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THE *SPHAGNUM* POPULATIONS OF THE ZEMPLÉN MTS, NE HUNGARY

E. SZURDOKI[1], Z. TÓTH[2] and G. PELLES[3]

[1]*Department of Botany, Hungarian Natural History Museum*
H-1476 Budapest, Pf. 222, Hungary
[2]*Department of Plant Taxonomy and Ecology, Loránd Eötvös University*
H-1083 Budapest, Ludovika tér 2, Hungary
[3]*Bükk National Park, Zemplén Landscape Protected Area*
H-3980 Sátoraljaújhely, Némahegy u. 7, Hungary

This paper summarises the *Sphagnum* occurrences of the Zemplén Mts. The authors mapped these, revised the collection material from this area and compared the old and new data. Nine *Sphagnum* occurrences were described from the mountains earlier, of which 6 locations still exist, and 10 new occurrences were identified. Earlier 5 species of peatmoss were collected from this area but recent studies have proven the presence of 14 species, of which 9 are new for the Zemplén Mts and one is new for Hungary. Four groups of habitats were established according to decreasing moisture: peat accumulating fens, *Sphagnum* occurrences along springs, streams and in other wet habitats, *Sphagnum* occurrences on moist roadside embankments and in temporarily wet places with occasional runoff, and *Sphagnum* occurrences in forest.

Key words: *Sphagnum* occurrences, Zemplén Mts, floristics, bryophytes

INTRODUCTION

Sphagna in Hungary are quite rare, they or their habitats are protected, and their occurrences were documented more or less accurately (mapped, specimens collected and the results published), so the old data can be checked, though in many cases with uncertainties, adequately.

In the northern part of the Zemplén Mts numerous *Sphagnum* occurrences are known. In these mountains, László Vajda was the first scientist to make an overall bryofloristical study. He published the results of his 10–15-year long collecting work in 1969. Ádám Boros also collected bryophytes in this area (and his documentation is also accessible by the way of his Floristical notes (BOROS 1947, 1948, 1949) and in the herbarium at BP). Tibor Simon carried out vegetation studies including collecting bryophytes, in the Zemplén Mts in the 1960s and 1970s (SIMON 1970, 1971, 1977*a, b*).

A recent floristical investigation on Hungarian *Sphagna* was started by the authors in 1994, and as part of the overall research, the study of the *Sphagnum* flora of the Zemplén Mts was started in 1997.

The aims of this study have been the following:
- mapping *Sphagnum* populations of the Zemplén Mts,
- grouping *Sphagnum* occurrences based on their habitat categories,
- revision of *Sphagnum* specimens, collected in these areas,
- comparison of recent and old data.

STUDY AREA

The Zemplén Mts is part of the Northern Mountain Range and is situated in the northeastern part of Hungary, between Bodrogköz and the Hernád Valley.

The Zemplén Mts is strongly divided by streams, which belong to two catchment areas. These ranges, after Simon's investigations (SIMON 1977*a*), can be divided into two parts on the basis of climate, soil conditions and plant distribution. The description of climate, bedrock, soil and vegetation of the Zemplén Mts follows Simon's overall study (SIMON 1977*a*). The Carpathian influenced northern part of the mountains, has more moist and cold climate than the southern part, which has a continental influence. In the southern part, the average annual precipitation is between 550 and 700 mm, the mean annual temperature is between 8–9 °C. In the northern part, the average annual rainfall is between 700 and 800 mm and the mean annual temperature is under 8 °C. Main bedrock types are riolite, andesite and silicate, covered by brown forest soils.

The subsequent zonal associations, from lower to high elevations, are usually dominated by oaks, hornbeam and beach (versions of *Quercetum petraeae-cerris, Carpino-Quercetum* and *Fagetum*). There are extensive planted spruce forests too. In the southern part, on the warm, dry and sunny slopes there are also shrub forests, open oak forests and open scrubs on loess. In the northern part of the range, on acidic soil, acidophilous oak and beech forests (*Luzulo-Genisto tinctoriae-Quercetum, Luzulo-Deschampsio-Fagetum*) are found with numerous Carpathian plants. In the degraded parts of the forests birch stands appear mixed with heath stands (*Betulo-Callunetum*). On open slopes, extensive presence of *Nardetum* can be observed. In addition, there are montane alder forests, fens and on the dryer parts meadows in the valleys.

