadémiai csereprogramok és a tematikus kutatási programok sikerét.

REFERENCES

Brugués, M. & Guerra, J. (2015): *Flora Briofítica Ibérica. Vol. II.* – Universidad de Murcia, Sociedad Espaňola de Briología, 355 pp.

Ćosić, M.V., Sabovljević, M.S., Papp, B., Giba, Z. S., Šinžar-Sekulić, J. B., Sabovljević, A. D. & Vujičić, M. M. (2022): Micropropagation of rare bryo-halophyte *Hennediella heimii* – *Botanica Serbica* **46(2)**: 187–195. DOI: https://doi.org/10.2298/BOTSERB2202187C

Csorba, G., Kun, A. & Ronkay, L. (2004): Zoological collectings by the Hungarian Natural History Museum in Korea 144. A report on the collectings of the twenty-first and twenty-second expeditions. – *Folia entomologica hungarica* **65**: 153–158.

Csorba, G., Korsós, Z. & Kun, A. (2006): Zoological collectings by the Hungarian Natural History Museum in Korea 145. A report on the collectings of the twenty-third, twenty-fourth and twenty-fifth expeditions – *Folia entomologica hungarica* **67**: 5–9.

Dragićević, S., Papp, B. & Erzberger, P. (2009): Distribution of the moss Buxbaumia viridis (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl. in Montenegro – 5th Balkan Botanical Congress, Belgrade, Serbia, September 07–11, 2009, Book of Abstracts: 84.

Ellis, L. T., Bednarek-Ochyra, H., Cykowska, B., Ochyra, R., Garcia, C., Sérgio, C., Lebouvier, M., Manolaki, P., Giannouris, E., Kadis, C., Markova, I., Papp, B., Szurdoki, E., Peralta, D.F., Plášek, Ristow, R., Sabovljević, M., Sim-Sim, M., Smith, V.R., Tsakiri, E., Váňa, J., Virchenko, V.M. & Barsukov, O.O. (2012a): New national and regional bryophyte records, 30. – *Journal of Bryology* **34(1):** 45–51.

Ellis, L.T., Bednarek-Ochyra, H., Ochyra, R., Cykowska, B., Dulin, M.V., Ezer, T., Kara, T., Flores, J.R., Suárez, G. M. Garcia, C., Martins, A., Sérgio, C., Garilleti, R., Kirmaci, M., Agcagil, E., Kurbatova, L.E., Lebouvier, M., Papp, B., Szurdoki, E., Philippov, D.A., Plášek, V., Pócs, T., Sabovljević, M., Sawicki, J., Sim-Sim, M., Szűcs, P., Bidló, A., Váňa, J., Vigalondo, B., Lara, F., Draper, I., Virchenko, V.M. & Wolski, G.J. (2012b): New national and regional bryophyte records, 33. – *Journal of Bryology* **34(4)**: 281–291.

Ellis, L.T., Aleffi, M., Asthana, A.K., Srivastava, A., Bakalin, V.A., Batan, N., Özdemir, T., Bednarek-Ochyra, H., Borovichev, E.A., Brugués, M., Cano, M.J., Choi, S.S., De Beer, D., Eckstein, J., Erzberger, P., Fedosov, V.E., Ganeva, A., Natcheva, R., Garcia, C.A., Sérgio, C., Garilleti, R., Albertos, B., Puche, F., Gücel, S., Higuchi, M., Hugonnot, V., Hylander, K., Kirmaci, M., Aslan, G., Koponen, T., Lara, F., Mazimpaka, V., van Melick, H., Müller, F., Özenoglu Kiremit, H., Papp, B., Szurdoki, E., Plášek, V., Čihal, L., vand der Pluijm, A., Poponessi, S., Mariotti, M.G., Reyniers, J., Sabovljević, M., Sawicki, J., Smith, V.R., Stebel, A., Ştefănuţ, S., Sun, B.-Y., Váňa, J. & Venanzoni, R. (2014): New national and regional bryophyte records, 40. – *Journal of Bryology* **36(3)**: 223–244.

Ellis, L.T., Alegro, A., Šegota, V., Bakalin, V.A., Barone, R., Borovichev, E.A., Hugonnot, V., Lebouvier, M., Nobis, M., Nowak, A., Ochyra, R., Papp, B., Szurdoki, E., Piwowarczyk, R., Plášek, V., Číhal, L., Ren, Z.-J., Sabovljević, M.S., Sérgio, C., Garcia, C.A., Melo, I., Sawicki, J., Stebel, A., Ştefănuţ, S., Ion, R., Manole, A., Tziortzis, I., Xiong, Y. & Zhao Z.-T. (2015): New national and regional bryophyte records, 44. – *Journal of Bryology* **37(3)**: 228–241.

Ellis, L.T., Adjie, B., Alvarez, D.J., Ardiles, V., Asthana, A.K., Atwood, J.J., Bakalin, V.A., Bednarek-Ochyra, H., Boiko, M., Budke, J.M., Cedrés-Perdomo, R.D., Cerrato, M.D., Csiky, J., Espinoza-Prieto, B., Gabriel, R., Gey, S., Gil, L., Graulich, A., Hylander, K., Kiebacher, T., Konstantinova, N. A., Kučera, J., Kunev, G., Larraín, J., Lönnell, N., Maciel-Silva, A.S., Mamontov, Yu. S., Mattos, G.H.R., Mir-Rosselló, P.M., Nadhifah, A., Natcheva, R., O'Leary, Sean V., Oliveira, M.F., Opisso, J., Papp, B., Peñaloza-Bojacá, G.F., Polaino-Martín, C., Rawat, K.K., Ribas-Serra, A., Rosadziński, S., Sahu, V., Sipos, A., Staniaszek-Kik, M., Starzomski, B. M., Suárez, G.M., Tucker, D.B.L., Verma, A. & Zagorodniuk, N. (2024): New national and regional bryophyte records, 77 – *Journal of Bryology*, https://doi.org/10.1080/03736687.2024.2388418

Ganeva, A., Papp, B. & Natcheva, R. (2008): Contribution to the bryophyte flora of the NW Bulgaria. – *Phytologica Balcanica* **14(3)**: 327–333.

Guerra, J., Cano, M.J. & Ros, R.M. (2006): *Flora Briofítica Ibérica. Vol. III.* – Universidad de Murcia, Sociedad Espaňola de Briología, 305 pp.

Guerra, J., Cano, M.J. & Ros, R.M. (2010): *Flora Briofítica Ibérica. Vol. IV*. – Universidad de Murcia, Sociedad Espaňola de Briología, 317 pp.

Guerra, J., Cano, M.J. & Brugués, M. (2014): *Flora Briofítica Ibérica. Vol. V*. –Universidad de Murcia, Sociedad Espaňola de Briología, 264 pp.

Guerra, J., Cano, M.J. & Brugués, M. (2018): *Flora Briofítica Ibérica. Vol. VI*. – Universidad de Murcia, Sociedad Espaňola de Briología, 463 pp.

Jadranin, B.Z., Papp, B., Božović, Đ.P., Ćosić, M.V., Sabovljević, A.D., Vujičić, M.M. & Sabovljević, M. S. (2023): Influence of plant growth regulators on multiplication of rare and threatened moss *Drepanocladus lycopodioides* (Amblystegiaceae) in *in vitro* conditions (Növényi növekedés szabályozók hatása a ritka és veszélyeztetett *Drepanocladus lycopodioides* (Amblystegiaceae) lombosmoha szaporodására *in vitro* körülmények között). – *Acta Biol. Plantarum Agriensis* **11(2)**: 29.

