Tirjaková, E., Matis, D., 1987: Ciliated protozoa (Ciliophora) from submerged, wet, moist and dry mosses in selected localities of Slovenský raj. Acta Fac. Rerum Nat. Univ. Comenianae Zool., *29*, p. 1–16.
Tirjaková, E., 1988: Structures and dynamics of communities of ciliated protozoa (Ciliophora) in field communities. I. Species composition, group dominance, communities. Biológia, Bratislava, *43*, p. 479–503.
Tirjaková, E., 1997: Structure and dynamics of communities of ciliated Protozoa (Ciliophora) in field communities. Succession, genus-species relationships, nutrition. Ekológia (Bratislava), *16*, p. 243–252.
Tirjaková, E., Mrva, M., Hlúbiková, D., 2002: Ciliophora and Rhizopoda in soil, leaf-litter and mosses of oak-hornbeam forests in the Malé Karpaty Mts (Western Slovakia). In Tajovský, K., Balík, J, Pižl, V. (eds): Studies on Soil Fauna in Central Europe, ISB AS CR, České Budějovice, p. 233–240.
Tirjaková, E., Bartošová, P., 2004: The first record of ciliated protozoa (Protozoa, Ciliophora) from Slovakia in the decaying wood mass (in Slovak). Folia Faunistica Slovaca, *9*, p. 11–20.
Wallwork, J.A., 1976: The distribution and diversity of soil fauna. Academic Press, London, 355 pp.
Wenzel, F., 1953: Die Ciliaten der Moosrasen trockner Standorte. Arch. Protistenk., *99*, p. 70–141.

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Bartošová P., Tirjaková E.: **Vybrané ekologické charakteristiky spoločenstiev nálevníkov** (Protozoa, Ciliophora) **v odumretej drevnej hmote na území Malých Karpát.**

V rokoch 2001–2004 sme v rámci výskumu spoločenstiev nálevníkov v odumretej drevnej hmote odobrali 28 vzoriek drevnej hmoty 14 druhov drevín z územia Malých Karpát. Vo vzorkách sme zaznamenali 58 druhov nálevníkov, z ktorých 9 sme zistili na území Slovenska prvýkrát. Okrem druhového spektra sme študovali zastúpenie systematických tried, potravné, rodovo-druhové vzťahy a formovanie spoločenstiev v závislosti od druhu dreviny. Zo systematických tried prevažovali zástupcovia triedy Colpodea a z potravných skupín bakteriovory. Maximálny počet druhov (8) sme zaznamenali v rode *Colpoda*. Hierarchická klasifikácia podľa identity druhového zastúpenia nálevníkov na jednotlivých druhoch drevín vyčlenila dve výrazné spoločenstvá. Napriek tomu druh dreviny pravdepodobne nezohráva významnú úlohu pri formovaní spoločenstiev nálevníkov. Nezistili sme dokonca ani osobitnú väzbu resp. odlišnosť druhového spektra medzi listnatými a ihličnatými drevinami.

DIVERSITY OF ACTIVE GYMNAMOEBAE (Rhizopoda, Gymnamoebia) IN MOSSES OF THE MALÉ KARPATY MTS (SLOVAKIA)

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Abstract

Mrva M.: Diversity of active gymnamoebae (Rhizopoda, Gymnamoebia) in mosses of the Malé Karpaty Mts (Slovakia). Ekológia (Bratislava), Vol. 24, Supplement 2, p. 51–58.

In the period of 2000–2002 the fauna of active naked amoebae (Rhizopoda, Gymnamoebia) was studied in mosses at five sites in oak-hornbeam forests of the Malé Karpaty Mts (Slovakia). The dry sample material was moistened by distilled water and after 5 days of incubation the amoebae were identified by direct examination. Identification of amoebae was performed on the base of morphological characters of the active stages. Relatively high diversity of 32 taxa of naked amoebae was recorded. The diversity at the sites varied from 17 to 23 taxa. The highest richness appeared in the family Thecamoebaidae (9 species), however some other families – Hartmannellidae, Vannellidae and Paramoebidae were significantly represented as well. The observed community of species of naked amoebae in mosses indicate considerable similarity to freshwater communities.