METHODS

The nomenclature of bryophytes follows CORLEY *et al.* (1981, 1991) and GROLLE (1983); for vascular plants and regarding associations, SIMON (1992).

The following works, collections and other sources have been consulted during this study: publications of VAJDA (1969), BOROS (1964, 1968), SIMON (1971, 1977a, b), floristical notes of BOROS (1947, 1948, 1949) and VAJDA (1948, 1951, 1953, 1956, 1957) (preserved at BP) and the bryological collections at BP and the Bryophyte Collection of EKTF Botanical Department (EGR). The collecting diaries, especially a hand drawn map of Vajda (that was found among his floristical notes), provided an important role in the localisation of *Sphagnum* occurrences.

Some new peatmoss populations, to be described in the present study, were found and partly reported by other botanist colleagues.

The revision of the *Sphagnum* specimens from the Zemplén Mts were confined to the collections at BP and EGR – since these institutes are holding most material available regarding this group.

During the fieldwork between 1997 and 1999, the occurrences were located as exactly as possible, they were marked on maps (scale 1 : 10,000), their size was estimated and both Sphagna and the associating bryophytes were collected. Also forestry maps (scale 1 : 25,000) were used to identify locations and record local names of forest compartments (containing the town name combined with numbers of the specific compartment and subcompartment). These collections will also be part of the herbaria at BP and at the Bryophyte Herbarium of Z. Tóth. Since the field trips were mostly conducted in early spring and autumn, lists of vascular plants were not assembled.

The occurrences were grouped on the basis of habitat conditions and by *Sphagnum* species.

RESULTS

Nine *Sphagnum* locations were described from the mountains earlier, of which 6 occurrence still exist, and 10 new occurrences were identified recently (see Tables 1–3). Earlier, 5 species of peatmoss were collected from this area but recent studies have proven the presence of 14 species (10 are new for the Zemplén Mts, see Tables 1–3). Four groups of habitats were established according to decreasing moisture: peat accumulating fens, *Sphagnum* occurrences along springs, streams and in other wet habitat, *Sphagnum* occurrences on moist roadside embankments and in temporarily wet places with occasional runoff, and *Sphagnum* occurrences in forests. All 19 occurrences known to date have been marked on the map (Fig. 1).

Peat accumulating fens of Komlóska and Kemence Valleys

The most beautiful valleys of the Zemplén Mts are the Komlóska and Kemence Valleys, which have a Carpathian character in both their landscapes and floristical properties. Fens and montane alder forests (*Carici brisoidi-Alnetum*) are situated along the streams (JÁRAI-KOMLÓDI and SIMON 1971). The main plant association, characterising the peat accumulating fens, is *Carici echinatae-Sphagnetum*, which has eriophoretosum latifolii and molinetosum subassociations (VOJTKÓ and MARSCHALL 1995).

The first *Sphagnum* specimens from these valleys were collected by Soó in 1938 (SOÓ 1938, BP), with the label containing a general location named "Kemence Valley, near Pálháza". These specimens were identified by BOROS as *Sphagnum contortum* and "*S. subbicolor*" (recently accepted name: *S. centrale*). Vajda has also found *Sphagna*, first in Kemence Valley, and later in Komlóska

