

CONTRIBUTIONS TO THE BRYOPHYTE FLORA OF THE POLONINY NATIONAL PARK, EASTERN SLOVAKIA

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Papp, B. & Širka, P. (2023): Contributions to the bryophyte flora of the Poloniny National Park, Eastern Slovakia. – *Studia bot. hung.* 54(2): 125–142.

Abstract: The Poloniny National Park, located largely in the Bukovské vrchy Mts, is the easternmost protected area in Slovakia. It is situated within the Eastern Carpathians and represents a special area in Slovakia, with the largest complex of primeval forests in the country. The bryophyte flora of this region has been relatively well studied in the past century and so far 375 bryophyte taxa have been reported from the territory of the national park. This paper contributes to the knowledge on the bryophyte flora of the Poloniny National Park. We recorded a total of 117 bryophyte taxa (one hornwort, 16 liverworts, and 100 mosses), out of which 12 are reported as new for the region. Two species are considered as endangered (EN) in Slovakia (*Dicranum viride*, *Zygodon rupestris*), three are vulnerable (VU) (*Anacamptodon splachnoides*, *Anomodon rugelii*, *Didymodon spadiceus*), four are near-threatened (NT) (*Buxbaumia viridis*, *Orthotrichum patens*, *Phaeoceros carolinianus*, *Ulota bruchii*), and three are reported here as new for the country (*Philonotis capillaris*, *Tortula schimperii*, *Ulota crispula*).

Key words: hornworts, liverworts, mosses, species of conservation interest

INTRODUCTION

The region of the Bukovské vrchy Mts (Poloniny National Park in the broader sense) forms a geographical and botanical border between the Eastern and Western Carpathian Mts. This is manifested in the flora of the territory mainly by the presence of some Eastern Carpathian elements, the range of which ends here, while some of them reach the western limit of their distribution. Although geologically more or less uniform, this region shows rich bryophyte flora due to its specific position, local climatic variations, and well-preserved ecosystems, especially beech forests, which represent the largest primeval forest complex in Slovakia (BURALOVÁ 2002).

From a bryological point of view, the region of Poloniny and its wider area have been relatively well studied since the beginning of the last century. First records from this region were documented by CHYZER (1905). Later, the area

was studied by BAUER (1941). Few data on bryophytes from the territory of the Poloniny National Park can be found in the works of ŠMARDÁ (1948), ŠMARDÁ and VANĚK (1955), KUČEROVÁ and JENÍK (1963), PECIAR (1960, 1970, 1985), HADAČ *et al.* (1986, 1988), HADAČ and TERRAY (1989) or KLIMENT *et al.* (2004). Sporadic records on the occurrence of liverwort species from the region were reported in the series of DUDA and VÁŇA (1970–1992). More comprehensive works on the bryophyte flora of the region were published by PECIAR (1965) and HERBEN *et al.* (1980), furthermore some unpublished manuscripts were prepared by SOLDÁN (1990, 1992, 1993). The work of PECIAR (1965) on epiphytic bryophyte communities of Slovakia is especially important, in which he reports 47 species from the territory of the Poloniny National Park. A summary of bryological studies from the Bukovské vrchy Mts with addition of own results was published by PECIAR (1987) and later by ŠOLTĚS and BURAL (2012), who reported a total of 375 bryophyte species from the Poloniny National Park.

The aim of this paper is to supplement knowledge on the bryophyte flora of the Poloniny National Park.

MATERIAL AND METHODS

Description of the investigated area

The investigated area belongs to the Poloniny National Park, located in Eastern Slovakia within the Eastern Carpathian Mts, along the borders of Slovakia, Poland, and Ukraine, with a larger part of the park area situated in the Bukovské vrchy Mts and smaller parts in the Laborecká vrchovina Highlands and the Beskydské predhorie Foothill. The park was established in 1997 and it is the easternmost large-scale protected area in Slovakia (KRAMARÍK 1998, BURALOVÁ 2002). The geological substrate of the area is built of Upper Cretaceous and Paleogene flysch rocks, including mainly fine-grained sandstones and claystones, partly including also moderately calcareous layers. Soils are mostly cambisols, to a lesser extent pseudogleys. Climatically, the largest part of the studied area is at higher elevations (800 m and more) and belongs to a cold, very wet climatic zone with a mean annual temperature of 5–5.5 °C, a mean July temperature from 12 °C to 16 °C and an average total precipitation of 1,000–1,200 mm. The area between 400–800 m a. s. l. belongs to a moderately warm, wet to very wet climatic zone with a July mean temperature of 16 °C or more and an average total precipitation of *ca* 800 mm. The average depth of snow cover in the lower parts is 30–40 cm, in the mountains it reaches about 70 cm. Hydrologically, the study region belongs to the Bodrog catchment area (VOLOŠČUK 1988, MIKLÓS 2002, OLAH *et al.* 2006).

