Collembola Diversity of Moss Habitats in the Sopron Region, NW-Hungary

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Abstract – The *Collembola* fauna of the moss flora in the Sopron region was studied. 18 moss species as well as 3.451 *Collembola* specimens (belonging to 60 species) were collected in 2003/04 in moss samples of three habitats. The highest *Collembola* diversity was found in Tómalom (a reed bed habitat) where very low abundance and relatively high species richness were characteristic. The *Collembola* diversity of the other two habitats (Sopron, Botanic Garden; Fertőrákos – a dry xerophile grass habitat) was lower. The results have shown a relatively high similarity between the *Collembola* communities in Sopron and Fertőrákos while just the opposite was observed between the Sopron and Tómalom samples.

bryofauna / Collembola diversity / dominance structure

Kivonat – Sopron környéki mohás élőhelyek Collembola-diverzitása. A Sopron környéki mohaflóra feltárása során vizsgáltuk a mohapárnákban élő ugróvillás közösségek diverzitását. 2003/2004-ben három vizsgálati területen gyűjtve 18 mohafaj mintáiban összesen 60 faj 3451 egyede került elő. A legmagasabb diverzitást a Tómalomnál, egy nádas-vizes habitatban találtuk. A két másik területen (Sopron, Botanikus kert; Fertőrákos, száraz sziklagyep) az egyedszám magasabb volt, a diverzitás azonban alacsonyabbnak adódott. Az eredmények a *Collembola* közösségek viszonylag nagy hasonlóságát mutatták Sopron és Fertőrákos viszonylatában, míg ennek ellenkezője igaz Sopron és Tómalom között.

bryofauna / Collembola-diverzitás / dominancia-viszonyok

1 INTRODUCTION

The *Collembola* (springtails) are the most abundant *Apterygota Entognatha* insects in the world, found in vast numbers from the tropics to the poles. The *Collembola* are mostly connected to forest habitats. They are chiefly soil dwellers, but we can also find springtails living in the canopy of tropical rain forests and they are also characteristic members of the bryofauna (Varga – Vargha 1992, Varga – Oldal 1998, Palacios-Vargas et al. 1998, 1999). In individual cases *Collembola* density can reach 98% proportion of the total density of *Arhtropoda* collected. An average square metre of soil in a temperate woodland can yield up to 50.000 individuals (Dunger 1983). Moreover, Dunger (1983) reveals that the optimal *Collembola* density would be tenfold of the mentioned value.

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The ecological importance of Collembola is indispensable in the decomposition of litter. They have an important role also in the food chain since they often form an important food source for predator Arthropods (e.g. for ground beetles). Most Collembola species prefer humid habitats. Their occurrence is furthermore determined by vegetation types, so springtails are important ecological indicator species for habitats and microhabitats. Although a paper on this region's Collembola fauna has already been published (Traser 2002), it doesn't treat the aspect of the springtail-moss connection.

The aim of this study was to determine the relationship between Collembola community composition, species richness, density, diversity in three different moss habitats in the Sopron region. Further investigations were related to the comparison of structural properties of Collembola communities between the moss habitats.

2 MATERIAL AND METHODS

2.1 Study area

The heart of the Sopron region is formed by the valley of the Ikva streamlet between the Sopron Mountains and the Szárhalmi Hillocks. The three study areas are the following: the Botanic Garden (Sopron), a wooded area with grass mosaic; Tómalom, a reed bed habitat and Fertőrákos, a dry limestone/grass habitat. *Table 1* shows further details on the study sites.

Table 1. Moss samples data and locality

Moss samples in 2003 / 2004			
Location	Date	GPS coordinate	Habitat
Sopron – Botanic Garden	06. 03. 2003. 09. 10. 2003. 02. 03. 2004.	47.68056°N 16.58222°E	wooded area with grass mosaic
Tómalom – reed bed	10. 09. 2003.	47.70965°N 16.62362°E	*Caricion davallianae* reed, wet area
Fertőrákos – dry grass	06. 05. 2004.	47.72844°N 16.64010°E	*Festucetalia valesiacae* limestone grassland

2.2 Data collection and analysis

Samples of 100 cm^3 of moss were collected. A total of 43 samples were obtained from the three different habitats ranging from 10 to 19 samples per site (Tómalom:10; Sopron: 14; Fertőrákos: 19).