Key words: Gymnamoebia, moss, diversity, Slovakia, oak-hornbeam forests

Introduction

Terrestrial habitats are recognised as specific freshwater ecosystems because active stages of protists always depend on presence of water (e.g. Bamforth, 1980; Finlay et al., 2000). Generally, higher moisture enhances the species diversity (Bamforth, 1973).

Modern studies of diversity of naked amoebae were focused mainly on water habitats. Some of them refer to freshwater (Smirnov, Goodkov, 1996) or sea (Butler, Rogerson, 2000). In terrestrial habitats quantity of amoebae has been analysed (Singh, 1946; Bischoff, Anderson, 1998; Anderson, 2000), however their systematic diversity in these habitats remains practically unknown. Recently only Brown, Smirnov (2004) have brought several results from a study on diversity of Gymnamoebia in soil.

The differences between the fauna in freshwater and in terrestrial habitats are well known for ciliates, which have formed specific morphological and physiological adaptations (Fenchel, 1987; Foissner, 1987; Cowling, 1994). Similarly, the fauna of testate amoebae is different in freshwater and soil habitats (Foissner, 1987). However, such information is unavailable for naked amoebae though some of the species were found both in freshwater and soil (Page, 1991).

Until now, mosses as habitats of the naked amoebae were studied scarcely or marginally. Some information can be found in the works of Bartoš (1940, 1947, 1949, 1963), Ertl (1955), Matis et al. (1997), Matis, Mrva (1998) and Page (1991). Practically there are no modern works directed to naked amoebae from these habitats and the diversity of naked amoebae in mosses is almost unknown.

For several years the Malé Karpaty Mts have been an object of research on both micro- and macrofauna of various habitats, dealing with Protozoa (Tirjaková et al., 2002; Mrva, 2003a), Tardigrada (Degma et al., 2005) and Arthropoda (Holecová, Sukupová, 2000; Majzlan et al., 2000; Štepanovičová, Országh, 2002; Krumpálová, Szabová, 2003; Holecová et al., 2005).

This article brings new information on diversity of the naked amoebae in the habitat of mosses from the Malé Karpaty Mts in Western Slovakia.

Material and methods

Samples of mosses growing on soil were collected monthly in the period of 2000–2002 at five sites in oak-hornbeam forests of the Malé Karpaty Mts (Western Slovakia): Fúgelka, Naháč–Katarínka 1, Naháč–Katarínka 2, Lindava, Lošonec-lom quarry. For detailed ecological characteristics and situation of sites see Zlinská et al. (2005).

The sampled material was analysed according to modification of method used for ciliates (e.g. Foissner, 1987; Matis, Tirjaková, 1994; Aescht, Foissner, 1995): dry sampled material of moss was flooded with distilled water and incubated 5 days on undirected light and laboratory temperature. The amoebae were directly examined in the suspension pipetted from the flooded sample. Observations were made using the Nikon Labophot microscope with phase contrast equipment. Identification of amoebae was performed on the base of morphological criteria according to Page (1988, 1991) with the help of other works, which included detailed descriptions of the species (Page, 1969a, b, 1977, 1983; Sawyer, 1975; Smirnov, Goodkov, 1994; Smirnov, 1995, 1999; Michel, Smirnov, 1999).

Results

Naked amoebae occurred in all the 78 samples examined. Totally 32 taxa of 3 orders, 8 families and 16 genera of naked amoebae were recorded: 23 species, 8 taxa being identified into the genus level only and 1 unidentified leptomyxid amoeba (Table 1). Unidentified heterolobosean amoebae were found at all the sites.

The diversity at the study sites varied from 17 to 23 taxa. The highest diversity appeared in the family Thecamoebaidae (9 species). Of the species observed, 7 were recorded at all the sites: *Dermamoeba minor*, *Thecamoeba quadrilineata*, *Platyamoeba stenopodia*, *Korotnevella stella*, *Flamella* sp. 1, *Acanthamoeba* sp. 1, *Acanthamoeba* sp. 2.

Table 1. Naked amoebae recorded from localities.