Jadranin, B.Z., Cosić, M.V., Bozović, Đ.P., Vujičić, M.M., Papp, B., Sabovljević, A.D. & Sabovljević, M.S. (2024): Novel Insights into the Conservation Physiology and Ex situ Conservation of the Threatened and Rare Semi-Aquatic Moss Drepanocladus lycopodioides (Amblystegiaceae). – *Phyton-International Journal of Experimental Botany* **93(11):** 3039–3054. https://doi.org/10.32604/phyton.2024.058469

Jadranin, B.Z., Ćosić, M.V., Vujičić, M.M., Božović, Đ.P., Papp, B., Sabovljević, A.D., & Sabovljević, M.S. (2025): Towards ex situ conservation of the moss Campyliadelphus elodes (Amblistegiaceae, Bryophyta) – *Comprehensive Plant Biology* **49(1)**: 49–60. https://doi.org/10.2298/CPB2501049J

Lőkös, L. & Papp, B. (2007): Biodiversity research on lichens and bryophytes in North Korea – 2007 International Symposium of Lichen Bioresources Center, Sunchon University, October 18, 2007, p. 73–91.

Mahunka, S., Zombori, L. & Csorba , G. (2002): Zoological researches of the Hungarian Natural History Museum in the Korean Peninsula. – Proceedings of the First KAST/HAS Bilateral Symposium on Biodiversity Research in the Korean Peninsula. The Korean Academy of Science and Technology, Seoul, pp. 58–61.

Mészáros, F. & Zombori, L. (1995): Zoological collectings by the Hungarian Natural History Museum in Korea 130. A report on the collectings of the twentieth expedition. – *Folia entomologica hungarica* **56**: 109–111.

Papp, B. (2008): Contribution to the bryophyte flora of Mt Taebaek, South Korea – *Studia bot. hung.* **39**: 89–100.

Papp, B. (2013): The Balkan collection in the Bryophyte Herbarium of the Hungarian Natural History Museum – *Field Bryology* **110**: 60–62.

Papp, B. & Rajczy, M. (1997): Investigations on the condition of bryophyte vegetation of montane streams in Hungary. – IAB Symposium on 2000's Bryology, Abstracts, Beijing, China, 26–30 May 1997, p. 39.

Papp, B. & Rajczy, M. (1998): Bryophytes of saline-alkaline areas of the Danube-Tisza Interfluve, Hungary. – The 3rd European Conference on the Conservation of Bryophytes, The Scientific Basis for Bryophyte Conservation, Program & Abstracts, Trondheim, Norway, p. 14.

Papp, B. & Erzberger, P. (2010): Contribution to the bryophyte flora of South-Eastern Serbia: Suva Planina Mts and its surroundings – 10th Symposium on the Flora of Southeastern Serbia and Neighbouring Regions, 17–20. June 2010, Vlasina lake, Abstracts: 35.

Papp, B. & Sabovljević, M. (2009): Interesting and new national bryophyte records in the historical collection of the Hungarian Natural History Museum – 5th Balkan Botanical Congress, Belgrade, Serbia, September, 07–11, 2009, Book of Abstracts: 80.

Papp, B., Rajczy, M., Ganeva, A. & Yurukova, L. (1997): Bryophytes and water quality along the river Iskur (Bulgaria). – First Balkan Botanical Congress, Abstracts, Thessaloniki, Greece, September 19–22, 1997. p. 113.

Papp, B., Lőkös, L. & Szollát, Gy. (2002a): Botanical expeditions of the Hungarian Natural History Museum in North Korea. – Proceedings of the First KAST/HAS Bilateral Symposium on Biodiversity Research in the Korean Peninsula. The Korean Academy of Science and Technology, Seoul, 69–79.

Papp, B., Ódor, P. & Szurdoki, E. (2002b): Threatened status of bryophyte species of Bern Convention in Hungary and problems in their monitoring. – Abstracts, World Conference of Bryology, January 23–30, 2002, Lucknow, India, International Association of Bryologists, National Botanical Research Institute, Lucknow-226001, India, p.40.

Papp, B., Ódor, P. & Szurdoki, E. (2005a): Bryophyte Biodiversity Monitoring System in Hungary – International Bryological Symposium for Prof. Pan-Chieh Chen's Centennial Birthday, Nanjing, China, 2005.10.25–31, p. 54–55.

Papp, B., Ódor, P. & Szurdoki, E. (2005b): Methodological overview and a case study of the Hungarian Bryophyte Monitoring Program – *Bol. Soc. Esp. Briol.* **26-27**: 23–32.

Papp, B., Ganeva, A. & Natcheva, R. (2006a): Bryophyte vegetation of Iskur River and its main tributaries – *Phytol. Balcanica* **12(2)**: 181–189.

Papp, B., Erzberger, P. & Sabovljević, M. (2006b): New, interesting and red-listed bryophyte species collected during the expeditions of the Hungarian Natural History Musem in Serbia between 2000–2005. – Books of abstracts. IV. Balkan Botanical Congress, Sofia, Bulgaria, 20–26 June 2006., p. 90.

Papp, B., Erzberger, P. & Sabovljević, M. (2009): European red-listed bryophyte species collected during the expeditions of the Hungarian Natural History Museum in Serbia between 2000–2006. – In: Ivanova, D. (ed.), Plant, fungal and habitat diversity investigation and conservation. Proceedings of IV Balkan Botanical Congress, Sofia, 20–26 June 2006. Institute of Botany, Sofia, pp. 541–546.

Papp, B., Ódor, P. & Szurdoki, E. (2010): Bryophyte Biodiversity Monitoring System in Hungary, Eastern Central Europe – International Academic Memorial Issue for Pan-Chieh. Nanjing Normal University, Nanjing, China, pp. 95–111.

Papp, B., Natcheva, R. & Ganeva, A. (2011): The bryophyte flora of Northern Mt Strandzha – *Phytol. Balcan.* **17(1)**: 21–32

Papp, B., Natcheva, R., Erzberger, P. & Sabovljević, M. (2012a): Didymodon sicculus, new to Bulgaria, Serbia and some notes on its ecology – *Nova Hedwigia* **95(1-2)**: 221–226.

Papp, B., Szurdoki, E. & Sabovljević, M. (2012b): Bryophyte flora of the Vlasina lake and its surrounding (SE Serbia). – *Studia bot. hung.* **43**: 27–45.

Papp, B., Szurdoki, E., Pantović, J. & Sabovljević, M. (2013a): *Physcomitrium eurystomum* and *Pohlia proligera,* new mosses in the bryophyte flora of Serbia – *Arch. Biol. Sci., Belgrade* **65(2)**: 703–706.

Papp, B., Szurdoki, E. & Sabovljevic, M. (2013b): Bryophyte flora of Vlasina lake and its surroundings – 11th Symposium on the Flora of Southeastern Serbia and Neighbouring Regions, 13–16. June 2013, Vlasina lake, Abstracts.

Papp, B., Pantović, J., Sabovljević, M. & Szurdoki, E. (2014a): *Myurella sibirica* (C. Muell.) Reim., new to Montenegro and Serbia – *Cryptog. Bryol.* **35(3)**: 321–326.