Extraction of *Collembola* specimens from the moss was carried with the help of a modified Tullgren's apparatus at room temperature (Balogh 1958). The *Collembola* and moss species have been stored in the archives of the authors. For identification of the *Collembola* fauna we used the keys of Gisin (1960), Bretfeld (1999), Jordana et al. (1997), Babenko et al.(1994), Deharveng (1982), Fjellberg (1980, 1998), Massoud (1967), Potapow (2001), Pomorski (1998), Thibaud et al. (2004), Zimdars & Dunger (1994), Stach (1960, 1963), Weiner (1996) and several other papers, while for the moss flora we used the keys of Orbán – Vajda (1983), Smith (1978, 1990) and Hedenas (1993).

Graphical methods (dominance curves) were employed to allow direct comparison of *Collembola* species diversity characteristics between the sites.

To measure *Collembola* similarity (based on dominance) between the habitats the Renkonen coefficient (Re %) was used:

$$Re\ \% = \sum \min D_{A;B}$$

where "D_A" and "D_B": dominance % of the common species in habitat "A" and "B"

Another similarity coefficients such as the Sörensen quotient ($QS\%=2G/(S_A+S_B)*100$), the Jaccard's species identity index [$J_N\%=G*100/(S_A+S_B-G)$] and the similarity index of Weinstein ($K_W=Re*J_N$) were calculated to determine the similarities/differences between the habitats and their collembolan communities. (Symbols are: "G"= number of the common species in the paired habitats; "S_A" and "S_B" are the species numbers in habitat "A" and habitat "B").

To compare *Collembola* diversity values of two different habitats a *t* test was used.

3 RESULTS AND DISCUSSION

Table 2 shows the distribution and quantity of the moss samples in the three different habitats. There are no common moss species in these habitats except for two species that are present in both Sopron and Tómalom and one species found both in Sopron and Fertőrákos.

Table 2. Moss species and the number of samples taken

Moss species	Sopron	Tómalom	Fertőrákos
Tortella tortuosa (HEDW.) LIMPR.			3
Pleurochaete squarrosa (BRID.) LINDB.			4
Plagiomnium elatum (BRUCH et SCHIMP.) T. J. KOP.		1	
Plagiomnium undulatum (HEDW.) T. J. KOP.	2		
Climacium dendroides (HEDW.) F. WEBER et D. MOHR	1		
Thuidium philibertii LIMPR.	1		
Thuidium abietinum (HEDW.) SCHIMP.			4
Campylium chrysophyllum (BRID.) LANGE			1
Amblystegium varium (HEDW.) LINDB.		2	
Drepanocladus cossonii (SCHIMP.) LOESKE		2	
Calliergonella cuspidata (HEDW.) LOESKE	3	4	
Homalothecium lutescens (HEDW.) H. ROB			3
Brachythecium rutabulum (HEDW.) SCHIMP.	1	1	
Scleropodium purum (HEDW.) LIMPR.	2		
Eurhynchium hians (HEDW.) SANDLE LAC.	1		
Hypnum cupressiforme HEDW.	2		3
Rhytidium rugosum (HEDW.) KINDB.			1
Rhytidiadelphus triquetrus (HEDW.) WARNST.	1		
number of moss samples	14	10	19
moss species number	9	5	7

The moss species *Calliergonella cuspidata* and *Brachythecium rutabulum* were present both in Sopron and Tómalom while *Hypnum cupressiforme* was found both in the Sopron and in the Fertőrákos samples. The common *Collembola* species in the mentioned moss cushions are the followings:

Moss sp.: ***Calliergonella cuspidata*** (HEDW.) LOESKE

In Tómalom 15 *Collembola* species were collected on September 10, 2003. Out of these species only two spp. (*Sphaeridia pumilis; Parisotoma notabilis*) were found common to

both Tómalom and Sopron samples (in Sopron 16 *Collembola* spp. were found on the same moss species).

Moss sp.: ***Brachythecium rutabulum*** (HEDW.) SCHIMP.
This moss species was collected from monospecific cushions in Tómalom**,** but mixed with *Scleropodium purum* (HEDW.) LIMPR. and *Eurhynchium hians* (HEDW.) SANDLE LAC. in the Sopron samples. The *Collembola* species richness was 4 in the samples of Tómalom and 9 in Sopron, but no common species to both samples were found.