Taxon	Locality				
	F	K1	K2	Lin	LQ
EUAMOEBIDA					
Amoebidae					
Deuteramoeba algonquinensis (Baldock, Rogerson & Berger, 1983) Page, 1987					+
Hartmannellidae					
Hartmannella cantabrigiensis Page, 1974				+	+
Hartmannella vermiformis Page, 1967	+	+	+		+
Saccamoeba limax (Dujardin, 1841) Page, 1974			+		
Saccamoeba stagnicola Page, 1974			+	+	+
Thecamoebidae					
Dermamoeba granifera (Greeff, 1866) Page & Blakey, 1979		+	+		+
Dermamoeba minor (Pussard, Alabouvette & Pons, 1979) Page, 1988	+	+	+	+	+
Paradermamoeba levis Smirnov & Goodkov, 1994		+		+	+
Paradermamoeba valamo Smirnov & Goodkov, 1993				+	
Sappinia diploidea (Hartmann & Nägler, 1908) Alexeieff, 1912	+		+		
Thecamoeba quadrilineata (Carter, 1856) Lepşi, 1960	+	+	+	+	+
Thecamoeba sphaeronucleolus (Greeff, 1891) Schaeffer, 1926					+
Thecamoeba striata (Penard, 1890) Schaeffer, 1926	+		+	+	+
Thecamoeba terricola (Greeff, 1866) Lepşi, 1960	+	+	+		+
Vannellidae					
Platyamoeba stenopodia Page, 1969	+	+	+	+	+
Vannella sp.			+	+	
Vannella lata Page, 1988	+	+		+	+
Vannella platypodia (Gläser, 1912) Page, 1976		+			
Paramoebidae					
Korotnevella bulla (Schaeffer, 1926) Goodkov, 1988	+	+			
Korotnevella diskophora Smirnov, 1999					+
Korotnevella stella (Schaeffer, 1926) Goodkov, 1988	+	+	+	+	+
Mayorella penardi Page, 1972		+	+		+
Mayorella vespertilioides Page, 1983		+	+		+
LEPTOMYXIDA					
Flabellulidae					
Flamella sp. 1	+	+	+	+	+
Flamella sp. 2					+
Leptomyxidae					
Leptomyxa reticulata Goodey, 1914	+			+	+
Rhizamoeba sp.	+				+
Unidentified leptomyxid amoeba	+			+	
ACANTHOPODIDA					
Acanthamoebidae					
Acanthamoeba sp.1	+	+	+	+	+
Acanthamoeba sp.2	+	+	+	+	+
Acanthamoeba sp.3		+			
INCERTAE SEDIS					
Stygamoeba sp.	+	+		+	
Total	**17**	**18**	**17**	**17**	**23**

Notes: F – Fúgelka, K1 – Naháč–Katarínka 1, K2 – Naháč–Katarínka 2, Lin – Lindava, LQ – Lošonec–lom quarry

Discussion

Since amoebae were examined only by light microscopy, the determination depended largely on the morphological criteria according to Page (1988, 1991). The results were consulted with other works containing descriptions and illustrations of trofozoits of naked amoebae published before but also after Page's monographs (Page, 1969a, b, 1977, 1983; Sawyer, 1975; Smirnov, Goodkov, 1994; Smirnov, 1995, 1999; Michel, Smirnov, 1999). The emphasis was given to detailed observations of locomotive and floating forms. The shape of the body and its dimensions, the type, number and dimensions of nuclei and the presence of crystals were key characters for identification.

Some of the recorded species are difficult to be identified. *Saccamoeba limax* was differentiated from *S. stagnicola* by absence of crystalic inclusions (Page, 1991). *Dermamoeba granifera* possess a zone of fine granules in anterior hyaloplasma (Page, 1977). This zone lacks in *D. minor*, which is a smaller species with more rounded anterior end than the previous one. *Paradermamoeba valamo* differs from *P. levis* by shape, larger size and floating form. Amoebae of the genus *Korotnevella* were typical with finger-like dactylopodia and by lack of the double crystalic inclusions that were characteristic for amoebae of the genus *Mayorella*. Of the genus *Korotnevella*, *K. bulla* was the largest species with floating form often with several very long (more than 4 times of diameter of central mass) thin subpseudopodia. *K. stella* formed typical floating form with about 6–8 bent pseudopodia and *K. diskophora*, the smallest species, formed floating form similar to *Vannella* amoebae with up to 4 straight thin pseudopodia. *Mayorella penardi* was typical with frequent absence of any subpseudopodia in its locomotive form. The similar species, *M. vespertilioides*, lacked all the subpseudopodia only rarely (Page, 1991).