Papp, B., Pantović, J., Szurdoki, E. & Sabovljević, M. (2014b): Interesting and new species for the bryophyte flora of Serbia – *Herzogia* **27(1)**: 221–225

Papp, B., Szurdoki, E., Pantović, J. & Sabovljević, M. (2014c): Contribution to the bryophyte flora of Pešter plateau, Serbia – *Studia bot. hung.* **45**: 33–47. *DOI: 10.17110/StudBot.2014.45.33*

Papp, B., Szurdoki, E., Pantović, J. & Sabovljević, M. (2016a): New records of Mediterranean-Atlantic mosses in the flora of Serbia. – *Herzogia* **29(1)**: 185–189.

Papp, B., Szurdoki, E., Pantović, J. & Sabovljević, M. (2016b): An insight into the bryophyte flora of the Ibar gorge and its surroundings (C and SW Seria) – *Acta Bot. Hung.* **58(3-4)**: 411–423. 1*0.1556/ABot.58.2016.3-4.10*

Papp, B., Szurdoki, E, Sabovljević, M., Sabovljević, A., Pantović, J. & Ódor, P. (2015): Szerb-magyar akadémiai együttmőködés (2013-2015) mohászati eredményei (Bryological results of Serbian-Hungarian inter-academic cooperation (2013–2015)). – III. Aktuális eredmények a kriptogám növények kutatásában – Absztrakt kötet (Conference of Cryptogams: Recent Research in Cryptogamic Botany III – Book of Abstracts) 2015. november 17–18, Eger, p. 28.

Papp, B., Szurdoki, E., Sabovljević, M., Sabovljević, A., Pantović, J. & Ódor, P. (2016c): Exploration of the bryophyte flora of Serbia last five years – 12th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, 16–19, June 2016, Kopaonik, Abstracts, Niš, 2016, p. 37.

Papp, B., Natcheva, R. & Ganeva, A. (2018): Bryophyte diversity along the northern part of the Black Sea coast in Bulgaria – *Phytol. Balcanica* **24(1)**: 25-33.

Papp, B., Szurdoki, E., Pantović, J. & Sabovljević, M. (2019): Contribution to the exploration of the bryophyte flora of Serbia in the last 20 years with a special attention to the species of conservation interest. – 13th Symposium on the Flora of Southeastern Serbia and Neighboring Regions, 20-23, June 2019, Stara Planina, Book of Abstracts, Institute for Nature Conservation of Serbia, Department of Biology and Ecology, Faculty of Science and Mathematics, University of Niš, p. 68.

Papp, B., Natcheva, R. & Gospodinov, G. (2021): New bryophyte species in the Bulgarian bryophyte flora (Új moha fajok Bulgária mohaflórájában). In Szűcs, P. (ed.): The abstracts of the 5th International Conference on Cryptogams, 25–26 November 2021, Eger, Hungary. – *Acta Biologica Plantarum Agriensis* **9**(1): 67. https://doi.org/10.21406/abpa.2021.9.1.67

Papp, B., Szurdoki, E., Sabovljević, M.S. & Sabovljević, A. (2022): Reintroduction of *Hamatocaulis vernicosus* to Hungary. – Book of abstracts, 10th ECCB (Conference of the European Committee for Conservation of Bryophytes) 24–27 May, Zagreb, Croatia, p. 24.

Papp, B., Gospodinov, G. & Natcheva, R. (2026): Contribution to the bryophyte flora of the metalliferous areas of the Eastern Rhodopi Mts, Bulgaria. – *Studia bot. hung.* **56(2):** 5–30.

Sabovljević, M., Ganeva, A., Tsakiri, E. & Ştefănuţ, S. (2001): Bryology and bryophyte protection in south-eastern Europe. – *Biological Conservation* **101**: 73–84.

Sabovljević, M., Papp, B., Vujičić, M., Szurdoki, E., Segarra-Moragues, J.G. & Sabovljević, A. (2012a): *In vitro* micropropagation of rare and endangered moss *Entosthodon hungaricus* (Funariaceae) – *Bioscience Journal, Uberlandia* **28(4)**: 632–640.

Sabovljević, M., Vujičić, M., Šinžar Sekulić, J., Segarra-Moragues, J.G., Papp, B., Skorić, M. & Sabovljević, A. (2012b): Reviving, In Vitro Differentiation, Development, and Micropropagation of the Rare and Endangered Moss Bruchia vogesiaca (Bruchiaceae) – *HortiScience* **47(9):**1347–1350.

Sabovljević, M., Vujičić, M., Papp, B., Petrović, N., Petrović, B., Szurdoki, E. & Sabovljević, A. (2013): Insights into biology of the moss Entosthodon hungaricus. – II. Aktuális erdemények a kriptogám növények kutatásában Konferencia, 09.30-01.10.2013, Eger, Book of Abstracts: 28.

Sabovljević, M., Papp, B., Szurdoki, E., Vujičić, M., Sabovljević, A. & Ódor, P. (2015): Eredmények az ex situ moha védelem területén szerb-magyar akadémiai együttműködés keretében (Bryophyte ex situ conservation in the frame of inter-academic cooperation between Serbia and Hungary). – III. Aktuális eredmények a kriptogám növények kutatásában – Absztrakt kötet (Conference of Cryptogams: Recent Research in Cryptogamic Botany III – Book of Abstracts) 2015. november 17–18, Eger, p. 30.

Sabovljević, M., Papp, B., Vujičić, M., Szurdoki, E., Nikolić, N. & Sabovljević, A. (2016): Ex situ conservation of bryophytes: rare species biology knowledge and biotechnological skill break through. – Book of Abstracts, 9th Conference of European Committee for Conservation of Bryophytes, 26–29, April, Bečići, Montenegro, p. 17.

Sabovljević, M., Nikolić, N., Vujičić, M., Šinžar-Sekulić, J., Pantović, J., Papp, B. & Sabovljević, A. (2018): Ecology, distribution, *in vitro* propagation, *ex situ* conservation and native population strenghtening of the rare and threatened halophytemoss *Entosthodon hungaricus* in Serbia – *Wulfenia* **25**: 117–130.

Vanderpoorten, A., Papp, B. & Gradstein, R. (2010): Sampling of bryophytes – In Eymann, J., Degreef, J., Häuser, Ch., Monje, J.C., Samyn, Y. & VandenSpiegel, D. (eds.): Manual on field recording techniques and protocols for All Taxa Biodiversity Inventories and Monitoring. – *Abc Taxa Vol.* **8(2)**: 331–345.

Vujičić, M., Milošević, S., Papp, B., Szurdoki, E., Sabovljević, M. & Sabovljević, A. (2013a): Does antioxydative system increase salt stress survival in facultative halophytic moss Entosthodon hungaricus? – 4th Croatian Botanical Symposium with international participation, Split, Croatia, 27-29.09.2013. Book of Abstracts: 148.

Vujičić, M., Sabovljević, A., Szurdoki, E., Papp, B. & Sabovljević, M. (2013b): The first report of apogamous Entosthodon hungaricus and the spores directly producing sporophytes in bryophytes. – 4th Croatian Botanical Symposium with international participation, Split, Croatia, 27–29.09.2013. Book of Abstracts: 153.