Moss sp.: ***Hypnum cupressiforme*** HEDW.
We collected 14 *Collembola* species in the Fertőrákos samples and 9 in the Sopron samples. The only *Collembola* species found common to both samples was *Entomobrya nivalis.*

Table 3 shows the number of *Collembola* individuals in the different habitats. Since the number of samples was not equal in the three habitats, these values can give approximate information on the volume only. The low number of individuals in the Tómalom samples is a very uncommon phenomenon.

Table 3 Number of Collembola individuals in the three habitats

	Sopron	Tómalom	Fertőrákos	Σ
Hypogastruridae				
Hypogastrura socialis (Uzel, 1891)	4	0	0	**4**
Hypogastrura vernalis (Carl, 1901)	0	0	284	**284**
Xenylla boerneri (Axelson, 1905)	400	0	145	**545**
Xenylla maritima (Tullberg, 1869)	1	0	0	**1**
Xenylla brevicauda (Tullberg, 1869)	1	0	120	**121**
Willemia virae (Kaprus, 1997)	0	0	1	**1**
Brachystomellidae				
Brachystomella parvula (Schaeffer 1896)	0	10	0	**10**
Neanuridae				
Friesea truncata (Cassagnau, 1958)	0	10	0	**10**
Micranurida pygmaea (Börner, 1901)	0	3	0	**3**
Neanura muscorum (Templeton, 1835)	0	1	0	**1**
Onychiuridae				
Supraphorura furcifera (Börner, 1901)	0	7	0	**7**
Protaphorura armata (Tullberg, 1869)	0	0	2	**2**
Doutnacia xerophila (Rusek, 1974)	4	0	0	**4**
Mesaphorura critica (Ellis, 1976)	0	0	4	**4**
Mesaphorura hylophila (Rusek, 1982)	14	0	0	**14**
Mesaphorura krausbaueri (Börner, 1901)	0	0	36	**36**
Mesaphorura macrochaeta (Rusek, 1976)	1	2	0	**3**
Metaphorura affinis (Börner, 1902)	1	0	0	**1**
Isotomidae				
Pachyotoma crassicauda (Tullberg, 1871)	0	10	0	**10**
Cryptopygus bipunctatus (Axelson, 1903)	311	0	319	**630**
Folsomia manolachei (Bagnall, 1939)	0	0	632	**632**
Folsomia penicula (Bagnall, 1939)	31	0	0	**31**
Folsomia quadrioculata (Tullberg, 1871)	0	4	0	**4**
Isotomiella minor (Schaeffer, 1896)	0	13	2	**15**
Parisotoma notabilis (Schäffer, 1896)	264	7	159	**430**
Isotoma viridis (Bourlet, 1839)	0	0	4	**4**
Isotoma riparia (Nicolet, 1842)	0	1	0	**1**
Isotomurus cf. palustris (Müller, 1776)	6	0	0	**6**
Isotomurus prasinus (Reuter, 1891)	0	21	0	**21**

Table 3 cont. Number of Collembola individuals in the three habitats

	Sopron	Tómalom	Fertőrákos	Σ
Entomobryidae				
Entomobrya corticalis (Nicolet, 1842)	2	0	0	**2**
Entomobrya handschini (Stach, 1922)	0	0	11	**11**
Entomobrya multifasciata (Tullberg, 1871)	0	0	4	**4**
Entomobrya nigriventris (Stach, 1929)	0	0	3	**3**
Entomobrya nivalis (Linnaeus, 1758)	1	0	11	**12**
Lepidocyrtus cyaneus (Tullberg, 1871)	0	3	0	**3**
Lepidocyrtus lanuginosus (Gmelin, 1788)	91	0	25	**116**
Lepidocyrtus lignorum (Fabricius, 1775)	0	0	2	**2**
Lepidocyrtus paradoxus (Uzel, 1890)	0	2	0	**2**
Lepidocyrtus peisonis (Traser et Christian, 1992)	0	15	0	**15**
Lepidocyrtus violaceus (Fourcroy, 1785)	1	0	0	**1**
Pseudosinella alba (Packard, 1873)	6	0	1	**7**
Pseudosinella octopunctata (Börner, 1901)	0	0	32	**32**
Orchesellidae				
Orchesella cincta (Linnaeus, 1758)	10	0	12	**22**
Orchesella bifasciata (Nicolet, 1842)	1	0	0	**1**
Orchesella xerothermica (Stach, 1960)	0	0	2	**2**
Heteromurus major (Moniez, 1889)	22	0	3	**25**
Heteromurus nitidus (Templeton, 1835)	11	0	0	**11**
Tomoceridae				
Tomocerus cf. baudoti (Denis, 1932)	3	0	0	**3**
Tomocerus minor (Lubbock, 1862)	3	0	0	**3**
Cyphoderidae				
Cyphoderus albinus (Nicolet, 1842)	1	0	1	**2**
Oncopoduridae				
Oncopodura crassicornis (Schoebotham, 1911)	0	0	1	**1**
Neelidae				
Megalothorax minimus (Willem, 1900)	16	13	4	**33**
Neelides minutus (Folsom, 1901)	0	3	0	**3**
Sminthuridida				
Sphaeridia pumilis (Krausbauer, 1898)	6	25	0	**31**
Katiannida				
Sminthurinus elegans (Fitch, 1863)	31	0	0	**31**
Sminthurinus aureus (Lubbock, 1862)	2	0	0	**2**
Dicyrtomida				
Dicyrtoma fusca (Lubbock, 1873)	0	2	0	**2**
Bourletiellida				
Deuterosminthurus bicinctus (Koch, 1840)	0	0	1	**1**
Fasciosminthurus strigatus (Stach, 1922)	0	1	6	**7**
Heterosminthurus bilineatus (Bourlet, 1842)	0	0	4	**4**
Σ	**1245**	**153**	**1831**	**3229**

