Published on paper: 1998. Published online: 2024-10-11.
ISSN 1502-4873 (paper). ISSN 1891-5396 (electronic).
doi: https://doi.org/10.5324/fn.v19i0.6009.

New records of the Testate Amoebae from Norway

Véra Opravilová

Opravilová, V. 1998. New records of the Testate Amoebae from Norway. - Fauna norv. Ser. A 19: 35-40.

A total of 8 samples consisting of moss, liverwort and sediments were analysed from three localities in Norway. The first locality - A (4 samples) is situated in northern Norway approximately 100 km south of Narvik, the second - B (3 samples) and third - C (1 sample) localities are situated in southern Norway. Samples were taken from brooks and surrounding area, and in one case from the sediment of the lake Finsevatnet. In total, we identified 59 taxa, of these 39 taxa were found in locality A, 43 taxa were found in locality B and 34 taxa were found in locality C. The highest abundance of taxa was found in the genera *Centropyxis* and *Difflugia.* Eleven taxa were recorded for the first time not only in Norway but in the whole subarctic area of northern Europe.

Véra Opravilová, Department of Zoology and Ecology, Faculty of Science, Masaryk University, Kotlářská 2, 611 37, Czech Republic.

INTRODUCTION

I had the opportunity to analyse 8 samples consisting of moss and sediments from three localities in Norway. The first locality is situated in northern Norway beyond the polar circle, approximately 100 km south of Narvik, the second and third localities are in southern Norway. Samples were obtained from brooks and surrounding area and in one case the sample was taken from sediment of the lake Finsevatnet.

Data of testate amoebae from northern Europe above the polar circle have been known since the begining of this century. There is research of Russian workers who were interested in the area of Murmansk and several islands in the Barents sea (Levander 1901, Awerintzew 1907a, 1907b) and in Swedish Lappland (Harnisch 1937, 1938, Thomasson 1952, Grospietsch 1954, Schönborn 1966, 1973, 1975). Decloitre (1962) reported several species of testate amoebae from the area around Narvik. The testate amoebae were also studied on the arctic archipelageo of Spitzbergen. Results of this research, which started as early as towards the end of the 19th century, were summarised by Opravilová (1989) and Balík (1994). The localities in southern Norway are situated at the same latitude as Shetland and Faeröer Islands where testate amoebae were analysed by Beyens & al. (1988).

MATERIAL AND METHODS

Samples of wet mosses and sediment were fixed in 4 % formaldehyd in situ. Terrestrial mosses were transported to the laboratory dried and subsequently rehydrated for one to two days. The mosses were compressed to extract the testate amoebae and water containing their shells was transferred into Sedgwick - Rafter counting cell. Three counts for each sample were used to obtain the relative representation of individual taxons (% dominance). The taxons were determined from permanent slides embedded in glycerol-gelatine. For all localities indices of diversity (according to Shannon-Weaver) and equitability (according to Shaldon) were calculated.

Description of localities and samples

Locality - A situated near Ulvsvang approximately 100 km south of Narvik. Brook with stone bottom which empties into a fjord. Max. width: 2 m; max. depth: 30 cm.
Sample no. l: Growth of moss *Racomitrium aciculare* (Hedw.) Brid. on stones out of water.
Sample no. 2: Detritus and sand on the bank of brook.
Sample no. 3: Growth of liverwort *Scapania* sp. in the stream.

Sample no. 4: Growth of moss *Racomitrium fasciculare* (Hedw.) Brid. at the confluence with the fjord.
Date of collection: August 30, 1989.

Locality - B was represented by a brook emptying into the lake Finsevatnet near the city Finse. The bottom of the brook is rocky." Max. width: 2 m; max. depth: 0.5 m.

Sample no. 1: Growth of moss *Drepanocladus* sp. on the bank of the brook.

Sample no. 2: Growth of moss *Drepanocladus* sp. in shallow water.

Sample no. 3: Sediment in the stream.
Date of collection: August 18, 1989.

Locality - C was represented by the shore of lake Finsevatnet.

Sample no. 1: Sediment from the lake bed.
Date of collection: August 18, 1989.

RESULTS AND DISCUSSION

Locality - A.

A total of 37 taxa were identified. The index of diversity was H'=4.02 and the index of equitability was E=0.11.