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TAXONOMICAL AND CHROLOGICAL NOTES 21 (204–207)

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Abstract: Floristic records of an alga from Hungary and a moss from Greece are reported, i.e. new Hungarian occurrence of a rare alga, *Sellaphora archibaldii* and the first confirmed record of a moss, *Entosthodon hungaricus* from Greece. We report the first data on *Orobanche bartlingii* from the Sokoró Hills and the first observation of *Trifolium diffusum* from the Kisalföld region.

Key words: Algae, Bacillariophyceae, bryophyte, Fabaceae, Funariaceae, Greece, Hungary, Orobanchaceae, moss

INTRODUCTION

This paper is the 21th part of the series launched in *Studia botanica hungarica* focusing on the new chorological records, nomenclature, and taxonomy of plant species from algae to vascular plants and fungi (Akác *et al.* 2024, Aszalósné Balogh *et al.* 2021, Barina *et al.* 2015, 2020, Bauer *et al.* 2023, Csiky *et al.* 2017, Deme *et al.* 2019, Dudáš *et al.* 2024, Farkas *et al.* 2022, Király *et al.* 2019*a*, *b*, Matus *et al.* 2018, Mesterházy *et al.* 2017, Papp *et al.* 2016, 2020, Rigó *et al.* 2023, Schmidt 2020, Schmidt *et al.* 2018, Süveges *et al.* 2021, Takács *et al.* 2016).

The recent part of the series provides new records of four species, an alga, a moss, and two vascular plants.

NEW RECORDS WITH ANNOTATIONS

Algae, Bacillariophyceae, Sellaphoraceae

(204) ***Sellaphora archibaldii*** (J.C. Taylor & H. Lange-Bertalot) É. Ács, C.E. Wetzel & L. Ector (Sellaphoraceae, Naviculales)

Hungary, Pest County, Soroksár-Danube, Ráckeve, near Árpád-bridge. Lat.: 47,161334° N; Long.: 18,948285° E; and Soroksár-Danube, Dunaharaszti, near railway bridge. Lat.: 47,359811° N; Long.: 19,080066°. E, Leg.: Akác, A., Cser, B., 27.08.2024, det.: Buczkó, K.

The species was found in two samples collected in the Soroksár-Danube system. The sites were sampled in the frame of biomonitoring implemented by the Nitrates Directive and Fish Physiology project of Pest County Government Agency, labelled as No.:3013/2024; 3015/2024, and deposited in the Collection of Algae, Hungarian National Museum Public Collection Centre, Budapest – Hungarian Natural History Museum as HNHM-ALG-D-2024/3013 and 2024/3015. *Sellaphora archibaldii* was described as *Eolimna archibaldii* by Taylor & Lange–Bertalot (2006).

The taxon was first recognized in March 2002, in River Vaal at Klipplaat Drift in South Africa and it was also detected in River Wilge in the same year. In River Vaal it was the dominant species with a relative abundance of 48% (Taylor 2004). For a long while, it had been considered as an endemic species to South Africa (Taylor *et al*., 2007a, b). The earliest European record came from Spain (Blanco *et al*., 2009), and it was subsequently reported from Hungary (Ács *et al*., 2017), Germany (Hofmann *et al*., 2018), and France (Peeters & Ector, 2019), refuting the previously assumed endemic status of the taxon. Ács *et al*., (2017) provided an emended description of *S. archibaldii* with a detailed distribution map based on its early records. The recent distribution data are available e.g. in Algabase (Guiry & Guiry 2025); including Asian records.

The taxon was first discovered in Hungary in an oxbow of the River Tisza, specifically Kanyari Holt–Tisza in 2011 (Ács *et al*., 2017). The next data about the Hungarian occurrences of *S. archibaldii* came from 2019 and 2020, when a comprehensive survey of lesser-known waterbodies was carried out in the framework of KEHOP-1.1.0-15-2016-00002 project (Ács *et al*., 2023). Altogether 75 lentic (standing waters) and 90 lotic (running waters) systems were sampled within the framework of this nationwide project associated with the EU WFD. *Sellaphora archibaldii* was detected in 7 lentic waters and 8 lotic waters among them with a maximum dominance value of 14.4% (Bíró *et al*., 2022, Ács *et al*., 2023).

In 2024 we recorded its presence in the Soroksári-Danube, interpreting this as the appearance of *Sellaphora archibaldii* in the waters of the Danube.

This may indicate that the species is spreading. The Soroksár-Danube is the second largest side arm of the Danube in Hungary with its 57.3 km length between the 1642 and 1586 river kms (Szabó *et al.,* 2001). It maintains a continuous connection with the main river channel; However, a sluice system regulates its flow rate and water level. The Soroksári-Danube lies in the densely populated agglomeration area of Budapest; thus, it is heavily exposed to human activities including significant industrial impacts. At the same time, it also offers various recreational activities such as rowing, angling, leisure activities, water sports. The water quality of the Soroksári-Danube has attracted general attention. The history of algological studies of the river is summarized in Szabó *et al.,* (2001).

In its natural habitat, *S. archibaldii* occurs in alkaline, eutrophic waters with elevated electrolyte content (Taylor *et al.* 2007a). Due to its small size, it can be easily confused with species of *Mayamaea* or especially with *Brevilinea kevei* (Ács *et al.,* 2023). Fortunately, it has great observable characteristics in LM such as the raphe and prominent central nodule. In general, the valve length is 5.5-6.5 µm while the valve width is 2.8-3.5 µm. Its shape is rhombic-elliptic with rounded to slightly pointed apices.

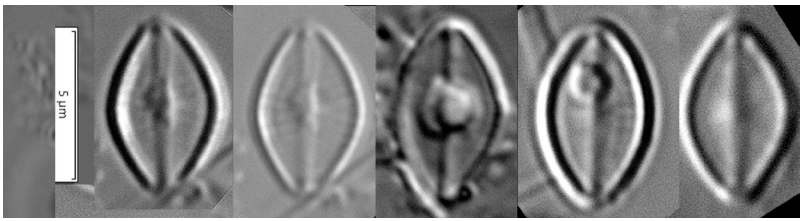

Fig. 1. *Sellaphora archibaldii* (light microscope). Soroksári-Danube, Ráckeve, 27.08.2024.

*Achnanthidium minutissimum (*Kützing*)* Czarnecki*, Nitzschia inconspicua* Grunow were the dominant taxa in the first sample (3013). Subdominant taxa were *Amphora pediculus* (Kützing) Grunow*, Nitzschia lacuum* Lange-Bertalot, and *Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot. Some rarely noticeable species were *Rhoicosphenia abbreviata* (C.Agardh) Lange-Bertalot*, Nitzschia amphibia f. amphibia* Grunow*, Nitzschia dissipata* (Kützing) Grunow, and *Gomphonema pumilum* (Grunow) Reichardt & Lange-Bertalot. On the other hand, *Nitzschia inconspicua* was the dominant species, in the sample taken from Ráckeve (3015), while *Achnanthidium minutissimum, Nitzschia dissipata*, *Nitzschia amphibia*, *Sellaphora nigri* (De Not.) C. E. Wetzel & Ector were subdominant. *Amphora pediculus*, *Navicula cryptotenella* Lange-Bertalot, *Staurosira venter* (Ehrenberg) Cleve & Moeller, and *Cyclotella meneghiniana*

Kützing were also detected in the sample. The relative abundance of *S. archibaldii* was less than 1% in both samples.