According to the phytogeographical division of Slovakia (FUTÁK 1984), the Bukovské vrchy Mts belong to the Eastern Carpathian floral region (Carpaticum orientale). The region has been intensively exploited for centuries, however, some forest stands, especially in less accessible areas, have preserved their primeval character. They now represent some of the most complex natural beech forests in Europe and are protected in several reserves within the Poloniny National Park. Their high conservation value lies also in the amount of dead wood they contain which is close to natural and means a significant component of the ecosystem, forming key habitats for many species and increasing overall forest biodiversity (ADAMČÍK *et al.* 2007, SOLÁR *et al.* 2016, 2017). The mountain range is covered predominantly by beech-dominated (*Fagus sylvatica*) forests with admixture of fir (*Abies alba*) in the eastern part (mainly in the Stužica National Nature Reserve), as well as small patches of ash (*Fraxinus excelsior*), sycamore maple (*Acer pseudoplatanus*), and elm (*Ulmus glabra*). In lower altitudes, beech forests form stands with European hornbeam (*Carpinus betulus*) and sessile oak (*Quercus petraea*) (JUŘIČKOVÁ *et al.* 2006, ŠTOFÍK and SANIGA 2012). Deforested mountain ridges are covered by alpine grasslands called 'poloniny' in this part of the Carpathians, which give the national park its name. Although they cover a much smaller area of the national park than deciduous forests, they contribute significantly to the natural richness of the region and enable the immigration of many Eastern Carpathian plant species (PECIAR 1987, HALADA 2000; BLAŽKOVÁ and BŘEZINA 2003).

Methods

The collection was made in October 2022 mainly in forest stands with *Dicranum viride* populations and their surroundings, because the main purpose of our visit was the monitoring of this species in the Poloniny National Park. Bryophytes were collected from different substrates (soil, rocks, tree bark, and decaying wood). The investigated area can be seen in Figure 1. The map was created using the QGIS software, version 3.22 (Open Source Geospatial Foundation).

The specimens are preserved in the Bryophyte Collection of the Hungarian Natural History Museum, Budapest (BP). Nomenclature of bryophytes follows HODGETTS *et al.* (2020). European and country red list status of species is given according to HODGETTS *et al.* (2019b) and HODGETTS and LOCKHART (2020).

Site details

1, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Topoľa, near the confluence of the Pľaša and Ulička streams, near a bus stop at the road junction

towards Runina and Ruské, 49.07345° N, 22.37815° E, 475 m, 25.10.2022. leg. and det. Papp, B.

2, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Runina, near a bus stop at the World War I. monument, *Fagetum* and a wet lawn, 49.06795° N, 22.3863° E, 480 m, 25.10.2022. leg. and det. Papp, B.

3, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Stakčín, towards Ruské, near Černegov potok stream, *Fagetum*, 49.108217° N, 22.3777° E, 650 m, 25.10.2022. leg. and det. Papp, B.

4, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Stakčín, towards Ruské, near Černegov potok stream, *Fagetum*, 49.108217° N, 22.3777° E, 650 m, 25.10.2022. leg. Lőkös, L., det. Papp, B.

5, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Nová Sedlica, Stužica National Nature Reserve, along the red tourist path starting at the Temný vršok hill, from 49.069783° N, 22.540283° E to 49.0787° N, 22.542° E, 780 m, 26.10.2022. leg. and det. Papp, B.

6, Slovakia, Bukovské vrchy Mts., Poloniny National Park, Stakčín, near Ruské, *Fagetum*, 49.10735° N, 22.36065° E, 525 m, 26.10.2022. leg. and det. Papp, B.

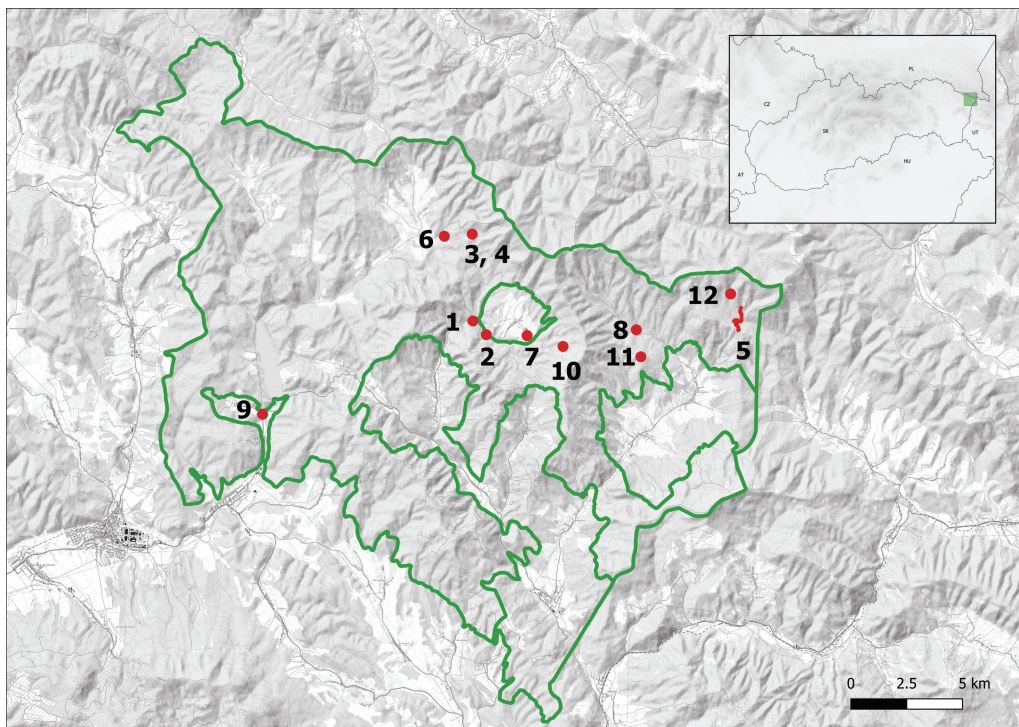


Fig. 1. Investigated localities (marked in red) within the Poloniny National Park (green boundaries).

7, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Runina, pasture, 49.067367° N, 22.4114° E, 565 m, 27.10.2022, leg. and det. Papp, B.

8, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Nová Sedlica, valley of the Zbojský potok stream, 49.069917° N, 22.477983° E, 510 m, 28.10.2022, leg. and det. Papp, B.

9, Slovakia, Laborecká vrchovina highlands, Poloniny National Park, Stakčín, at Beskydský panteón, *Carpinetum* on a steep slope and an adjacent meadow, 49.036083° N, 22.24955° E, 305 m, 28.10.2022, leg. and det. Papp, B. and Širka, P.

10, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Runina, valley of the Hlboký potok stream, production *Fagus sylvatica* forest 49.063269° N, 22.433208° E, 700 m, 27.10.2022, leg. Širka, P., det. Širka, P. and Papp, B.

11, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Nová Sedlica, near the Bahno Nature Reserve, *Fagus sylvatica* forest with admixture of *Quercus petraea*, *Carpinus betulus*, and *Acer pseudoplatanus*, sporadically also *Cerasus avium* and *Larix decidua*, 49.059119° N, 22.480767° E, 700 m, 27.10.2022, leg. Širka, P., det. Širka, P. and Papp, B.

12, Slovakia, Bukovské vrchy Mts, Poloniny National Park, Nová Sedlica, Stučica National Nature Reserve, beech-fir forest, mainly south and central part of the reserve, roughly between 49.073272° N, 22.528883° E and 49.087844° N, 22.533939° E, 720–980 m, 26.10.2022, leg. Širka, P., det. Širka, P. and Papp, B.

RESULTS AND DISCUSSION

Altogether, 117 bryophyte taxa (one hornwort, 16 liverworts, and 100 mosses) were recorded during our field trip. The complete list of species can be found in the Appendix.

Three species are reported for the first time from Slovakia (*Philonotis capillaris*, *Tortula schimperi*, *Ulota crispula*).

Out of the recorded species, two species are endangered (EN) in Slovakia (*Dicranum viride*, *Zygodon rupestris*), three are vulnerable (VU) (*Anacamptodon splachnoides*, *Anomodon rugelii*, *Didymodon spadiceus*), and four are near-threatened (NT) (*Buxbaumia viridis*, *Orthotrichum patens*, *Phaeoceros carolinianus*, *Ulota bruchii*).

According to the lists of bryophyte taxa occurring in the territory of the Poloniny National Park published by PECIAR (1987) and ŠOLTÉS and BURAI (2012), we report here 12 species new for the area: *Brachythecium geheebii*, *Bryum dichotomum*, *Didymodon spadiceus*, *Lewinskya fastigiata*, *Metzgeria consanguinea*, *Orthotrichum patens*, *Phaeoceros carolinianus*, *Philonotis capillaris*, *Tortula schimperi*, *Ulota crispula*, *U. intermedia*, *Zygodon rupestris*.

Species of conservation interest and other interesting records

Phaeoceros carolinianus (Michx.) Prosk. – It is a hornwort of the southern temperate zone of Europe (DÜLL 1983). It is near-threatened (NT) in Europe. In Slovakia, it is also red-listed in the same threat category (MIŠÍKOVÁ *et al.* 2021). In the surrounding countries, it is endangered (EN) in Austria and near-threatened (NT) in Hungary. It grows in arable fields on slightly acid clayey, sandy soils. This species is threatened by intensive agricultural practices as it depends on traditional field management. Immediate ploughing after harvesting crops prevents the species from completing its annual life cycle (BISANG *et al.* 2009). The species is known from many regions of Slovakia, including the nearby Vihorlat Protected Landscape Area (PUJMANOVÁ *et al.* 1990), however, here we report the first finding from the Bukovské vrchy Mts. In the Poloniny National Park it was found in a ditch by the road at the edge of a small wetland in the valley of the Zbojský potok stream in the Nová Sedlica village.

Metzgeria consanguinea Schiffn. – It is an Atlantic-Mediterranean epiphyte liverwort (DÜLL 1983) becoming very rare, with sporadic distribution towards the east. It is not included in the checklist of Slovakia (MIŠÍKOVÁ *et al.* 2021), although an unpublished record of this species is known from the Badínsky prales National Nature Reserve from a *Fagus* tree (29.09.2011, leg. and det. Fritz, Ö., conf. Papp, B. and Širka, P.). We reported it based on our collection as new for the Slovakian bryophyte flora in ELLIS *et al.* (2023). In the surrounding countries it is known only from Austria. In the Poloniny National Park it was found on a *Fagus* tree in the valley of the Zbojský potok stream near the Nová Sedlica village.

Anacamptodon splachnoides (Froel. ex Brid.) Brid. – It is a sub-Mediterranean-sub-Atlantic, montane moss (DÜLL 1985) growing mostly around knot-holes or other hollows of trees, where water can accumulate (dendrotelm). The species requires bright and constant humid habitats (SCHRÖCK *et al.* 2019). It is near-threatened (NT) in Europe. In Slovakia, it is assessed as vulnerable (VU) (MIŠÍKOVÁ *et al.* 2020). In the surrounding countries it is highly endangered in Austria, endangered (EN) in the Czech Republic, Poland, and Hungary, and vulnerable (VU) in Ukraine. The major threat to this species is forestry. Clear-cutting completely destroys its habitat and changes the local micro-climate. Old host trees are important for the species and time plays an important role in colonization (SCHRÖCK *et al.* 2019). According to the recent forestry practice, old trees are usually removed. From the Bukovské vrchy Mts it is already known (ŠOLTÉS and BURAL 2012). We found it on the bark of a *Fagus* tree in an old stand near Ruské.