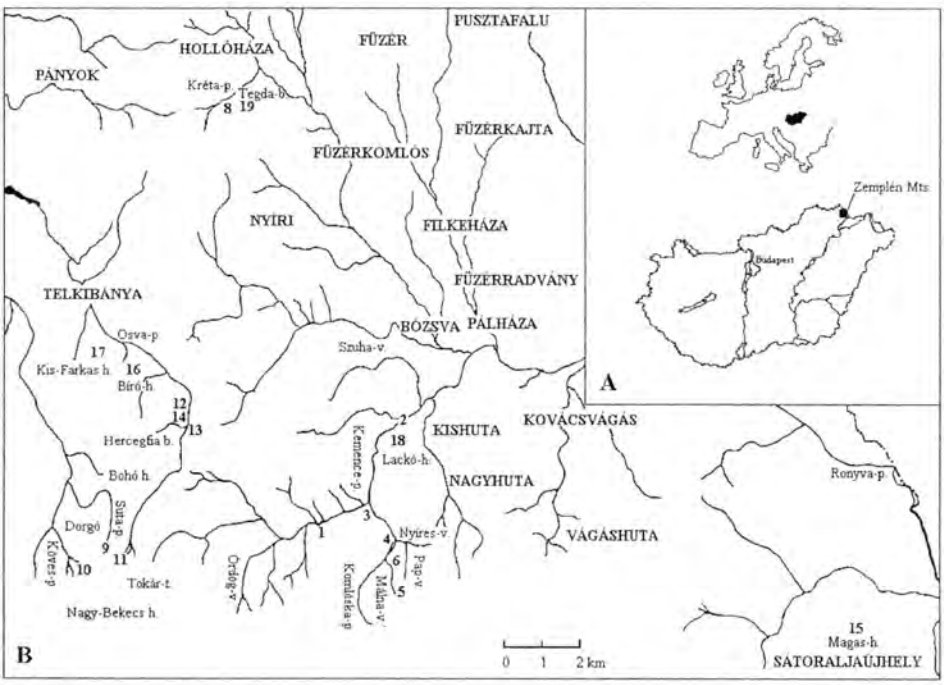


Fig. 1. A = Map of Hungary. B = The map of the investigated area (drawn on the basis of Hungarian Tourist Map number 22) shows the distribution of the *Sphagnum* occurrences. Key: 1–19. Number of occurrences (see text), p = patak (stream), v = völgy (valley), h = hegy (hill or mountain), t = tető (hill or heights), b = bérc (hilltop).

Table 1. *Sphagnum* occurrences of peat accumulating fens of Komlóska and Kemence valleys. The table shows the old and new *Sphagnum* occurrences by species; the old ones, reported earlier and have been revised, while the new ones are results of recent studies.

Sphagnum species	Kemence valley				Komlóska valley and connected valley							
	1		2		3		4		5		6	
	old	new	old	new	old	new	old	new	old	new	old	new
S. centrale	+	+			+	+	+				+	
S. compactum								+				
S. contortum	+	+		+	+	+	+	+				
S. palustre	+				+				+		+	

Valley (as well as in other valleys connected to Komlóska). He visited this area many times in the following years: 1948, 1951, 1953, 1956, 1957 (VAJDA1948, 1951, 1953, 1956, 1957). Boros visited these valleys too (BOROS 1947, 1948, 1949); he collected the same *Sphagna* in Komlóska Valley from 1947, 1948, 1949 and later he also recorded them from Kemence Valley (1949). Investigations of Vajda and Boros resulted in five exact *Sphagnum* occurrences in these valleys, and their identified the specimens as *S. palustre* and *S. contortum*. Simon worked here in the 1960s and 1970s, and he published occurrences of the same peatmoss species (SIMON 1977*b*).

BP and EGR have extensive collections of *Sphagnum* specimens from these valleys (collectors: Boros, Vajda, Soó, Pócs and Bakalár). All specimens were re-

Table 2. *Sphagnum* occurrences along springs, streams and waterstanding places. The table shows the old ones, reported earlier and have been revised, while the new ones are results of recent studies.