Although algae – including diatoms - are widely distributed and often considered cosmopolitan, they still exhibit distinct and well-defined biogeographical patterns and community structures. Understanding these patterns is especially important, as investigating invasive species in rapidly changing habitats is both necessary and well-justified.

K. Buczkó, A. Akác, B. Cser, and L.V. Kardos

Bryophytes

(205) ***Entosthodon hungaricus*** (Boros) Loeske (Funariaceae, Funariales)

Greece, Central Macedonia, Vromolimnes near Xiropotamos village, saline grassland at a drainage channel. Lat.: 40°46'39,1" N; Long.: 23°30'03,9" E; Alt.: 340 m a.s.l., leg. Papp, B. and Tsakiri, E., 06.04.2025, det. Papp, B., [BP 199558], and Lat.: 40°46'34,3" N; Long.: 23°30'11,2" E; leg. Papp, B. and Tsakiri, E., 06.04.2025, det. Papp, B., [BP 199568], and Lat.: 40°46'29,7" N; Long.: 23°30'18,0" E; leg. Papp, B. and Tsakiri, E., 06.04.2025, det. Papp, B., [BP 199570]

It is a continental, Mediterranean moss (Düll 1985) of steppe and saline grasslands. Its European distribution includes the Canary Islands, Malta, Portugal, Spain, Sicily, Austria, Germany, Slovakia, Greece, Hungary, Montenegro, Romania, Serbia, Moldova, south-eastern European Russia, and Ukraine. It has also been recorded in Asian Russia, Kazakhstan, Kyrgyzstan, and Israel (Sabovljević *et al.* 2019).

Entosthodon hungaricus was reported for the first time from Greece by Papp (2002) from the same locality, Vromolimnes basin. However, the voucher specimens deposited at the Hungarian Natural History Museum (BP 165060, 165061) have recently been revised to *Physcomitrium arenicola* Laz., thus, based on these specimens, *Ph. arenicola* has been reported for the first time in Greece (Sabovljević *et al.* 2025). As these voucher specimens were the only records of *E. hungaricus* from Greece, it means that the species should have been excluded from the Greek bryophyte flora. The two species are morphologically very similar at first glance, the main distinguishing characters are microscopic features found on the sporophytes: the size and wall thickness of the exothecial cells of the capsule, and the size and shape of the spores. Moreover, they live in the same habitats, saline grasslands, and can occur together in the same localities. Both species are spring ephemerals and appear in March-April. Therefore, at the beginning of April 2025, we conducted field research targeting these two species at the same locality mentioned by Papp (2002), which resulted in the collection of three specimens of *E. hungaricus*. These specimens are the first real records of the species in Greece. A specimen of *Ph. arenicola* was also collected during the survey, which proves the coexistence of the two species at

Fig. 2. The Vromolimnes basin.

the same locality in Greece as well. Further accompanying bryophyte species were the following: *Barbula unguiculata* Hedw., *Bryum argenteum* Hedw., *Bryum dichotomum* Hedw., *Didymodon vinealis* (Brid.) R.H. Zander, *Ptychostomum torquescens* (Bruch & Schimp.) Ros & Mazimpaka, *Rhynchostegium megapolitanum* (Blandow ex F. Weber & D. Mohr) Schimp., *Scleropodium cespitans* (Wilson ex Müll.Hal.) L.F.Koch, *Tortella squarrosa* (Brid.) Limpr., *Tortula acaulon* (With.) R.H. Zander.

The area of Vromolimnes is situated in a basin (Fig. 2) surrounded by the Vertiskos Mt. (1.103 m a. s. l. north-west), the Kerdylia Mt. (1.091 m a. s. l., north-east), and the Volvi Mt. (659 m a. s. l., south-west). The plant composition of the area is considered a relic of the once rich coastal vegetation (Babalonas *et al.* 1980), when the sea intruded into the basin from the Strymon Gulf through a small, tectonic valley during the Pleistocene epoch. Then, in the Middle Pleistocene, the Vromolimnes basin was cut off from the sea due to the elevation of the nearby mountain ranges. At its lower part, a lake was formed, which was later divided into two smaller lakes (Mavrouda and Lantza; Psilovikos 1978).

Fig. 3. Habitat of *Entosthodon hungaricus.*

Nowadays, as a result of drainage processes the lakes disappeared. The area is an agricultural landscape with fragments of semi-natural meadows and remnants of halophytic vegetation. *Entosthodon hungaricus* and *Ph. arenicola* occur mainly along the drainage channels (Fig. 3), and their population size in the area can be estimated to be less than 50, based on population size measurements in 1x1 m squares in line with the IUCN (2017) recommendation.

B. Papp, E. Tsakiri

Vascular plants

(206) ***Orobanche bartlingii*** Griseb. (Orobanchaceae)

Hungary, Transdanubian Mountains, Pannonhalma Hills: Győrújbarát, Francia-kő, near Napóleon lookout tower, abandoned wine yard, 47.606809° N, 17.634940° E, 218 m a.s.l., leg. D. Schmidt & B. Bozsaky 11.06.2021 (BP HNHM-TRA 00703726)

This Eurasian species is sporadic or rare throughout its range (Kreutz 1995). *Orobanche bartlingii* Griseb., belonging to the section Osproleon Wallr. subsection Curvatae Beck, was generally treated as a taxon within the closely

related species, *Orobanche alsatica* Kirschl., until the end of the 20th century (e.g., Gilli 1966, Soó 1968). It was first described as an independent species by Nieschalk and Nieschalk (1968), and from the 1990s onward this view was gradually adopted by an increasing number of European works (e.g. Kreutz 1995; Melzer and Barta 1995; Uhlich *et al.* 1995; Virók 2009).

Its occurrence in Hungary became known during a herbarium revision: according to Virók *et al.* (2004), its first specimens were collected in 1937 in the Velence Hills by Ádám Boros. The number of its confirmed localities is currently low in Hungary. It appears to be locally frequent only in smaller areas of the North Hungarian Mountains, such as the Rudabánya Hills (Virók *et al.* 2004) and the Uppony Hills (Beránek in Molnár *et al.* 2019, Sulyok and Beránek 2019). It is considered data deficient species (Király 2007, Virók 2025). In addition to the general identification difficulties typical of broomrapes, its presumed rarity may also be explained by its short flowering period. At the same time, its identification is facilitated by the fact that its exclusive host plant, *Libanotis pyrenaica* (L.) Bourg. is an easily recognizable species.

From the Transdanubian Mountains only one published record and three floristic mapping records had previously been known. In the Balaton Uplands, near Paloznak, it was found along vineyard margins and in shrubby grassland patches (Bauer 2010), it has also been reported from a quadrant near Pécsely (Mészáros A. 2014 in Bartha *et al.* 2021+) and from a quadrant in Zalahaláp (Voigt W. and Szalai-Dobosné Márta M. 2021 in Bartha *et al.* 2021+).

Its new occurrence is located in the Sokoró Hills, where the species had not previously been recorded. Its habitat is a somewhat shrubby, dicot-rich semi-dry grassland that developed in an abandoned orchard, where *Libanotis pyrenaica* is an abundant species. Among the host plant population, a few dozen flowering shoots of *O. bartlingii* were found. Parasitism of the host species was confirmed by excavating the haustorium attached to its root.