Anomodon rugelii (Müll. Hal.) Keissl. – It is a northern subcontinental, montane element (DÜLL 1985). It is near-threatened (NT) at European level and

vulnerable (VU) in Slovakia (MIŠÍKOVÁ *et al.* 2020). In the neighbouring countries it is endangered (EN) in Austria and Hungary, and vulnerable (VU) in the Czech Republic and Poland. It grows on tree barks or on basic and acidic rocks in deciduous or mixed montane forests. It is directly threatened by forestry activity, which degrades and destroys its habitat. Climate change may also impact the species by prolonged periods of drought (SABOVLJEVIĆ *et al.* 2019a). In the Poloniny National Park it was already reported from several localities (ŠOLTÉS and BURAI 2012). We found it on the bark of a *Fagus* tree in the Stužica National Nature Reserve.

Brachythecium geheebii Milde – It is a subcontinental, montane, dealpine moss (DÜLL 1985). It is near-threatened (NT) in Europe, but least-concern (LC) in Slovakia (MIŠÍKOVÁ *et al.* 2020). In the neighbouring countries, it is endangered (EN) in the Czech Republic, vulnerable (VU) in Poland, “risk assumed” in Austria and data-deficient (DD) in Hungary. This species grows mostly on shaded rocks. In mountainous areas it also occurs on tree bases. The main threat to this species is forest destruction and degradation due to forestry (SABOVLJEVIĆ *et al.* 2019b). It has not been reported from the Poloniny National Park yet. In our study it was found on bark on the base of trees in the Stužica National Nature Reserve, and in an old beech stand near the Ruské village.

Buxbaumia viridis (Moug. ex Lam. et DC.) Brid. ex Moug. et Nestl. – It is a boreal element (DÜLL 1984), included in the EU Habitat Directive and an important flagship species of nature conservation growing on moist decaying wood. In Slovakia, it is considered near-threatened (NT) (MIŠÍKOVÁ *et al.* 2020) and it is red-listed in many European countries, including neighbouring Austria (highly endangered), Hungary, Poland (EN, endangered) and the Czech Republic (VU, vulnerable). Main threat to this species is forestry and the removal of coarse woody debris. The protection of *B. viridis* also ensures the protection of other species from different taxonomic groups occupying the same habitat (HODGETTS *et al.* 2019a). In Slovakia, it has a scattered occurrence, mainly in central, northern, and eastern parts of the country and the populations are regularly monitored. From the Stužica National Nature Reserve it was already reported by PEČIAR (1970). During our field work it was found growing on dead wood on three fir logs (10 sporophytes in total).

Dicranum viride (Sull. et Lesq.) Lindb. – It is a species of the temperate zone of Europe (DÜLL 1984), included in the EU Habitat Directive. It grows mainly on the bark of deciduous trees, especially beech. This moss species is endangered (EN) in Austria, vulnerable (VU) in Hungary, near-threatened (NT) in the Czech Republic, and rare in Poland. In Slovakia, it is endangered (EN) (MIŠÍKOVÁ *et al.* 2020), distributed mainly in the Bukovské vrchy Mts, recently, however, new

localities have been found in Eastern and mostly Central Slovakia (Širka *et al.*, unpublished records). All populations in Slovakia are regularly monitored. Within the Poloniny National Park, large populations of *D. viride* were known especially in the Stučica National Nature Reserve, near Runina and Ruské and near the Bahno Nature Reserve. All populations in the Poloniny National Park were monitored during our visit. At some localities they are threatened by forestry.

Didymodon spadiceus (Mitt.) Limpr. – It is a montane element of the temperate zone of Europe (DÜLL 1984). It is vulnerable (VU) in Slovakia (MIŠÍKOVÁ *et al.* 2020). It grows usually on base rich rocks in fast-flowing rivers (SMITH 2004). In the neighbouring countries, it is endangered (EN) in Hungary and near-threatened (NT) in the Czech Republic. The species has a scattered occurrence in Slovakia. This is the first record from the Bukovské vrchy Mts. In the Poloniny National Park it was found in the Zbojský potok stream near Nová Sedlica village.

Lewinskya fastigiata (Bruch ex Brid.) Vigalondo, F. Lara et Garilleti – This species is not included in the latest checklist of Slovakia (MIŠÍKOVÁ *et al.* 2020). It was re-established by VIGALONDO *et al.* (2019) based on integrative taxonomic analyses of the *Lewinskya affinis* complex and further description and distinguishing characters were published in VIGALONDO *et al.* (2020). According to DÜLL (1985), it is under the name *Orthotrichum affine* Brid. var. *fastigiatum* (Brid.) Hueb. and it is a taxon of the temperate zone of Europe. As it has been considered as an infraspecific taxon, variety or subspecies of *L. affinis* and has been elevated to the species rank only recently, it has rarely been taken into consideration in bryological works in the region. Therefore, the distribution of this species in Slovakia is not known. So far, there is only one published record of this species from the Poľana Mts (ŠIRKA *et al.* 2020) and one unpublished record from the Turzovská vrchovina Hills (28.07.2022, leg. Skokanová, K., Mereda, P. *et al.*, det. Širka, P. and Papp, B.). In the Poloniny National Park, it was collected from a *Populus tremula* tree near the village of Runina.