If we compare the obtained results with literary data, the observed diversity of 32 taxa is relatively high. From the older literature, Bartoš (1940) detected 6 species of naked amoebae in mosses from Karpaty Mts (Slovakia), in later works he reported 2 species from mosses near Prague (Czech Republic) (Bartoš, 1947), 2 species in Šumava mosses (Czech Rrepublic) (Bartoš, 1949) and 2 species of gymnamoebae in moss from China (Bartoš, 1963). Fantham, Porter (1945) found 12 species of naked amoebae in mosses in Canada. Unfortunately many of their species can not be identified at present and some of them have invalid names. Ertl (1955) noted 2 species in moss of the peat -bog Bór (Slovakia). From mosses of the Slovenský raj Mts (Slovakia) 4 species of the family Thecamoebidae have been known (Matis et al., 1997). Matis, Mrva (1998) found 6 species of ameboid protists in mosses in Bratislava (Slovakia). Finally, we should note that the low number of species in the cited works is a result of focusing mainly on testate amoebae or of few samples investigated. Closer number of species was reported by Brown, Smirnov (2004) who revealed 48 species in grassland soil.

Interestingly, in the present study the richness of 32 species is distinctly higher or similar to the data on diversity of naked amoebae in freshwater habitats. In lakes, 15 species were found by O'Dell (1979), 29 by Smirnov, Goodkov (1996), 14 by Matis et al. (1997), 23 by Butler (1999a), 16 by Butler (1999b), 13 by Butler et al. (2000), 20 and 30 by Smirnov (2003). In rivers, 17 species were identified by Ertl (1984) and 14 by Mrva (2003b). Please note that cited works are established on enrichment cultivation with exception of Mrva (2003b) who used the direct examination of the samples.

The opinion that the enrichment cultivation is the only method for investigating the species diversity, is widespread among researchers working with amoebae (e.g. Butler, Rogerson, 2000; Smirnov, 2003; Smirnov, Brown, 2004). Despite of this, the study revealed relatively high diversity of active gymnamoebae by long-term direct and detailed examination of the samples. Recently, treeholes were examined by this method with 19 species of Gymnamoebia recovered (Mrva, 2003a) and similarly a river with 14 recorded species (Mrva, 2003b). However, the present study probably did not exhaust the whole community of species of gymnamoebae. The distribution of gymnamoebae in habitats is heterogeneous (Smirnov, 2003) and many amoebae are adhered to substrate particles, so some of them could be omitted.

Until now we do not know how the fauna of naked amoebae differs in freshwater and terrestrial habitats though there are indications that the fauna is similar as many freshwater species were isolated from soil, moss or leaf litter (Page, 1991; Brown, Smirnov, 2004; Smirnov, Brown, 2004). The exception includes probably only large species of the family Amoebidae that were not reported from terrestrial samples (Smirnov, Brown, 2004). From this family only *Deuteramoeba algonquinensis*, known as „typical soil" species, was recorded in the paper. Members of the family Thecamoebidae seem to be the dominant group of Gymnamoebia in mosses, in this study 9 species of this family were revealed. Though it is known that amoebae of the genus *Thecamoeba* are frequent in soil and mosses (Page, 1977), surprisingly Brown, Smirnov (2004) in their study of grassland soil did not find any members of this genus. They suppose mainly the influence of enrichment methods. Their next assumption, that the amoebae were destroyed by drying the soil samples, is less probable. In the present study the moss samples were air-dried and all the recorded species had surely formed cysts or pseudocysts. Further, species of the families Hartmannellidae, Vannellidae and Paramoebidae that are well known from freshwater (Ertl, 1984; Smirnov, Goodkov, 1996; Matis et al., 1997; Butler, 1999a, b; Butler et al., 2000; Smirnov, 2003), were numerously represented (Table 1) but at present it is impossible to consider gymnamoebae as typical for habitat of mosses because the knowledge on the occurrence of gymnamoebae in various habitats is not sufficient.

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References

Aescht, E., Foissner, W., 1995: Microfauna. In Schinner, F., Öhlinger, R., Kandeler, E., Margesin, R. (eds): Methods in soil biology. Springer, Berlin-Heidelberg-New York, p. 316–337.

Anderson, O.R., 2000: Abundance of terrestrial gymnamoebae at a northeastern U. S. site: A four year study, including the El Nino winter. J. Eukaryot. Microbiol., *47*, p. 148–155.