D. Schmidt

(207) ***Trifolium diffusum*** L. (Fabaceae)

Hungary, Kisalföld: Felpéc, Sísek Hill, on sandy fallow land on the eastern side of the hill, 47.536641° N, 17.588762° E, 125 m a.s.l. [8471.4], leg. and det. D. Schmidt, 07.06.2024; Felpéc, Sísek Hill, on sandy fallow land on the southern side of the hill, 47.532013° N, 17.587034° E, 127 m a.s.l. [8471.4], leg. and det. D. Schmidt, 07.06.2024; (BP HNHM-TRA 00732426, 00732427)

A species with a Pontic–Mediterranean distribution (Soó 1966), whose continuous range extends westward to the Carpathian Basin (already absent in Austria), while it also appears in southern France and on the Iberian Peninsula. In Hungary, it occurs predominantly in the Great Hungarian Plain and its periphery, mainly in loess- and less frequently in sand-based grasslands, with many

observations coming from disturbed or fragmented grassland remnants (Lukács *et al.* 2017, Bátori *et al.* 2024). Systematic studies of the vegetation of the lowland kurgans over the past decade have significantly expanded its previously scattered records (Deák *et al.* 2019, Süveges *et al.* 2025, 2026), and these have been further supplemented by data collected as part of the Community Floristic Mapping in Hungary (2025) iNaturalist project (Bartha *et al.* 2021+). East of the Danube, the species becomes much rarer, with only a few reports from the Balaton Uplands (Bauer *et al.* 2004, Bauer 2010), the Velence Hills, and the Dinnyési-Fertő area (Bauer 2019).

The occurrence of *Trifolium diffusum* has not been previously recorded in the Kisalföld region. In the summer of 2024, two localities were recorded during habitat mapping of the Sísek Hill near Felpéc, close to the southwestern foot of the Pannonhalma Hills. Both sites are sand-based fallow lands used as wild fields, which are occasionally disked. By early summer, the dominant species in the weed community were: *Ambrosia artemisiifolia, Ballota nigra, Bromus tectorum, Centaurea stoebe, Chondrilla juncea, Conyza canadensis, Erigeron annuus, Erysimum diffusum, Plantago lanceolata, Trifolium arvense*, and *Verbascum phlomoides*. Its appearance in the area can be considered unexpected due to the previous lack of records, but on the other hand, it supports the general slow expansion observed in the Great Hungarian Plain (Süveges *et al.* 2026). It is also noteworthy that in Transdanubia, the precipitation conditions in spring 2024 were highly favourable compared to previous years for annual species flowering in late spring and early summer, and several legume species showed exceptional numbers of individuals.

D. Schmidt

* * *

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Összefoglaló: A sorozatban adatokat közlünk egy ritka alga, a *Sellaphora archibaldii* új magyarországi előfordulásáról és egy mohafaj, az *Entosthodon hungaricus* első bizonyított görögországi előfordulásáról. Az *Orobanche bartlingii* első előfordulási adatait közöljük a Sokorói-dombságból és a *Trifolium diffusum* első megfigyelését a Kisalföld régióban.

REFERENCES

Ács, É., Wetzel, C. E., Buczkó, K., Kiss, K. T., Nagy, K., Trábert, Z., Földi, A., Pozderka, V., Werner, P., Heudre, D. and Ector, L. (2017): Biogeography and morphology of a poorly known *Sellaphora* species. – *Fottea* **17**(1): 57–64. https://doi.org/10.5507/fot.2016.021

Ács, É., Bíró, T., Duleba, M., Földi, A., Kiss, K. T., Orgoványi, P., Trábert, Z. and Buczkó, K. (2023): *Képes útmutató Magyarország leggyakoribb bevonatlakó kovaalgáihoz (Bacillariophyceae)* [Illustrated guide to Hungary's most common coating-dwelling diatoms (Bacillariophyceae)]. 1–447. *Budapest: Ludovika Egyetemi Kiadó.*

Akác, A., Buczkó, K., Cser, B., Farkas, E., Lőkös, L., Molnár, Cs., Stenger-Kovács, Cs., Szűcs, P. and Varga, N. (2024): Taxonomical and chorological notes 19 (195–199). – Studia bot. hung. 55(1): 169–180. https://doi.org/10.17110/StudBot.2024.55.1.169 Babalonas, D., Karagiannakidou, V. and Kokkini, S. (1980): Untersuchungen über die Salzwiesen des ausgetrockneten Lantza – Salzsees (Nordgriechenland). – *Feddes Repertorium* **91(1-2)**: 117–126.

Aszalósné Balogh, R., Buczkó, K., Erzberger, P., Freytag, Cs., Homm, Th., Lőkös, L., Matus, G., Nagy, Z., Papp, B. and Farkas, E. (2021): Taxonomical and chorological notes 15 (153–163). – *Studia bot. hung.* **52**(2): 165–184. https://doi.org/10.17110/studbot.2021.52.2.165

Barina, Z., Benedek, L., Boros, L., Dima, B., Folcz, Á., Király, G., Koszka, A., Malatinszky, Á., Papp, D., Pifkó, D. and Papp, V. (2015): Taxonomical and chorological notes 1 (1–19). – *Studia bot. hung.* **46**(2): 205–221. https://doi.org/10.17110/studbot.2015.46.2.205

Barina, Z., Molnár, Cs., Somogyi, G., Szederjesi, T., Pifkó, D., Rigó, A., Mártonffy, A., Virók, V. and Dudáš, M. (2020): Taxonomical and chorological notes 11 (112–125). – *Studia bot. hung.* **51**(1): 67–76. https://doi.org/10.17110/StudBot.2020.51.1.67

Bartha, D., Bán, M., Schmidt, D. and Tiborcz, V. (2021+): *Magyarország edényes növényfajainak online adatbázisa* [Online database of the vascular plant species of Hungary] *(http://floraatlasz.uni-sopron.hu).* – Soproni Egyetem, Erdőmérnöki Kar, Növénytani és Természetvédelmi Intézet. [accessed on 02.02.2026]

Bátori, Z. (2024): Az alföldi tájak 'piramisainak' megőrzése. – *Természetvédelmi Közlemények* **30**: 15136.

Bauer, N. (2010): Adatok a Balaton-felvidék flórájának ismeretéhez IV. – *Kitaibelia* **15**(1–2): 53–63.

Bauer, N. (2019): A Velencei-hegység növényföldrajzi és florisztikai kutatásának eredményei. [Results of plant geographic and floristic research in the Velence Mts] – *Kitaibelia* **24**(2): 117–152. https://doi.org/10.17542/kit.24.117

Bauer, N., Mészáros, A. and Simon, P. (2004): Adatok a Balaton-felvidék flórájának ismeretéhez III. [Data on the flora of the Balaton Uplands] – *Kitaibelia* **9**(1): 207–219.