Sphagnum species	*Sphagnum* occurrences along springs, streams and waterstanding places									
	7		8		9		10		11	
	old	new	old	new	old	new	old	new	old	new
S. fallax				+		+				+
S. fimbriatum				+		+		+		
S. magellanicum						+				
S. obtusum								+		
S. palustre										+
S. riparium								+		
S. squarrosum				+		+				
S. subsecundum										+
S. teres	+									

vised, and our study (mainly based on the difference in cross-section of branch leaves) has proven that some *S. centrale* specimens were found among those labelled as *S. palustre*. These two species have similar morphological characters, and the subtle differences can only be observed through study in microscope. The shape of stem leaves and the cross-section of branch leaves distinguishes the two species. In cross-section, the green cells of *S. palustre* are triangular or of trapezoid shape and are closed among the hyaline cells only on the abaxial side of the leaves and exposed widely on the adaxial side. Green cells of *S. centrale* are of oval shape, and are strongly thickened at the adaxial walls (DANIELS and EDDY 1985). *S. palustre* is relatively the most wide-spread species of the genus in Hungary, and its occurrence can be expected on the fens. It should be noted, that identification of peatmosses (e.g. WARNSTORF 1911) in the time of Boros and Vajda was indeed difficult and *S. centrale* was treated as the subspecies of *S. palustre* in many references (which is true even nowadays).

Sphagnum occurrences of Kemence Valley

Near Kőkapu, *Sphagna* can be found in a fen (see 1 on Fig. 1 and Table 1), as it was published by VAJDA(1969), BOROS (1964, 1968) and also SIMON(1977*b*). They recognised the presence of *S. palustre* (the authors' revision has resulted in the recognition of *S. palustre* and *S. centrale* among the collected material) and *S. contortum*. Today a well visible takeover of the area by alder stands is observed in the fen, shading and suppressing the peatmosses. Thus, *S. centrale* and *S. contortum* can only live in larger patches in the open parts of the habitat with sufficient light. The other bryophyte species of the habitat are: *Lophocolea heterophylla, Calliergonella cuspidata, Climacium dendroides, Plagiomnium affine, Plagiomnium undulatum, Pleurozium schreberi* and *Polytrichum formosum*.

Table 3. *Sphagnum* occurrences on moist roadsides and on the water-flooded places and in forests. The table shows the old and new *Sphagnum* occurrences by species; the old ones, reported earlier and have been revised, while the new ones are results of recent studies.

Sphagnum species	Moist roadsides and on the water-flooded places												Forests			
	12		13		14		15		16		17		18		19	
	old	new	old	new	old	new	old	new	old	new	old	new	old	new	old	new
S. capillifolium																+
S. fallax				+		+		+								
S. flexuosum		+														
S. palustre									+		+					
S. quinquefarium													+	+		

Recently *Sphagnum contortum* was discovered (see 2 on Fig. 1 and Table 1) in a fen in front of the Dzedó Valley, near the local railway (Kishuta 20RL stand). The other bryophytes of the habitat are *Aulacomnium palustre, Calliergonella cuspidata, Fissidens taxifolius, Plagiomnium medium, Philonotis caespitosa.*

Sphagnum occurrences of the Komlóska Valley-complex

The first occurrence of peatmosses is situated near the merge of Komlóska and Kemence Valleys, not far from the local railway (see 3 on Fig. 1 and Table 1; Nagyhuta 85 Ti3 stand). Earlier collectors (VAJDA 1969, BOROS 1964, 1968 and SIMON 1977*b*) recognised *S. palustre* (the authors' revision has resulted in the recognition of *S. palustre* and *S. centrale* among the collected material) and *S. contortum*. Recently, *S. centrale* and *S. contortum* grow there with *Calliergonella cuspidata*. In the nearby alder forest no peatmosses were detected.

From the place named "Borzás oldal" (in front of Nyíres Valley, Nagyhuta 77 RL forest stand) *S. centrale* has completely disappeared (earlier it was identified as *S. palustre*), but *S. contortum* still thrives there (see 4 on Fig. 1 and Table 1). However, *S. compactum* (with sporophyte) is new to the whole area of the Zemplén Mts. The total cover of peatmosses at "Borzás oldal" is about 100 m^2. This occurrence was earlier reported by SIMON (1977*b*).

We found that *S. palustre*, which was a correct identification by Vajda (1969), has completely disappeared from the Málna Valley (see 5 on Fig. 1 and Table 1).