Orthotrichum patens Bruch ex Brid. – It is a sub-Atlantic epiphytic moss (DÜLL 1985). It is near-threatened (NT) in Slovakia (MIŠÍKOVÁ *et al.* 2020). In the neighbouring countries, it is endangered (EN) in Austria, vulnerable (VU) in Hungary, near-threatened (NT) in the Czech Republic, and rare in Poland. Probably the national threat status is overestimated, because for example in Hungary, several data of this species have arisen in the last decade (PAPP 2021). It seems to be spreading in the region. In the Poloniny National Park, it also does not seem to be rare. It was found in five investigated forest stands.

Philonotis capillaris Lindb. – It is a northern sub-Atlantic element (DÜLL 1985). It is not included in the latest checklist of Slovakia (MIŠÍKOVÁ *et al.* 2020). There were three unpublished records in the Museum of the Tatra National Park (TNP), but after checking these specimens (1/07434, 1/15510, 1/12803) none of

them proved to be *P. capillaris*. All of them have leaf cells with proximal papillae. Two specimens have papillae tending to be in the middle of the leaf cells, in the lower part of the leaf, which is a character of *P. seriata*. The remaining one specimen is probably *P. fontana*. *P. capillaris* seems to be rare and threatened in the region, because it is red-listed in many countries, e.g. highly endangered in Austria, endangered (EN) in the Czech Republic, vulnerable (VU) in Poland, and near-threatened (NT) in Hungary. In the investigated area it was found in a wet lawn at the World War I monument, near a bus stop in Runina, and in a ditch by the road at the edge of a small wetland in the valley of the Zbojský potok stream near Nová Sedlica village.

Tortula schimperi M. J. Cano, O. Werner et J. Guerra – It is a sub-Atlantic, Mediterranean, montane element (DÜLL 1984). It is not included in the latest checklist of Slovakia (MIŠÍKOVÁ *et al.* 2020). In the past, it was treated as a variety of *T. subulata* (var. *angustata* (Schimp.) Limpr.), hence it was not taken into consideration in some national checklists. Later on, it was elevated to the species rank by CANO *et al.* (2005). After partial revision of herbarium specimens deposited in SLO (Herbarium of Comenius University in Bratislava) by V. Peciar *T. schimperi* was identified from several regions of Slovakia and it seems to be common in the country. In the Poloniny National Park, it was collected on soil on the roadside, in the valley of the Zbojský potok stream, near Nová Sedlica village.

Uloa bruchii Hornsch. ex Brid. – It is an epiphytic species with a northern sub-Atlantic distribution (DÜLL 1985). It is near-threatened (NT) in Slovakia (MIŠÍKOVÁ *et al.* 2020). In the neighbouring countries, it is vulnerable (VU) in Hungary and Poland. In the Poloniny National Park, it was already reported from the Stužica National Nature Reserve (PLÁŠEK 2007). We found it on a *Fagus* tree in the valley of the Zbojský potok stream, near Nová Sedlica village.

Uloa crispula Bruch – It is not included in the latest checklist of Slovakia (MIŠÍKOVÁ *et al.* 2020). It is an epiphytic moss. The study of CAPARRÓS *et al.* (2016) divides the *Uloa crista* complex into three species; *U. crista* s. str., *U. crispula* Bruch, and *U. intermedia* Schimp. The paper of BLOCKEEL (2017) also gives useful details on the correct identification of *Uloa* species. This species of the *Uloa crista* complex was found in the Poloniny National Park on *Fagus* and *Acer platanoides* trees in the valley of the Zbojský potok stream near Nová Sedlica village and on *Fagus* tree near the confluence of the Pľaša and Ulička streams at the road junction towards Runina and Ruské.

Uloa intermedia Schimp. – It is not included in the latest checklist of Slovakia (MIŠÍKOVÁ *et al.* 2020). It is an epiphytic moss, which was also separated from the *Uloa crista* complex by CAPARRÓS *et al.* (2016). The distribution of this species in Slovakia is poorly known, as there is only one published record from the Poľana Mts (ŠIRKA *et al.* 2020). It was found on *Fagus* trees in the Stužica

National Nature Reserve and in the valley of the Zbojský potok stream near Nová Sedlica village.

Zygodon rupestris Schimp. ex Lorentz – It is an epiphytic moss with a sub-Atlantic, Mediterranean distribution (DÜLL 1985). It is endangered (EN) in Slovakia (MIŠÍKOVÁ *et al.* 2020) and red-listed in many countries in the region, e.g. highly endangered in Austria, vulnerable (VU) in Hungary, near-threatened (NT) in the Czech Republic and Poland. In the past, this species was not distinguished from *Z. viridissimus* and therefore its current distribution in Slovakia is poorly known. Recently, it has been reported only from two localities, one in the Muránska planina Mts (PLÁŠEK *et al.* 2016) and the other in the Bukovské vrchy Mts, in the village Ruský Potok (PLÁŠEK 2007). In the studied area of the Poloniny National Park, it was found on the bark of a *Fagus* tree in the Stužica National Nature Reserve and on *Acer* trees in the valley of the Zbojský potok stream near Nová Sedlica village.

CONCLUSIONS

Although bryological research in the Slovak part of the Eastern Carpathians has been relatively intensive, it is far from complete. This is highly proved by the considerable number of species new for the region and for the whole country, reported in this paper. Most of them are due to new taxonomic results in some species groups like the *Lewinskya affinis* or the *Ulota crispa* complexes, but there are some newly discovered taxa in the country, e.g. *Metzgeria consanguinea* or *Philonotis capillaris*. Besides the new country records, several species of European or regional conservation interest were also found during our field work. These data contribute to the better knowledge on the distribution of threatened species and on the factors threatening them and help the effective conservation of bryophytes in the country. Ultimately, the results of this study supplement the knowledge on the bryophyte flora of the Poloniny National Park and the Eastern Carpathians as a whole.