Bamforth, S.S., 1973: Population dynamics of soil and vegetation Protozoa. Amer. Zool., *13*, p. 171–176.

Bamforth, S.S., 1980: Terrestrial Protozoa. J. Protozool., *27*, p. 33–36.

Bartoš, E., 1940: Studien über die moosbewohnenden Rhizopoden der Karpaten. Arch. Protistenkd., *94*, p. 93–160.

Bartoš, E., 1947: The moss-dwelling Rhizopoda of the neighbourhood of Prague (in Czech). Sb. Kl. Přír. v Brně, *28*, p. 1–10.

Bartoš, E., 1949: Microscopical fauna of the Šumava-mosses. – I. Mosses from neighbourhood of Lac-Plešné (in Czech). Acta Soc. Zool. Bohemoslov., *13*, p. 10–29.

Bartoš, E., 1963: Die Rhizopoden einiger Moosproben aus China. Acta Soc. Zool. Bohemoslov., *27*, p. 85–96.

Bischoff, P J., Anderson, O.R., 1998: Abundance and diversity of gymnamoebae at varying soil sites in northeastern U.S.A. Acta Protozool., *37*, p. 17–21.

Brown, S., Smirnov, A.V., 2004: Diversity of gymnamoebae in grassland soil in southern Scotland. Protistology, *3*, p. 191–195.

Butler, H.G., 1999a: Seasonal dynamics of the planktonic microbial community in a maritime Antarctic lake undergoing eutrophication. J. Plankton Res., *21*, p. 2393–2419.

Butler, H.G., 1999b: Temporal plankton dynamics in a maritime Antarctic lake. Arch. Hydrobiol., *146*, p. 311–339.

Butler, H.G., Edworthy, M.G., Ellis-Evans, J.C., 2000: Temporal plankton dynamics in an oligotrophic maritime Antarctic lake. Freshwater. Biol., *43*, p. 215–230.

Butler, H.G., Rogerson, A., 2000: Naked amoebae from benthic sediments in the Clyde Sea Area, Scotland. Ophelia, *53*, p. 37–54.

Cowling, A.J., 1994: Protozoan distribution and adaptation. In Darbyshire, J. F. (ed.): Soil Protozoa. CAB International, Wallingford. p. 5–42.

Degma, P., Šimurka, M., Gulánová, S., 2005: Community structure and ecological macrodistribution of moss-dwelling water bears (Tardigrada) in Central European oak-hornbeam forests (SW Slovakia). Ekológia (Bratislava), *24*, Suppl. 2, 59–75.

Ertl, M., 1955: Rhizopoda of the peat-bog Bór (Orava) (in Slovak). Práce II. sekcie SAV, *1, 12*, p. 1–39.

Ertl, M., 1984: Die Besiedlung verschiedener Typen des Grundes und des hyporheischen Interstitials des Flusses Belá durch Sarcodina. Práce Lab. Rybár. Hydrobiol., *4*, p. 63–98.

Fantham, H.B., Porter, A., 1945: The microfauna, especially the Protozoa, found in some Canadian Mosses. Proc. Zool. Soc., *115*, p. 97–174.

Fenchel, T., 1987: Ecology of Protozoa. Science Tech Publishers, Madison. 197 pp.

Finlay, B.J., Black, H.I.J., Brown, S., Clarke, K.J., Esteban, G.F., Hindle, R.M., Olmo, J.L., Rollett, A., Vickerman, K., 2000: Estimating the growth potential of the soil protozoan community. Protist, *151*, p. 69–80.

Foissner, W., 1987: Soil Protozoa: fundamental problems, ecological significance, adaptations in ciliates and testaceans, bioindicators and guide to the literature. Prog. Protistol., *2*, p. 69–212.

Holecová, M., Sukupová, J., 2000: Weevils (Coleoptera, Curculionoidea: Attelabidae, Apionidae, Curculionidae) of the Nature reserve Lošonecký háj (SW Slovakia) (in Slovak). Folia faunistica Slovaca, *5*, p. 123–134.

Holecová, M., Lukáš, J., Haviar, M., Harakaľová, E., 2005: Ants (Hymenoptera, Formicidae) as an important part of the epigeic fauna in Carpathian oak-hornbeam forests. In Tajovský, K., Schlaghamerský, J., Pižl, V. (eds): Contribution to Soil Zoology in Central Europe I. ISB AS CR, České Budějovice. p. 31–35.