We also found that *S. palustre* and *S. centrale* (the authors' revision has resulted in the recognition of *S. centrale* among the collected material) have completely disappeared from the Pap Valley (see 6 on Fig. 1 and Table 1). This occurrence was reported earlier by VAJDA (1969).

Sphagnum occurrences along springs, streams and in other wet habitats

In recent years, numerous new *Sphagnum* occurrences were recognised along the springs and small streams of the Zemplén Mts. It is interesting that all *Sphagna* in these localities are new to the moss flora of the investigated area. These occurrences can not be regarded as classifiable *Sphagnum* communities, since they appear to be recent establishments of *Sphagna*.

The following occurrences belong to this category:

VAJDA (1959, 1969) has found a *Sphagnum teres* patch near Telkibánya along the Ósva stream (see 7 on Fig. 1 and Table 2). Repeated search has not confirmed this occurrence.

Several peatmoss species appeared around the springs of Tegda Valley near Füzér (see 8 on Fig. 1 and Table 2; Füzér 12J forest stand). The peatmosses grow in a disturbed, secondary, wet and open birch stand, mainly around springs and brooks. The patches were observed in an area of about 100 m². Beside the most frequent *S. fimbriatum*, small patches of *S. squarrosum* and *S. fallax* occur in this place. The other bryophytes of this habitat are *Calypogeia muellerana, Chiloscyphus pallescens, Amblystegium riparium, Brachythecium rivulare, B. rutabulum, Calliergonella cuspidata, C. lindbergii, Hylocomium splendens, Mnium hornum, Philonotis caespitosa, Plagiomnium elatum, P. ellipticum, P. medium, Plagiothecium laetum, Polytrichum formosum, Rhytidiadelphus squarrosus.*

The following occurrence (see 9 on Fig. 1 and Table 2) is situated south of the hunting lodge of Dorgó, near the springs of Suta stream (Háromhuta 2F forest stand, at the mark numbered 44). *S. fimbriatum* is the most frequent peatmoss there, and small amounts of *S. fallax, S. magellanicum* and *S. squarrosum* are present also. The *Sphagnum* species form a mixed carpet and the total area of the patches is estimated at 10–20 m², while there are also some small patches of *S. fimbriatum*.

There is a *Sphagnum* occurrence at the upper part of Köves stream (see 10 on Fig. 1 and Table 2), in the spruce stands of "Kis-Bohó-rét" (Regéc 61B forest stand). The small (0.25–0.5 m²) patches grow around a small depression with permanent standing water. Three *S. fimbriatum* patches were observed and a mixed one, composed of *S. fimbriatum, S. obtusum* and *S. riparium*. The latter (*S. riparium*) is a new record for the present territory of Hungary.

The last occurrences can be found in the meadow called Tó-oldal, at the foot of Nagy-Bekecs Hill (see 11 on Fig. 1 and Table 2). One part of the wet meadow consists of a tall-sedge community, in the other part *Calamagrostis canescens* stand grows, and there is a hornbeam-oak stand around the meadow. The peatmoss carpet is situated under the *Calamagrostis* and spreads into the edge of the forest stand but cannot be found under the sedges. There are numerous large patches of *S. fallax* and smaller ones of *S. subsecundum* and *S. palustre* in the 50 m² sized place. Unusually loose patches of *Sphagnum* under the *Calamagrostis* look viable.

Sphagnum occurrences on moist roadside embankments and in temporarily wet places with occasional runoff

These *Sphagnum* occurrences are usually found on acidic soils. These patches consist of peatmoss species different from those in forest occurrences (see below). On these places grow for example *S. palustre, S. girgensohnii, S. obtusum* and *S. compactum*. Habitats, very similar to these, have been reported earlier in the

Vendvidék and in Őrség (PÓCS 1958), in the Kőszeg Mts, and in Tarnavidék (BAKALÁR *et al.* 1975), as well as from the Zemplén Mts. *S. fallax* and *S. flexuosum* are new species for the Zemplén Mts.