Some of the data are interesting since species richness is much higher in the moss cushions of Sopron region than the one recorded in the Bükk Mountains in NE Hungary (Varga 1989, 1991, 1992, 1998).

Collembola dominance curves (*Figures 1-3*) of the three habitats show very different characteristics. The most abundant species in the samples are different for all three habitats. The dominant species primarily belong to taxa *Isotomidae* and *Hypogastruridae* (followed by taxa *Entomobryidae* and *Symphypleona*). There are only few species belonging to the family

Neanuridae. This proportion of species roughly corresponds to the one characteristic for the Central European *Collembola* fauna.

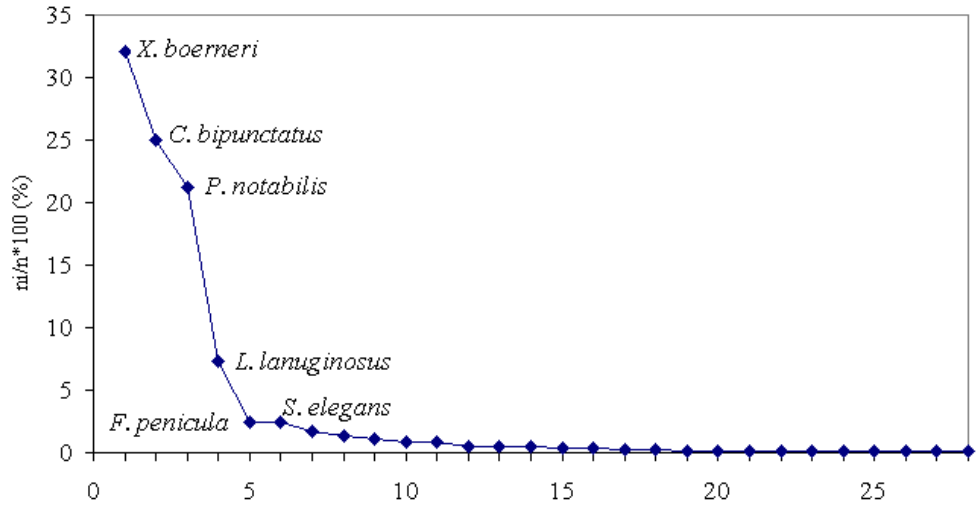

Figure 1. Collembola dominance in Sopron (n =1245 specimens)

The *Collembola* dominance curve of the Sopron sample shows three species with relatively high dominance rank. *Xenylla boerneri*, accounting for > 30 % of the total number of individuals, is a widely distributed species in Europe (including Ukraine and Latvia), occurring in litter, mosses and lichens on trunks and under the bark of trees (Thibaud et al. 2004). *Cryptopygus bipunctatus* (D = 25%) is rather common in Central Europe, rarer in Northern and Southern Europe. It is a xerothermic, ruderal species, mostly occurring in open and disturbed sites (Potapow 2001). *Parisotoma notabilis* (D = 21 %) is one of the most ubiquist *Collembola* of the Western Palaearctic. Its optimum is located in Central Europe and in the European part of Russia. It reaches high densities in both natural and disturbed sites (open grasslands, shelter belts, forests). Its presence in every kind of biotopes (excluding the too extreme ones) is a characteristic of this species (Potapow 2001).