Krumpálová, Z., Szabová, S., 2003: Epigeic araneocoenoses of oak-hornbeam forest in the Nature Reserve Katarínka – Malé Karpaty Mts (in Slovak). Entomofauna Carpathica, *15*, p. 49–55.

Majzlan, O., Gajdoš, P., Fedor, P., 2000: The chosen arthropod groups (Arthropoda) in the suggested Vrchná Hora Reserve near town of Stupava (Protected landscape area CHKO Malé Karpaty) (in Slovak). Acta Fac. Paed. Univ. Tyrnaviensis, *4*, p. 3–14.

Matis, D., Tirjaková, E., 1994: Contribution to the knowledge of Ciliophora of the river Morava. Ekológia (Bratislava), Suppl. 1, p. 55–61.

Matis, D., Tirjak, J., Tirjaková, E., 1997: Synopsis of amoebae of Slovakia (in Slovak). Folia Faunistica Slovaca, 2, p. 1–6.

Matis, D., Mrva, M., 1998: New amoebae for fauna of Slovakia (in Slovak). Folia Faunistica. Slovaca, *3*, p. 1–8.

Michel, R., Smirnov, A.V., 1999: The genus *Flamella* Schaeffer, 1926 (Lobosea, Gymnamoebia), with description of two new species. Europ. J. Protistol., *35*, p. 403–410.

Mrva, M., 2003a: Diversity of active gymnamoebae (Rhizopoda, Gymnamoebia) in dendrotelmae of oak-hornbeam forests in Malé Karpaty Mts. (Western Slovakia). Protistology, *3*, p. 121–125.

Mrva, M., 2003b: Notes on active gymnamoebae (Rhizopoda, Gymnamoebia) in Turiec river. Folia Faunistica Slovaca, *8*, p. 23–26.

O'Dell, W D., 1979: Isolation, enumeration and identification of amoebae from a Nebraska Lake. J. Protozool., *26*, p. 265–269.

Page, F C., 1969a: *Hartmannella limax*: the original limax amoeba? Trans. Am. Microsc. Soc., *88*, p. 199–204.

Page, F.C., 1969b: *Platyamoeba stenopodia* n. g., n. sp., a freshwater amoeba. J. Protozool., *16*, p. 437–441.

Page, F C., 1977: The genus *Thecamoeba* (Protozoa, Gymnamoebia). Species distinctions, locomotive morphology, and protozoan prey. J. Nnat. Hist., *11*, p. 25–63.

Page, F.C., 1983: Three freshwater species of *Mayorella* (Amoebida) with a cuticle. Arch. Protistenkd., *126*, p. 201–221.

Page, F C., 1988: A new key to freshwater and soil Gymnamoebae. Freshwater Biological Association, Ambleside. 122 pp.

Page, F.C., 1991: Nackte Rhizopoda. In Page, F. C., Siemensma, F. J.: Nackte Rhizopoda und Heliozoea. G. Fischer Verlag, Stuttgart-New York. p. 1–170.

Sawyer, T.K., 1975: Marine amoebae from surface waters of Chincoteague Bay, Virginia: two new genera and nine new species within the families Mayorellidae, Flabellulidae and Stereomyxidae. Trans. Am. Microsc. Soc., *94*, p. 71–92.

Singh, B.N., 1946: A method of estimating the numbers of soil Protozoa, especially amoebae, based on their differential feeding on bacteria. Ann. Aappl. Biol., *33*, p. 112–119.

Smirnov, A.V., Goodkov, A.V., 1994: Freshwater gymnamoebae with a new type of surface structure *Paradermamoeba valamo* and *Paradermamoeba levis* sp. n. (Thecamoebidae), and notes on the diagnosis of the family. Acta Protozool., *33*, p. 109–115.

Smirnov, A V., 1995: *Stygamoeba regulata* n. sp. (Rhizopoda) – A marine amoeba with an unusual combination of light-microscopical and ultrastructural features. Arch. Protistenkd., *146*, p. 299–307.

Smirnov, A.V., Goodkov, A.V., 1996: Systematic diversity of gymnamoebae in the bottom sediments of a freshwater lake in Karelia (Lobosea, Gymnamoebia). Zoosyst. Rossica, *4*, p. 201–203.