The following occurrences belong to this category:

There is a *Sphagnum flexuosum* patch in Bika-rét (see 12 on Fig. 1 and Table 3), under the young spruce stand (Telkibánya 10F forest stand). It grows in moist, acidic forest-soil near extensive populations of *Lycopodium annotinum* (ÓDOR 1996).

There are *Sphagnum fallax* patches on the roadside embankment near Csaponta spring, (see 13 on Fig. 1 and Table 3, Telkibánya) and in front of the northeastern slope of Hercegfia-bérc (see 14 on Fig. 1 and Table 3, Telkibánya 68I forest stand). On Hercegfia-bérc, the peatmoss grows with *Lycopodium annotinum, Calamagrostis epigeios, Agrostis capillaris and Molinia arundinacea.*

There is a new *Sphagnum fallax* occurrence (15 on Fig. 1 and Table 3) on the side of the ski-run of Magas Hill (Sátoraljaújhely). The size of the patch is about 0.5 m^2. When SIMON (1970) made a bryocoenological and ecological study in the Zemplén Mts, he collected data from Magas Hill too, but he did not find any *Sphagnum* there.

Near Telkibánya, Vajda (VAJDA 1959, 1969) found *S. palustre* on Bíró Hill (16 on Fig. 1 and Table 3) and on Kis Farkas Hill (17 on Fig. 1 and Table 3). The authors did not find the vouchers from Kis Farkas Hill either in BP or in EGR, but they could find the specimen from the Bíró Hill in EGR (it was correctly identified as *S. palustre*). These two occurrences have not been found by authors so far.

Sphagnum occurrences in forests

In Hungary, *Sphagnum* patches can rarely be found even on acidic forest soil, because they need suitably moist, cool and humid microclimate beside the basic need of lime free soil. The most typical forest occurrences of *Sphagnum* were described from Vendvidék and Őrség (PÓCS 1958) and Vasi-Hegyhát (BARBALICS 1967), where these patches are composed of *S. capillifolium, S. rubellum, S. quinquefarium* and rarely of *S. russowii* (PÓCS 1958, SZURDOKI 1996). Similar forest occurrences can be also found in the Zemplén Mts.

On the riolite bedrock of Lackó Hill, the acidophilous oak forests and beech forests are mixed with birch stands (SIMON 1977*b*). On the boulder of the northern slope a small *Sphagnum* patch thrives (see 18 on Fig. 1 and Table 3). This occurrence was reported earlier (SOÓ 1938, BOROS 1953, 1964, 1968, VAJDA 1951, 1953, 1955, 1969, SIMON 1977*b*) as a fairly large, of several m^2 sized patch of *Sphagnum*. Today, this is very small, only a few dm^2 sized patch of *Sphagnum*

quinquefarium grows on the humus covered rock, in the shade of old beech trees. The peatmoss occurs in a large *Dicranodontium denudatum* carpet with *Vaccinium myrtillus, Vaccinium vitis-idaea* and *Polypodium vulgare*. Other bryophytes of this habitat are *Blepharostoma trichophyllum, Bazzania trilobata, Lepidozia reptans, Lophocolea heterophylla, Plagiochila porelloides, Dicranum scoparium, Hylocomium splendens, Hypnum cupressiforme, Leucobryum glaucum, Orthodicranum montanum, Plagiomnium elatum, Plagiothecium laetum, Plagiothecium succulentum, Polytrichum formosum, Tetraphis pellucida*.