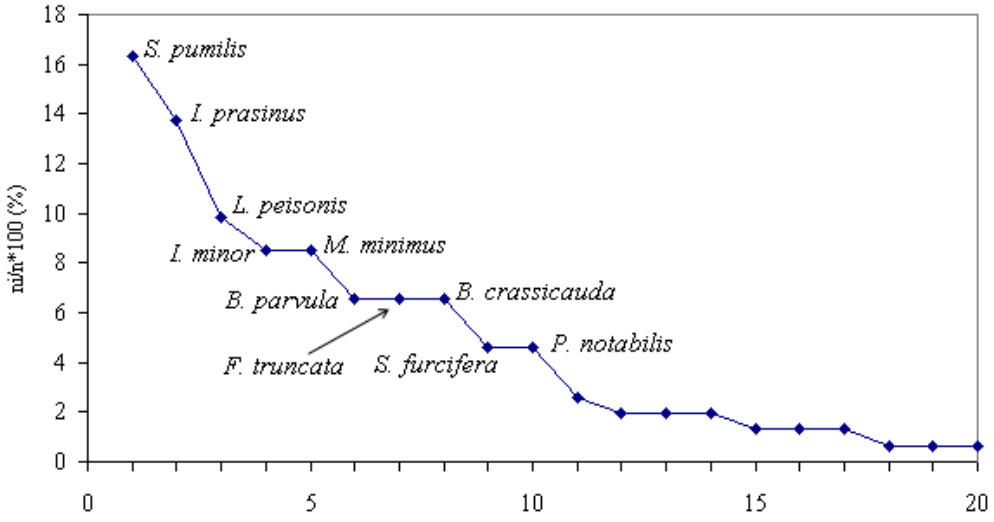

Figure 2. Collembola dominance in Tómalom (n =153 specimens)

The most dominant *Collembola* (D = 16,5%) in the Tómalom samples was *Sphaeridia pumilis*, a widespread species in Europe and North America (type locality: Germany, on *Rumex nemorosus* and *Glyceria* of a forest path), occurring on the surface and in upper layers of different moist soil types and in their low vegetation (Bretfeld 1999). Further dominant member (D =14 %) of this community is *Isotomurus prasinus*, a typical hydrophilous species, common and abundant in various moist sites, often occurring also in agricultural fields (especially in Central Europe). Its exact distribution has still to be determined. Type locality: Siberia, Yenisei River (Potapow 2001). The third most dominant collembola, *Lepidocyrtus peisonis* is a typical hydrophile species, occurring mostly on banks of stagnant eutrophic waters in the Kisalföld region. It has only been recorded in Hungary and Austria (Traser – Christian 1992). Type locality: Fertőrákos, in a humid sedge (*Carex riparia* and *Phragmites australis*) field.

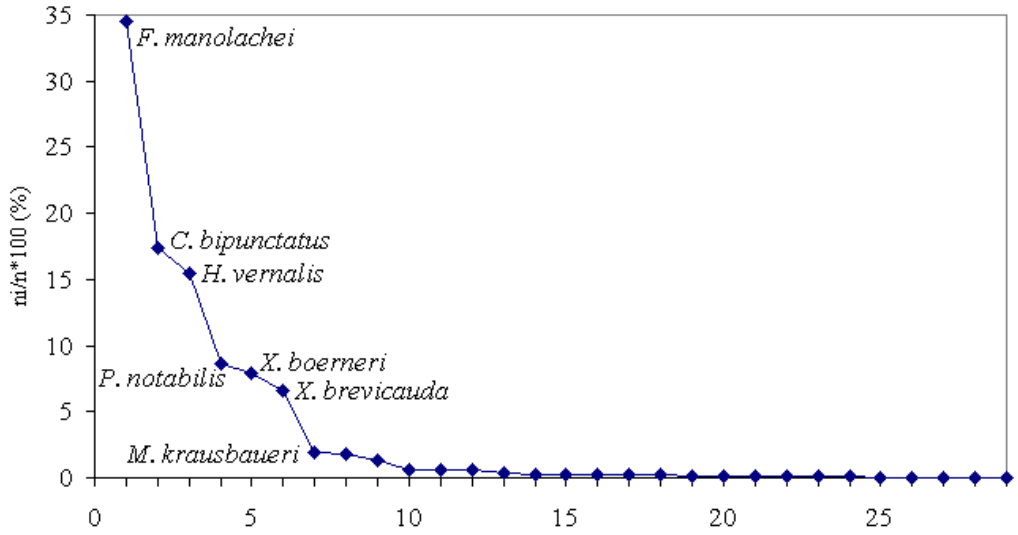

Figure 3. Collembola dominance in Fertőrákos (n =1831 specimens)