Smirnov, A. V., 1999: *Korotnevella diskophora* n. sp. (Gymnamoebia, Paramoebidae) – small freshwater amoeba with peculiar scales. Protistology, *1*, p. 30–33.

Smirnov, A.V., 2003: Optimizing methods of the recovery of gymnamoebae from environmental samples: a test of ten popular enrichment media, with some observations on the development of cultures. Protistology, *3*, p. 47–57.

Smirnov, A.V., Brown, S., 2004: Guide to the methods of study and identification of soil gymnamoebae. Protistology, *3*, p. 148–190.

Štepanovičová, O., Országh, I., 2002: To the occurence of bug *Myrmedobia exilis* (Heteroptera, Microphysidae) in Slovakia (in Slovak). Folia Faunistica Slovaca, *7*, p. 35–38.

Tirjaková, E., Mrva, M., Hlúbiková, D., 2002: Ciliophora and Rhizopoda in soil, leaf-litter and mosses of oak-hornbeam forests in the Malé Karpaty Mts (Western Slovakia). In Tajovský, K., Balík, V., Pižl, V. (eds): Studies on soil fauna in Central Europe. ISB AS CR, České Budějovice. p. 233–240.

Zlinská, J., Šomšák, L., Holecová, M., 2005: Ecological characteristics of studied forest communities of an oak-hornbeam tier in SW Slovakia. Ekológia (Bratislava), *24*, Suppl. 2, p. 3–19.

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Mrva M.: **Diverzita nahých meňaviek** (Rhizopoda, Gymnamoebia) **v machoch Malých Karpát (Slovensko).**

Počas rokov 2000–2002 som študoval faunu nahých meňaviek (Rhizopoda, Gymnamoebia) machov na piatich lokalitách dubovo-hrabových lesov Malých Karpát. Vysušený materiál som navlhčil destilovanou vodou a po piatich dňoch kultivácie som sledoval zastúpenie meňaviek. Determinácia prebehla na základe morfologických kritérií aktívnych štádií. Zaznamenal som pomerne vysokú celkovú diverzitu 32 taxónov nahých meňaviek, ktorá sa pohybovala na jednotlivých lokalitách od 17 po 23 taxónov. Najviac bola druhovo zastúpená čeľaď Thecamoebidae (9 druhov), pomerne vysoké počty druhov boli zistené aj u čeľadí Hartmannellidae, Vannellidae a Paramoebidae. Zistené druhové zastúpenie nasvedčuje tomu, že spoločenstvo nahých meňaviek v skúmaných machoch je podobné spoločenstvám v sladkovodných biotopoch.

COMMUNITY STRUCTURE AND ECOLOGICAL MACRODISTRIBUTION OF MOSS-DWELLING WATER BEARS (Tardigrada) IN CENTRAL EUROPEAN OAK-HORNBEAM FORESTS (SW SLOVAKIA)

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Abstract

Degma P., Šimurka M., Gulánová S.: Community structure and ecological macrodistribution of moss-dwelling water bears (Tardigrada) in Central European oak-hornbeam forests (SW Slovakia). Ekológia (Bratislava), Vol. 24, Supplement 2/2005, p. 59–75.

The structure of tardigrade communities in mosses of Central European oak-hornbeam forests was studied at 10 sites located in the Malé Karpaty Mts and Trnavská pahorkatina hills (SW Slovakia). A total of 3, 050 tardigrade specimens of 21 species and 2 families were gathered from 79 quantitative samples taken from 2000 and 2002.
Kruskal-Wallis' tests and regression analyses showed no statistically significant influence between the 12 studied environmental variables and the number of Tardigrada specimens or number of species in the samples. A chi-square goodness of fit test suggested that the number of Tardigrada species in samples of moss *Hypnum cupressiforme* was random within the investigated area.
A t-test of tardigrade species diversity resulted in significant differences between study sites. The group of communities with the lowest diversity does not differ mutually. Majority of differences in species diversity were caused by randomly found species.
Results of cluster analysis as well as CCA point out that distribution of tardigrades and their colonisation of particular substrata is a random process.
Although the results are affected by restricted number of samples, we believe that Tardigrada as passively dispersed organisms are without significant relationship to ecological variables related to their distribution amongst substrata.

Key words: Tardigrada, community structure, ecological macrodistribution, mosses, oak-hornbeam forests, Central Europe