In the above mentioned publications, several authors have made reference to this peatmoss patch. However, these descriptions were not precise enough and make an impression that they did not speak about the same occurrence. The first specimen was collected by Antal Margittai in 1938 (SOÓ 1938) and identified by Boros as *S. acutifolium* (today *S. capillifolium*). Vajda visited Lackó Hill and collected *Sphagnum* specimens in 1951, 1953 and 1955 (VAJDA 1951, 1953, 1955), and Boros has collected peatmoss from the forest occurrence of Lackó Hill in 1953 (BOROS 1953). The label information of the specimen of Margittai reads: "in an oak forest, on the andesite rock in the Kemence Valley, near Pálháza"; in the diary of Vajda: "... *S. acutifolium* grows with *Plagiothecium elegans* at the end of the road from Kishuta to Kemence Valley, on the second boulder after the wooden bridge"; in the diary of Boros: "... andesite boulder of the forest, not far from the bridge of Kishuta". In their floristical notes (BOROS 1953, VAJDA 1951, 1953, 1955) and publications (BOROS 1964, 1968, VAJDA 1969) they did not mention that this was the same patch as Margittai's. These specimens were published as *S. capillifolium*, which was later revised as *S. quinquefarium* (Boros sent some specimens to specialists). Although the result of this revision was not published, the authors could detect it from the labels of specimens, as well as the correspondence attached to them. Simon (1977*b*) mentioned this occurrence, as well as the revised name. According to Simon (personal communication), this was the only *Sphagnum* occurrence on Lackó Hill and all earlier reports must have reported on the same.

There is a new forest occurrence of peatmoss near Füzér (see 19 on Fig. 1 and Table 3; Füzér 12C forest stand). The 0.5 m² sized red *S. capillifolium* patch is located on the soil around the heath. This biotope is composed of *Vaccinium myrtillus, Vaccinium vitis-idaea*, and birch. Other bryophytes of the habitat are: *Barbilophozia barbata, Ptilidium pulcherrimum, Atrichum undulatum, Dicranum scoparium, Hylocomium splendens, Hypnum cupressiforme, Plagiothecium denticulatum, Pleurozium schreberi*.

DISCUSSION

The larger mires and fens are well-known, they can be easily localised, and may exist for a long period of time. There are numerous publications, data in herbaria and vegetation maps which help the scientist who investigates the changes in the vegetation. The comparative study, however, is not easy and the scientist can only show the main directions of changes and register the appearance or disappearance of species in the large vegetation units.

The largest *Sphagnum* occurrences of peat accumulated fens along the Komlóska and Kemence Valleys (1, 3, 4), which have a good water supply, could survive in the last decades and presumably will exist in the future too. The *Sphagnum* species of some occurrences described earlier along these valley systems have shown certain changes (1, 3, 4); there is a new occurrence (2) and some occurrences have disappeared (5, 6). *S. contortum* is the most frequent peatmoss, the quantity of *S. centrale* has been decreasing and *S. palustre* was not found by the authors in the whole valley-systems. There is a species, *S. compactum*, new to the whole investigated area.

The smaller *Sphagnum* patches and occurrences are less-known. Once located, it is difficult, or in most cases, impossible to decide whether these are new or old establishments. Nobody really knows the dynamics of these patches and occurrences of *Sphagnum*, when and why they colonise a certain place, where the propagulums came from, how long these patches will exist, what sorts of environmental changes they can tolerate. One additional problem is that they are not easy to find on the basis of literature data or the labels of specimens. It would be worthwhile to study these occurrences thoroughly in the future. Will they still exist there? Will a fen or an intermediate mire community develop there? How will the *Sphagnum* species change during these processes? Based on the fact that the dynamics of *Sphagnum* species appears to be shorter, then they were described in earlier publications, these occurrences might disappear. This suspicion is supported, for example, by the disappearance of *Sphagna* around Telkibánya (6, 15, 16). The small *Sphagnum* patches and occurrences can be found in many different habitats. In this study, three types were distinguished on the basis of water supply and the species. The new *Sphagnum* species for the Zemplén Mts in these habitats are *S. fallax, S. flexuosum, S. fimbriatum, S. girgensohnii, S. magellanicum, S. obtusum* and *S. squarrosum*. One species, *S. riparium*, is new for the whole country. Although 4 occurrences (7, 16, 17, 18) from these types of habitats were published, only one occurrence (18) of them can be found recently. On the other hand, 10 new occurrences from these types have been described.

The large number of new species and occurrences raises the questions of why in the Zemplén Mts these appear, why do they not grow in the large fens, and whether or not the propagulums came from the Carpathians? The authors plan on further investigations of these issues.

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