The species *Folsomia manolachei* was found the most dominant in the Fertőrákos sample (accounted for 35 % of the total number of individuals). It is a widespread springtail presumably all over the Palaearctic, recorded in almost all European countries (Potapow 2001). An eurytopic species, reaching high abundances in various biotopes (forests, open grasslands). It is also common but less abundant in strongly disturbed areas (intensively cultivated agricultural fields, recultivated sites etc.). Similarly to the Sopron samples, *Cryptopygus bipunctatus* was found among the most dominant species (D = 17%) also in the Fertőrákos sample. Dominant species also include the Palaearctic *Collembola Hypogastrura vernalis* (D = 15,5%), characteristic for seashore meadows with wide distribution along the Nordic coasts. Sporadic European inland records (mostly in continental sands) are also known (Thibaud et al. 2004).

The result of various similarity calculations is presented in *Tables 4-7.* Despite of the high *Collembola* species richness, the similarity between the Sopron-Tómalom-Fertőrákos samples is very low.

Table 4. Renkonen's similarity

	Sopron	Tómalom
Tómalom	6.4028	
Fertőrákos	36.6434	5.1819

Table 5 Sörensen's similarity

	Sopron	Tómalom
Tómalom	0.1276	
Fertőrákos	0.3509	0.1250

Table 6. Jaccard's similarity

	Sopron	Tómalom
Tómalom	6.8182	
Fertőrákos	21.2767	7.1429

Table 7. Wainstein's similarity

	Sopron	Tómalom
Tómalom	43.6557	
Fertőrákos	779.6476	37.0137

The Renkonen similarity index indicates a relatively high similarity between Sopron and Fertőrákos while just the opposite can be observed for the Sopron and Tómalom samples. The other similarity coefficients calculated (Sörensen quotient, Jaccard's species identity index, Weinstein similarity index) also show the "marginal" position of Tómalom.

Table 8 shows the most important structural properties of the *Collembola* communities.

Table 8. Structural properties of Collembola communities

	Sopron	Tómalom	Fertőrákos
Species richness *(S)*	28	20	29
Number of individuals	1245	153	1831
Shannon diversity *(H)*	1.883	2.628	2.01
Equitability *(J)*	0.5651	0.8771	0.597

Despite of the lower abundance in Tómalom the species diversity is relatively high, higher than for the other two habitats. The higher community equitability value for the Tómalom sample can be explained with the lower species richness with a relevant implication on the algorithm used.

Table 9 shows the results of *t* test based on Shannon diversity indices.

Table 9. Results (t-values) of comparison of Shannon diversity indices (significant difference at P=0.05 level)*

	Sopron	Tómalom
Tómalom	5.0778*	
Fertőrákos	1.9089	4.0871*

Concerning the Sopron and Fertőrákos samples, there are no remarkable differences between diversity values of *Collembola* communities collected in these habitats. Significant difference can be observed between the Sopron - Tómalom and the Tómalom - Fertőrákos samples.

CONCLUSION

Knowing the ecology of the collected species a strong connection between them and the moss species cannot be proved. Their presence is supposedly determined by the surrounding habitats.

Typical bryobiont species – like e.g. *Hymenaphorura creatricis* (Traser – Salló 2003) – were not recorded, only some bryophile species (e.g. *Xenylla boerneri*) were found. Among the most dominant *Collembolas* there are no species living solely on moss. Most of the dominant species collected are eurytopic and less sensitive to anthropogenic disturbance.