* * *

Acknowledgements – This paper was supported by the Scientific Grant Agency of the Slovak Republic under Grant VEGA 1/0624/21. Many thanks to László Lőkös for his help in field work and to Kristína Pulišová for the map design.

Összefoglaló: A Poloniny Nemzeti Park a Bukovec-hegység része és Szlovákia legkeletibb védett területe. A Keleti-Kárpátokhoz tartozik és Szlovákián belül is egy speciális terület, mivel a legnagyobb őserdők itt találhatók az országban. A régió mohavegetációját a múlt század folyamán jól feltárták és 375 moha taxont mutattak ki a nemzeti park területéről. Jelen cikkben további adatokkal járulunk hozzá a park mohafőrájának ismeretéhez. Összesen 117 mohafajt (egy becősmoha, 16 májmoha és 100 lombosmoha) találtunk a *Dicranum viride*, EU Természetvédelmi Irányelvek lis-

táján szereplő, ún. közösségi jelentőségű faj, populációinak monitorozására irányuló projekt során. Három faj (*Philonotis capillaris*, *Tortula schimperi*, *Ulotia crispula*) új Szlovákia mohafldrájában. 12 fajt először sikerült kimutatnunk a területen. Ezenkívül számos európai vagy regionális szinten veszélyeztetett fajnak a populációit fedeztük fel. Két faj (*Dicranum viride*, *Zygodon rupestris*) veszélyeztetett (EN), három faj (*Anacamptodon splachnoides*, *Anomodon rugelii*, *Didymodon spadiceus*) sérülékeny (VU), és négy faj (*Buxbaumia viridis*, *Orthotrichum patens*, *Phaeoceros carolinianus*, *Ulotia bruchii*) a közel veszélyeztetett (NT) kategóriában szerepel Szlovákia Moha Vörös Listáján.

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(submitted: 7.12.2023; accepted: 25.12.2023)

Appendix. Complete list of bryophyte records.

The numerals following the species names refer to the collection sites listed in Materials and Methods.

Hornworts

Phaeoceros carolinianus (Michx.) Prosk. – 8: bank of a ditch

Liverworts

- Apopellia endiviifolia* (Dicks.) Nebel et D. Quand – 8: bank of a ditch
Calypogeia suecica (Arnell et J. Perss.) Müll. Frib. – 5: decaying wood
Cephaloziella divaricata (Sm.) Schiffn. – 7: on soil
Chiloscyphus pallescens (Ehrh.) Dumort. – 8: on soil
Frullania dilatata (L.) Dumort. – 4, 6, 7: *Fagus* bark; 8: bark of *Fagus* and *Acer pseudo-platanus*
Fuscocephaloziopsis connivens (Dicks.) Váňa et L. Söderstr. – 5: decaying wood
Lophocolea heterophylla (Schrad.) Dumort. – 8, 12: decaying wood near stream
Metzgeria conjugata Lindb. – 2, 6: *Fagus* bark; 8: on soil
Metzgeria consanguinea Schiffn. – 8: *Fagus* bark
Metzgeria furcata (L.) Corda – 1, 4, 5, 6, 11, 12: *Fagus* bark; 8: bark of *Fagus*, *Acer platanoides*, and *A. pseudoplatanus*; 9: *Carpinus* bark
Nowellia curvifolia (Dicks.) Mitt. – 5, 12: decaying wood
Pellia epiphylla (L.) Corda – 6: at a source
Porella cordaeana (Huebener) Moore – 2, 5: *Fagus* bark
Porella platyphylla (L.) Pfeiff. – 6: *Fagus* bark; 8: bark of *Acer pseudoplatanus*, 9: *Carpinus* bark
Radula complanata (L.) Dumort. – 1, 2, 4, 5, 6: *Fagus* bark, 8: bark of *Fagus* and *Acer platanoides*
Riccardia palmata (Hedw.) Carruth. – 5: decaying wood; 8: decaying wood at the stream

Mosses

- Alleniella complanata* (Hedw.) S. Olsson, Enroth et D. Quandt – 2, 5, 6: *Fagus* bark
Amblystegium serpens (Hedw.) Schimp. – 11: *Fagus* bark
Anacamptodon splachnoides (Froel. ex Brid.) Brid. – 4: *Fagus* bark
Anomodon longifolius (Schleich. ex Brid.) Hartm. – 2, 5, 6: *Fagus* bark
Anomodon rugelii (Müll. Hal.) Keissl. – 5: *Fagus* bark
Anomodon viticulosus (Hedw.) Hook. et Taylor – 2, 5, 6: *Fagus* bark; 8: bark of *Acer platanoides*, 9: *Carpinus* bark
Atrichum undulatum (Hedw.) P. Beauv. – 3: on soil; 9: on soil in *Carpinetum*
Aulacomnium palustre (Hedw.) Schwägr. – 2: on soil
Barbula unguiculata Hedw. – 8: on soil