Bauer, N., Rédei, T., Barabás, S., Locsmándi, Cs., Mesterházy, A., Mészáros, A., Molnár, Cs., Vajna, F. and Takács, A. (2023): Taxonomical and chorological notes 18 (184–194). – *Studia bot. hung.* **54**(2): 205–224. https://doi.org/10.17110/StudBot.2023.54.2.205

Bíró, T., Duleba, M., Földi, A., Kiss, K. T., Orgoványi, P., Trábert, Z., Vadkerti, E., Wetzel, C. E. and Ács, É. (2022): Metabarcoding as an effective complement of microscopic studies in revealing the composition of the diatom community–a case study of an oxbow lake of Tisza River (Hungary) with the description of a new Mayamaea species. *Metabarcoding and Metagenomics* **6**: e87497. https://doi.org/10.3897/mbmg.6.87497

Blanco, S., Novais, M. H., Hofmann, L. and Ector, L. (2009): *Eolimna becaresii* sp. nov.; a new diatom taxon from a Spanish shallow lake. *Diatom Research* **24**(2): 487–494. https://doi.org/10.1080/0269249X.2009.9705815

Community Floristic Mapping in Hungary (2025): https://www.inaturalist.org/projekts/kozossegi-floraterkepezes-magyarorszagon-community-floristic-mapping-in-hungary [accessed on 02.02.2026]

Csiky, J., Kováts, D., Deme, J., Takács, A., Óvári, M., Molnár, V. A., Malatinszky, Á., Nagy, J. and Barina, Z. (2017): Taxonomical and chorological notes 4 (38–58). – *Studia bot. hung.* **48**(1): 133–144. https://doi.org/10.17110/studbot.2017.48.1.133

Deák, B., Török, P., Tóthmérész, B., Radócz, Sz., Lukács, K. and Valkó, O. (2019): A középtiszavidéki halmok flórakutatásának új eredményei. [New results of the floristic research of the Central Tisza region] – *Kitaibelia* **24**(1): 94–105. https://doi.org/10.17542/kit.24.94

Deme, J., Palla, B., Haszonits, Gy., Csiky, J., Baráth, K., Kovács, D., Zurdo Jorda, A., Erzberger, P., Wolf, M., Papp, V. and Schmidt, D. (2019): Taxonomical and chorological notes 9 (94–98). – *Studia bot. hung.* **50**(2): 379–389. https://doi.org/10.17110/StudBot.2019.50.2.379

Dudáš, M., Lőkös, L., Molnár, Cs. and Sinigla, M. (2024): Taxonomical and chorological notes 20 (200–203). – *Studia bot. hung.* **55**(2): 285–293. https://doi.org/10.17110/StudBot.2024.55.2.285

Düll, R. (1985): Distribution of the European and Macaronesian mosses (Bryophytina) II. – *Bryologische Beiträge* **5**: 110–232.

Farkas, E., A. Balogh, R., Bauer, N., Lőkös, L., Matus, G., Molnár, Cs., Papp, B., Pifkó, D. and Varga, N. (2022): Taxonomical and chorological notes 16 (164–177). – *Studia bot. hung.* **53**(1): 249–266. https://doi.org/10.17110/studbot.2022.53.2.249

Gilli, A. (1966): Bestimmungsschlüssel der mitteleuropäischen Varietäten und Formen von *Orobanche*. – *Verh. Zool. Bot. Ges. in Wien* **105-106**: 171–181.

Guiry, G. M. in Guiry, M. D. & Guiry, G. M. 12 October 2023. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org; searched on 25 February 2025

Hofmann, G., Lange-Bertalot, H., Werum, M. and Klee, R. (2018): Rote Liste und Gesamtartenliste der limnischen Kieselalgen (Bacillariophyta) Deutschlands. In: Metzing, D., Hofbauer, N., Ludwig, G. & Matzke-Hajek, G. (Eds.): Rote Liste gefährdeter Tiere, Pflanzen und Pilze Deutschlands. Band 7: Pflanzen. Münster: Landwirtschaftsverlag. *Naturschutz und Biologische Vielfalt* **70**(7): 601–708.

IUCN Standards and Petitions Subcommittee (2017): *Guidelines for using the IUCN Red List Categories and Criteria. Version 13.* – The Standards and Petitions Subcommittee, 108 pp.

Király, G. (ed., 2007): *Vörös Lista. A magyarországi edényes flóra veszélyeztetett fajai.* [*Red list of the vascular flora of Hungary*]. – private edition, Sopron, 73 pp.

Király, G., Baráth, K., Bauer, N., Erzberger, P., Papp, B., Szűcs, P., Veres, Sz. and Barina, Z. (2019a): Taxonomical and chorological notes 8 (85–93). – *Studia bot. hung.* **50**(1): 241–252. https://doi.org/10.17110/StudBot.2019.50.1.241

Király, G., Hohla, M., Süveges, K., Hábenczyus, A. A., Barina, Z., Király, A., Lukács, B. A., Türke, I. J. and Takács, A. (2019b): Taxonomical and chorological notes 10 (98–110). – *Studia bot. hung.* **50**(2): 391–407. https://doi.org/10.17110/StudBot.2019.50.2.391

Kreutz, C.A.J. (1995): *Orobanche Die Sommerwurzarten Europas 1. Mittel- und Nordeuropa (The European broomrape species 1.Central and Northern Europe).* – Maastricht, 159 pp.

Lukács, B.A., Gulyás, G., Horváth, D., Hődör, I., Schmotzer, A., Sramkó, G., Takács, A. and Molnár, A. (2017): Florisztikai adatok a Tiszántúl középső részéről. [Floristic data on the Central Tisza region] – *Kitaibelia* **22**(2): 317–357. https://doi.org/10.17542/kit.22.317

Matus, G., Csiky, J., Bauer, N., Baráth, K., Vasuta, G., Barabás, A., Hricsovinyi, D., Takács, A., Antal, K., Budai, J., Erzberger, P., Molnár, P. and Barina, Z. (2018): Taxonomical and chorological notes 7 (75–84). – *Studia bot. hung.* **49**(2): 83–94. https://doi.org/10.17110/studbot.2018.49.2.83

Melzer, H. and Barta, T. (1995): *Orobanche bartlingii* Grisebach, die Bartling-Sommerwurz, Neu für das Burgenland und andere Neuigkeiten zur Flora dieses Bundeslandes, sowie von Nieder- und Oberösterreich. – *Linzer biol. Beitr.* **27**(2): 1021–1043.

Mesterházy, A., Matus, G., Király, G., Szűcs, P., Török, P., Valkó, O., Pelles, G., Papp, V. G., Virók, V., Nemcsok, Z., Rigó, A., Hohla, M. and Barina, Z. (2017): Taxonomical and chorological notes 5 (59–70). – *Studia bot. hung.* **48**(1): 263–275. https://doi.org/10.17110/studbot.2017.48.2.263

Molnár, Cs., Haszonits, Gy., Pintér, B., Korda, M., Peregrym, M., Nótári, K., Malatinszky, Á., Toldi, M. and Beránek, Á. (2019): Pótlások Magyarország edényes növényfajainak elterjedési atlaszához IX. [Addition to the distribution atlas of the vascular plant species in Hungary] – *Kitaibelia* **24**(2): 253–256. https://doi.org/10.17542/kit.24.253

Nieschalk, A. and Nieschalk, Ch. (1968): *Orobanche libanotidis* Ruprecht (=*O. bartlingii* Grisebach) in Hessen. – *Hessische Floristische Briefe* **17**: 35–42.

Papp, B. (2002): New records of bryophytes from a saline area of Greece – *Studia bot. hung.* **33**: 21–24.