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Appendix. Raw data of the Collembola specimens collected

Tortella tortuosa (HEDW.) LIMPR.
Fertőrákos, 06. 05. 2004: *Hypogastrura vernalis 35; Xenylla brevicauda 50; Lepidocyrtus lanuginosus 1; Pseudosinella octopunctata 12; Orchesella cincta 2; Orchesella xerothermica 2; Folsomia manolachei 5; Cryptopygus bipunctatus 5; Entomobrya multifasciata 4; Parisotoma notabilis 11; Protaphorura armata 2; Isotomiella minor 1;*

Pleurochaete squarrosa (BRID.) LINDB.
Fertőrákos, 06. 05. 2004: *Lepidocyrtus lanuginosus 4; Folsomia manolachei 237; Entomobrya handschini 7; Entomobrya nivalis 8; Fasciosminthurus strigatus 1; Parisotoma notabilis 9; Cryptopygus bipunctatus 5; Isotoma viridis 2; Pseudosinella octopunctata 13; Hypogastrura vernalis 24; Xenylla brevicauda 70; Orchesella cincta 2; Megalothorax minimus 1; Mesaphorura krausbaueri 1;*

Plagiomnium elatum (BRUCH et SCHIMP.) T. J. KOP.
Tómalom, 10. 09. 2003: *Lepidocyrtus cyaneus 1; Lepidocyrtus peisonis 2; Friesea truncata 1; Supraphorura furcifera 1;*

Plagiomnium undulatum (HEDW.) T. J. KOP.
Sopron, 27. 03. 2003: *Lepidocyrtus lanuginosus 8; Sminthurinus elegans 20; Mesaphorura macrochaeta 1; Parisotoma notabilis 5; Heteromurus major 5;* **- Sopron, 10. 09. 2003**: *Parisotoma notabilis 2; Lepidocyrtus lanuginosus 10;*

Climacium dendroides (HEDW.) F. WEBER et D. MOHR
Sopron, 10. 09. 2003: *Megalothorax minimus 4; Parisotoma notabilis 4; Folsomia penicula 12; Heteromurus nitidus 2; Lepidocyrtus lanuginosus 5; Cryptopygus bipunctatus 42; Pseudosinella alba 2;*

Thuidium philibertii LIMPR.
Sopron, 20. 03. 2003: *Heteromurus major 1; Tomocerus minor 1; Metaphorura affinis 1; Parisotoma notabilis 35; Orchesella cincta 2; Cryptopygus bipunctatus 20; Sminthurinus elegans 6; Megalothorax minimus 2; Pseudosinella alba 2;*

Thuidium abietinum (HEDW.) SCHIMP.
Fertőrákos, 06. 05. 2004: *Mesaphorura krausbaueri 2; Lepidocyrtus lanuginosus 9; Cryptopygus bipunctatus 1; Hypogastrura vernalis 48; Folsomia manolachei 41; Megalothorax minimus 1; Entomobrya nigriventris 3; Fasciosminthurus strigatus 3; Pseudosinella octopunctata 2; Isotoma viridis 2; Parisotoma notabilis 10; Heteromurus major 1; Willemia virae 1; Heterosminthurus bilineatus 2; Entomobrya handschini 4; Isotomiella minor 1;*

Campylium chrysophyllum (BRID.) LANGE
Fertőrákos, 06. 05. 2004: *Cryptopygus bipunctatus 1; Lepidocyrtus lanuginosus 2; Parisotoma notabilis 8; Hypogastrura vernalis 4;*

Amblystegium varium (HEDW.) LINDB.
Tómalom, 10. 09. 2003: *Lepidocyrtus cyaneus 1; Lepidocyrtus peisonis 5; Friesea truncata 3; Megalothorax minimus 5; Spaeridia pumilis 5; Isotomiella minor 2; Supraphorura furcifera 2; Parisotoma notabilis 2; Lepidocyrtus paradoxus 1; Neanura muscorum 1;*

Drepanocladus cossonii (SCHIMP.) LOESKE
Tómalom, 10. 09. 2003: *Lepidocyrtus peisonis 3; Lepidocyrtus paradoxus 1; Brachystomella parvula 2; Isotomurus prasinus 8; Supraphorura furcifera 1; Friesea truncata 2; Megalothorax minimus 2; Spaeridia pumilis 1; Isotomiella minor 1;*

Calliergonella cuspidata (HEDW.) LOESKE
Tómalom, 10. 09. 2003*: Lepidocyrtus cyaneus 1; Lepidocyrtus peisonis 1; Isotomurus prasinus 5; Friesea truncata 4; Megalothorax minimus 6; Spaeridia pumilis 18; Isotomiella minor 10; Supraphorura furcifera 3; Parisotoma notabilis 5; Pachyotoma crassicauda 2;*