- Brachytheciastrum velutinum* (Hedw.) Ignatov et Huttunen – 1, 11: *Fagus* bark; 8: on soil; 9: on soil in *Carpinetum*
- Brachythecium albicans* (Hedw.) Schimp. – 2, 7: on soil
- Brachythecium geheebii* Milde – 5, 6: *Fagus* bark
- Brachythecium rutabulum* (Hedw.) Schimp. – 2, 7: on soil; 8: wet meadow 9: in a meadow and *Carpinus* bark
- Brachythecium salebrosum* (Hoffm. ex F. Weber et D. Mohr) Schimp. – 7: bark of *Populus tremula*
- Bryum dichotomum* Hedw. – 7: on soil
- Buxbaumia viridis* (Moug. ex Lam. et DC.) Brid. ex Moug. et Nestl. – 12: decaying wood (fir)
- Calliergonella cuspidata* (Hedw.) Loeske – 8: wet meadow; 9: in a meadow
- Calliergonella lindbergii* (Mitt.) Hedenäs – 8: by the stream and wet meadow
- Campyliadelphus chrysophyllus* (Brid.) R. S. Chopra – 9: in a meadow
- Chionoloma tenuirostre* (Hook. et Taylor) M. Alonso, M. J. Cano et J. A. Jiménez – 8: on soil
- Cirriphyllum piliferum* (Hedw.) Grout – 2, 8: on soil
- Climacium dendroides* (Hedw.) F. Weber et D. Mohr – 2: on soil
- Cratoneuron filicinum* (Hedw.) Spruce – 6: at a source
- Ctenidium molluscum* (Hedw.) Mitt. – 8: on soil
- Dichodontium pellucidum* (Hedw.) Schimp. – 8: rocks in the stream
- Dicranella heteromalla* (Hedw.) Schimp. – 1, 3: on soil
- Dicranella subulata* (Hedw.) Schimp. – 8: wet meadow
- Dicranodontium denudatum* (Brid.) E. Britton – 5, 12: decaying wood
- Dicranum montanum* Hedw. – 1, 12: decaying wood; 8: *Fagus* bark
- Dicranum scoparium* Hedw. – 1, 10: *Fagus* bark; 12: decaying wood and on bases of *Fagus sylvatica*
- Dicranum viride* (Sull. et Lesq.) Lindb. – 1, 2, 3, 4, 5, 6, 10, 11, 12: *Fagus* bark; 8: bark of *Acer platanoides* and *A. pseudoplatanus*; 9: bark of *Carpinus betulus* and *Betula pendula*
- Didymodon spadiceus* (Mitt.) Limpr. – 8: rocks in the stream
- Diphyscium foliosum* (Hedw.) D. Mohr – 3: on soil; 9: on soil in *Carpinetum*
- Drepanocladus aduncus* (Hedw.) Warnst. – 7: on soil; 9: in a meadow
- Eurhynchium angustirete* (Broth.) T. J. Kop. – 8: on soil
- Fissidens bryoides* Hedw. – 8: on soil
- Herzogiella seligeri* (Brid.) Z. Iwats. – 1, 10, 12: decaying wood
- Homalia trichomanoides* (Hedw.) Brid. – 1, 2, 5, 6: *Fagus* bark; 8: on soil, bark of *Fagus* and *Acer pseudoplatanus*
- Homalothecium sericeum* (Hedw.) Schimp. – 6: *Fagus* bark; 8: bark of *Acer platanoides* and *A. pseudoplatanus*
- Hygrohypnum luridum* (Hedw.) Jenn. – 8: rocks in the stream
- Hylocomium splendens* (Hedw.) Schimp. – 2: on soil
- Hypnum cupressiforme* Hedw. – 1: acidic rock and *Fagus* bark; 4, 5, 6, 8, 10, 11, 12: *Fagus* bark, 7: bark of *Populus tremula*; 9: bark of *Carpinus betulus*, *Betula pendula* and *Fagus sylvatica*