Papp, V., Király, G., Koscsó, J., Malatinszky, Á., Nagy, T., Takács, A. and Dima, B. (2016): Taxonomical and chorological notes 2 (20–27). – Studia bot. hung. 47(1): 179–191. https://doi.org/10.17110/studbot.2016.47.1.179

Papp, B., Erzberger, P., Lőkös, L., Szurdoki, E., Németh, Cs., Buczkó, K., Höhn, M., Aszalósné Balogh, R., Baráth, K., Matus, G., Pifkó, D. and Farkas, E. (2020): Taxonomical and chorological notes 12 (126–136). – *Studia bot. hung.* **51**(1): 77–98. https://doi.org/10.17110/StudBot.2020.51.1.77

Peeters, V. and Ector, L. (2019): Atlas des diatomées des cours d'eau du territoire bourguignon. Volume 3: Naviculacées partie 1. 1–324. *Dijon: Direction Régionale de l'Environnement, de l'Aménagement et du Logement Bourgogne-Franche-Comté.*

Psilovikos, A. (1978): *Über die Paläogeographie Mazedoniens im Raum des Beckens von Vromolimnes.* – Aristotle University of Thessaloniki, Thessaloniki, Greece (manuscript).

Rigó, A., Döme, B., Dudáš, M., Karikás, M., Lőkös, L., Pifkó, D., Varga, N. and Farkas, E. (2023): Taxonomical and chorological notes 17 (178–183). – *Studia bot. hung.* **54**(1): 93–104. https://doi.org/10.17110/StudBot.2023.54.1.93

Sabovljević, M., Papp, B., Blockeel, T., Ignatov, M., Hallingbäck, T. and Söderström, L. (2019): *Entosthodon hungaricus. The IUCN Red List of Threatened Species* 2019: e.T85841487A87779152. [Accessed 22 December 2025].

Sabovljević, M. S., Tomović, G., Sabovljević, A. D., Kunev, G., Palpurina, S., Kutnar, L., Ilchev, I., Assyov, B., Djordjević, V., Papp, B., Dragićević, S., Szűcs, P., Stanković, S., Mežaka, A., Shivarov, V. V. and Ştefănuţ, M-M. (2025): New records and noteworthy data of plants, algae and fungi in SE Europe and adjacent regions, 21 – *Comprehensive Plant Biology* **49(1)**: 131–146. https://doi.org/10.2298/CPB2501131S

Schmidt, D. (2020): Taxonomical and chorological notes 13 (137). – *Studia bot. hung.* **51**(2): 87–90. https://doi.org/10.17110/StudBot.2020.51.2.87

Schmidt, D., Csiky, J., Matus, G., Balogh, R., Szurdoki, E., Höhn, M., Ábrán, P., Buczkó, K. and Lőkös, L. (2018): Taxonomical and chorological notes 6 (71–74). – *Studia bot. hung.* **49**(1): 121–130. https://doi.org/10.17110/studbot.2018.49.1.121

Soó, R. (1966): *A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve II.* [The systematic and geographic manual of the Hungarian flora and vegetation] – Akadémiai Kiadó, Budapest, 655 pp.

Soó, R. (1968): *A magyar flóra és vegetáció rendszertani-növényföldrajzi kézikönyve III.* [The systematic and geographic manual of the Hungarian flora and vegetation] – Akadémiai Kiadó, Budapest, 558 pp.

Sulyok, J., and Beránek, Á. (2019): Adatok a Tarnavidék, az Upponyi-hegység és környéke flórájához. [Data on the flora of the Uppony Mts and Tarna regions] – *Kitaibelia* **24**(2): 173–172. https://doi.org/10.17542/kit.24.173

Süveges, K., Takács, A., Tóth, K., Török, P., Vikár, J. and Molnár, Cs. (2021): Taxonomical and chorological notes 14 (138–152). – *Studia bot. hung.* **52**(1): 65–79. https://doi.org/10.17110/studbot.2021.52.1.65

Süveges, K., Valkó, O., Kelemen, A., Tölgyesi, Cs., Bede, Á., Godó, L., Borza, S. and Deák, B. (2025): Rare and data-deficient weed flora of East Hungarian kurgans – a largescale survey. – *Acta Botanica Hungarica* **67**(4): 457–488. https://doi.org/10.1556/034.67.2025.4.6

Süveges, K., Valkó, O., Kelemen, A., Tölgyesi, C., Bede, Á., Godó, L., Borza, S. and Deák, B. (2026). Adatok az Alföld kunhalom-flórájának ismeretéhez. [Floristic data on the kurgans of the Great Hungarian Plain] – *Kitaibelia* **31**(1): 31–44. https://doi.org/10.17542/kit.31.087

Szabó, K., Ács, É., Pápista, É., Kiss, K. T., Barreto, S. and Makk, J. (2001): Periphyton and phytoplankton in the Soroksár-Danube in Hungary. I. Periphytic algae on reed stems. *Acta Botanica Hungarica* **43**(1–2): 13–35. https://doi.org/10.1556/abot.43.2001.1-2.2

Takács, A., Baráth, K., Csiky, J., Csikyné, R. É., Király, G., Nagy, T., Papp, V., Schmidt, D., Tamási, B. and Barina, Z. (2016): Taxonomical and chorological notes 3 (28–37). – *Studia bot. hung.* **47**(2): 345–357. https://doi.org/10.17110/studbot.2016.47.2.345

Taylor, J. C. (2004): The application of diatom–based pollution indices in the Vaal catchment [MSc Dissertation]. Potchefstroom Campus, North–West University. 192 pp.

Taylor, J. C. and Lange-Bertalot, H. (2006): *Eolimna archibaldii* spec. nov. and *Navigiolum adamantiforme* comb. nov. (Bacillariophyceae): two possibly endemic elements of the South African diatom flora tolerant to surface water pollution. *African Journal of Aquatic Science* **31**(2): 175–183. https://doi.org/10.2989/16085910609503889

Taylor, J. C., Harding, W. R. and Archibald, C. G. M. (2007a): An Illustrated Guide to Some Common Diatom Species from South Africa. WRC Report TT 282/07. 178 pp. *Pretoria: Water Research Commission.*

Taylor, J. C., Janse van Vuuren, M. S. and Pieterse, A. J. H. (2007b): The application and testing of diatom–based indices in the Vaal and Wilge Rivers, South Africa. *Water SA* **33**(1): 51–59. https://doi.org/10.4314/wsa.v33i1.47871

Uhlich, H., Pusch, J. and Barthel, K.-J. (1995): *Die Sommerwurzarten Europas.* – Wissenschaften, Magdeburg.

Virók, V. (2009): Orobanchaceae – Vajvirágfélék családja. In: Király, G. (ed.): *Új magyar füvészkönyv. Határozókulcsok.* – Aggteleki Nemzeti Park Igazgatóság, Jósvafő, pp. 381–385.

Virók, V. (2025): Bartling-vajvirág. – *Orobanche bartlingii* Griseb. In: Takács, A., Bauer, N. and Molnár, V.A.: Magyarország védett hajtásos növényei. [Protected vascular plant species of Hungary] – Debreceni Egyetem Természettudományi és Technológiai Kar, Debrecen – MNMKK Magyar Természettudományi Múzeum, Budapest, p. 228.

Virók, V., Farkas, R., Szmorad, F. and Boldoghné Szűts, F. (2004): Florisztikai adatok Borsod-Abaúj-Zemplén-megye északi részéről. [Floristic data on the northern region of the Borsod-Abaúj-Zemplén county] – *Kitaibelia* **9**(1): 143–150.

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