Brachystomella parvula 1; Neelides minutus 2; Micranurida pygmaea 3; F. quadrioculata 4; Dicyrtoma fusca 2; - **Sopron, 06. 03. 2003:** *Heteromurus major 3; Lepidocyrtus lanuginosus 2; Parisotoma notabilis 5; Cryptopygus bipunctatus 220; Pseudosinella alba 1;* - **Sopron, 20. 03. 2003***: Lepidocyrtus lanuginosus 20; Heteromurus major 4; Tomocerus cf. baudoti 1; Cryptopygus bipunctatus 100; Parisotoma notabilis 200; Spaeridia pumilis 4; Mesaphorura hylophila 12; Doutnacia xerophila 6; Megalothorax minimus 2; Orchesella cincta 2; Heteromurus major 8; Sminthurinus elegans 2;* - **Sopron, 10. 09. 2003:** *Megalothorax minimus 1; Spaeridia pumilis 2; Parisotoma notabilis 5; Folsomia penicula 6; Sminthurinus aureus 2; Tomocerus minor 1; Heteromurus nitidus 1; Lepidocyrtus lanuginosus 6; Cryptopygus bipunctatus 2;*

Homalothecium lutescens (HEDW.) H. ROB

Fertőrákos, 06. 05. 2004: *Mesaphorura critica 4; Folsomia manolachei 73; Parisotoma notabilis 14; Heteromurus major 2; Hypogastrura vernalis 64; Fasciosminthurus strigatus 2; Oncopodura crassicornis 1; Orchesella cincta 8; Orchesella xerothermica 1; Cryptopygus bipunctatus 11; Mesaphorura krausbaueri 3; Parisotoma notabilis 4; Lepidocyrtus lignorum 2; Pseudosinella octopunctata 1;*

Brachythecium rutabulum (HEDW.) SCHIMP.

Tómalom, 10. 09. 2003: *Lepidocyrtus peisonis 4; Isotomurus prasinus 8; Spaeridia pumilis 1; Pachyotoma crassicauda 4;*

Scleropodium purum (HEDW.) LIMPR.

Sopron, 10. 09. 2003: *Parisotoma notabilis 8; Folsomia penicula 11; Lepidocyrtus lanuginosus 10;*

Eurhynchium hians (HEDW.) SANDLE LAC.

together with *Scleropodium purum* (HEDW.) LIMPR. and with *Brachythecium rutabulum* (HEDW.) SCHIMP. samples **Sopron, 06. 03. 2003:** *Mesaphorura macrochaeta 2; Lepidocyrtus lanuginosus 17; Heteromurus major 4; Orchesella cincta 6; Isotomurus cf. palustris 6; Parisotoma notabilis 35; Cryptopygus bipunctatus 47; Megalothorax minimus 2; Pseudosinella alba 1;*

Hypnum cupressiforme HEDW.

Fertőrákos, **06. 05. 2004:** *Pseudosinella alba 1; Pseudosinella octopunctata 3; Lepidocyrtus lanuginosus 7; Entomobrya nivalis 3; Folsomia manolachei 270; Parisotoma notabilis 93; Hypogastrura vernalis 32; Megalothorax minimus 2; Mesaphorura krausbaueri 23; Cryptopygus bipunctatus 58; Xenylla boerneri 145; Cryptopygus bipunctatus 88; Heterosminthurus bilineatus 2;* - **Sopron, 02. 03. 2004:** *Xenylla boerneri 400; Hypogastrura socialis 4; Entomobrya nivalis 1; Lepidocyrtus violaceus 1; Entomobrya corticalis 2; Orchesella bifasciata 1; Xenylla brevicauda 2; Xenylla maritima 1; Cyphoderus albinus 1;*

Rhytidium rugosum (HEDW.) KINDB.

Fertőrákos, 06. 05. 2004: *Cryptopygus bipunctatus 150; Hypogastrura vernalis 75; Lepidocyrtus lanuginosus 2; Mesaphorura krausbaueri 8; Parisotoma notabilis 10; Cyphoderus albinus 1; Folsomia manolachei 6; Fasciosminthurus strigatus 1;*

Rhytidiadelphus triquetrus (HEDW.) WARNST.

Sopron, 20. 03. 2003: *Tomocerus minor 1; Tomocerus cf. baudoti 2; Lepidocyrtus lanuginosus 8; Folsomia penicula 2; Heteromurus major 5; Parisotoma notabilis 10; Sminthurinus elegans 5*