- Jochenia pallescens* (Hedw.) Hedenäs, Schlesak et D. Quandt – 1: *Fagus* bark; 5, 12: decaying wood
- Isothecium alopecuroides* (Lam. ex Dubois) Isov. – 1, 4, 5, 6, 10, 12: *Fagus* bark; 8: on soil, bark of *Fagus* and *Acer pseudoplatanus*
- Leskea polycarpa* Hedw. – 7: bark of *Populus tremula*
- Leucodon sciuroides* (Hedw.) Schwägr. – 5, 6: *Fagus* bark; 8: bark of *Acer platanoides* and *A. pseudoplatanus*
- Lewinskya affinis* (Schrad. ex Brid.) F. Lara, Garilleti et Goffinet – 1: *Fagus* bark, 7: bark of *Populus tremula*
- Lewinskya fastigiata* (Bruch ex Brid.) Vigalondo, F. Lara et Garilleti – 7: bark of *Populus tremula*
- Lewinskya speciosa* (Nees) F. Lara, Garilleti et Goffinet – 1, 5: *Fagus* bark; 7: bark of *Populus tremula*
- Lewinskya striata* (Hedw.) F. Lara, Garilleti et Goffinet – 7: bark of *Populus tremula*
- Mnium marginatum* (Dicks.) P. Beauv. – 2: *Fagus* bark
- Mnium stellare* Hedw. – 6: *Fagus* bark
- Nyholmiella obtusifolia* (Brid.) Holmen et E. Warncke – 7: bark of *Populus tremula*
- Orthotrichum pallens* Bruch ex Brid. – 1, 5, 6: *Fagus* bark; 7: bark of *Populus tremula*
- Orthotrichum patens* Bruch ex Brid. – 1, 2, 5, 6, 8: *Fagus* bark
- Orthotrichum stramineum* Hornsch. ex Brid. – 7: bark of *Populus tremula*; 8: *Fagus* bark and bark of *Acer platanoides*
- Oxyrrhynchium hians* (Hedw.) Loeske – 2: on soil
- Palustriella commutata* (Hedw.) Ochyra – 6: at a source
- Paraleucobryum longifolium* (Hedw.) Loeske – 1: acidic rock; 3, 4, 5, 6, 10, 11, 12: *Fagus* bark
- Philonotis capillaris* Lindb. – 2: on soil; 8: on the bank of a ditch
- Plagiochila asplenioides* (L.) Dumort. – 8: on soil
- Plagiochila porelloides* (Torr. ex Nees) Lindenb. – 2, 4, 5: *Fagus* bark; 6: at a source; 8: on soil
- Plagiomnium affine* (Blandow ex Funck) T. J. Kop. – 1, 6: on soil; 9: on soil in *Carpinetum*
- Plagiomnium cuspidatum* (Hedw.) T. J. Kop. – 6: *Fagus* bark; 8: on soil and *Fagus* bark
- Plagiomnium rostratum* (Schrad.) T. J. Kop. – 8: on soil
- Plagiothecium cavifolium* (Brid.) Z. Iwats. – 1: on the base of *Fagus* tree; 9: on soil in *Carpinetum*
- Plagiothecium curvifolium* Schlieph. ex Limpr. – 1, 12: on the base of *Fagus* tree
- Plagiothecium denticulatum* (Hedw.) Schimp. – 1: on the base of *Fagus* tree
- Platygyrium repens* (Brid.) Schimp. – 5, 12: *Fagus* bark; 7: bark of *Populus tremula*
- Pleurozium schreberi* (Willd. ex Brid.) Mitt. – 2: on soil
- Pohlia nutans* (Hedw.) Lindb. – 9: on soil in *Carpinetum*
- Pohlia wahlenbergii* (F. Weber et D. Mohr) A. L. Andrews – 8: wet meadow
- Polytrichum formosum* Hedw. – 1, 8: on soil
- Pseudanomodon attenuatus* (Hedw.) Ignatov et Fedosov – 2, 5, 6: *Fagus* bark; 8: bark of *Acer pseudoplatanus*; 9: *Carpinus* bark

- Pseudoamblystegium subtile* (Hedw.) Vanderp. et Hedenäs – 5, 6: *Fagus* bark; 8: bark of *Acer pseudoplatanus*
- Pseudoleskeella nervosa* (Brid.) Nyholm – 3, 4, 5, 6, 11, 12: *Fagus* bark; 8: bark of *Acer pseudoplatanus*; 9: *Carpinus* bark
- Pseudoscleropodium purum* (Hedw.) M. Fleisch. – 9: in a meadow
- Pterigynandrum filiforme* Hedw. – 2, 4, 5, 6, 8, 10, 11: *Fagus* bark, 9: *Carpinus* bark
- Ptychostomum moravicum* (Podp.) Ros et Mazimpaka – 1, 5, 6: *Fagus* bark; 8: on soil; 9: *Carpinus* bark
- Ptychostomum pseudotriquetrum* (Hedw.) J. R. Spence et H. P. Ramsay ex Holyoak et N. Pedersen – 2: on soil
- Pulviger a lyellii* (Hook. et Taylor) Plášek, Sawicki et Ochyra – 8: bark of *Acer platanoides*
- Pylaisia polyantha* (Hedw.) Schimp. – 6: *Fagus* bark; 7: bark of *Populus tremula*
- Racomitrium canescens* (Hedw.) Brid. – 2: on soil
- Rhizomnium punctatum* (Hedw.) T. J. Kop. – 5: decaying wood; decaying wood at the stream
- Rhynchostegium riparioides* (Hedw.) Cardot – 8: rocks in the stream
- Rhytidiadelphus squarrosus* (Hedw.) Warnst. – 2: on soil
- Sanionia uncinata* (Hedw.) Loeske – 1: *Fagus* bark
- Schistidium apocarpum* (Hedw.) Bruch et Schimp. – 8: rocks in the stream
- Sciuro-hypnum populeum* (Hedw.) Ignatov et Huttunen – 5, 6, 11: *Fagus* bark; 8: on soil and bark of *Acer platanoides*
- Sciuro-hypnum reflexum* (Starke) Ignatov et Huttunen – 3, 5: *Fagus* bark
- Streblotrichum convolutum* (Hedw.) P. Beauv. – 7: on soil
- Thuidium assimile* (Mitt.) A. Jaeger – 2: on soil; 9: in a meadow
- Thuidium tamariscinum* (Hedw.) Schimp. – 6: at a source
- Tortula schimperii* M. J. Cano, O. Werner et J. Guerra – 8: on soil
- Tortula truncata* (Hedw.) Mitt. – 7: on soil; 8: wet meadow
- Ulot a bruchii* Hornsch. ex Brid. – 8: *Fagus* bark
- Ulot a crisp a* (Hedw.) Brid. – 1, 2: *Fagus* bark; 8: bark of *Fagus*, *Acer platanoides* and *A. pseudoplatanus*
- Ulot a crispula* Bruch – 1: *Fagus* bark; 8: bark of *Fagus* and *Acer platanoides*
- Ulot a intermedia* Schimp. – 5, 8: *Fagus* bark
- Zygodon rupestris* Schimp. ex Lorentz – 5: *Fagus* bark; 8: bark of *Acer platanoides* and *A. pseudoplatanus*