From the moss *Racomitrium aciculare* (Hedw.) Brid. from the dry environment (sample A1) the species *Cyclopyxis eurystoma* (D=36.36 %), *Euglypha laevis* (D=10.39 %) and *Corythion dubium* (D=10.39 %) were abundant. Grospietch (1954) has also reported the occurence of the species *Cyclopyxis eurystoma* in one sample from dry Sphagnetum. In addition to the taxa that prefer drier habitats, typical species of water habitats were also found: *Centropyxis aculeata* v. *oblonga* and *Euglypha filifera.*This community contained 42.07 % of the total number of individuals from all samples of locality A. The sample of the moss *Racomitrium fasciculare* (Hedw.) Brid. from the aquatic environment (sample 4) contained a different community structure with low abundance of species recorded. Only the following species had higher abundance compared with the other species: *Centropyxis aculeata, Cyclopyxis kahli, Phryganella acropodia* and *Cyphoderia ampulla.* Of the total number of individuals found in the locality A, this sample reperesented only 9.84 %. In the detritus (sample 2) taxa inhabiting water habitats were found, for example *Phryganella acropodia, Euglypha filifera* and *Trinema lineare*. The sample of liverwort *Scapania* sp. (sample 3) was interesting as it contained a high abundance of *Centropyxis aculeata* (D=42.31%), *Phryganella acropodia* (D=34.60%) and *Arcella discoides* (D=7.69%). The taxon *Phryganella acropodia* was found in several samples except the sample of aerophytic moss *Racomitrium aciculare* (Hedw.) Brid. (sample 1). (Table 1). Similarly Harnisch (1937, 1938) found this species in almost all samples of the Sphagnets that were not from peatbogs. Decloitre (1962) processed 10 samples of terrestrial mosses and lichens from the area around Narvik, where he found 24 taxa of testate amoebae. A high abundance of the species *Corythion dubium* was recorded and also a high number of the genus *Euglypha.*

Researchers studying testate amoebae from northern Europe beyond the polar circle have debated whether the fauna was different from communities in southerly areas. For example Levander (1901) compared the species composition of the community of testate amoebae in pools from the west Murmansk coast, including inshore islands, with the fauna of southern Finland. Harnisch (1937, 1938) studied the occurence of tyrphobiont species *Amphitrema flavum* in the highlands of central Europe and Sphagnets from Swedish Lappland. Grospietsch (1954) assumed that the factor governing the occurence of testate amoebae in northern areas was not only a short vegetation period, but also water saturation of the inhabited substrate. During summer, mosses and lichens absorb water from the melting snow and that is why the degree of humidity fluctuats only sligtly. This factor allows the occurence of tyrphobionts even in sphagnets that do not form highland peatbogs as they are known from central Europe. This was confirmed by Schönborn (1966) in an extensive study of testate amoebae of Swedish Lappland. He investigated different habitats such as sphagnets, moss, edafon and lakes. He found that species which are bound to highland peatbogs in Central Europe have a wider ecological valence in nothern subarctic areas. They occur under a particular humidity of substrate and can not be considered tyrphobionts. In another study from the Swedish Lappland, Schönborn (1975) reported the following species as being dominant in the subarctic area; *Difflugia globulosa, Difflugia oblonga* (=*D. pyriformis*) and *Centropyxis aerophila.*

Table 1. List of taxa; abundance expressed as a percentage of the total number of the individuals in the sample. The anterisk * marks new taxa for Norway. The degree of humidity is determined for samples of mosses and liverwort, but not for sediment samples (A2, B3, C1).

Locality	A				B			C
No. of sample	1	2	3	4	1	2	3	1
Scale of humidity (according to Jung)	VII-VIII		VI	IV	VII-VIII	III-IV	II-III	
Taxon								
Microchlamys patella Claparede & Lachmann	1.30						19.74	2.34
Arcella catinus Penard				0.96				
Arcella discoides Ehrenberg			7.69					1.57
Arcella rotundata v. *aplanata* Playfair	1.30							
* *Pyxidicula cymbalum* Penard					0.96			0.39
Centropyxis aculeata Stein		4.84	42.31	11.10	0.96	0.63	6.58	
Centropyxis aculeata v. oblonga Deflandre	9.09	3.23			2.88	3.80	26.31	0.39
Centropyxis aerophila Deflandre	3.90	1.61			15.38	3.80		7.03
Centropyxis aerophila v. *sphagnicola* Deflandre	1.30	1.61			4.82	5.70		0.78
Centropyxis cassis (Wallich) Deflandre	1.30	4.84		5.56	1.92	0.63		2.34
Centropyxis constricta Ehrenberg		1.61					3.29	
Centropyxis ecornis (Ehrenberg) Leidy								0.39
Centropyxis minuta Deflandre				1.92				
* *Centropyxis patula* Štepánek								1.95
Centropyxis platystoma (Penard) Deflandre				5.56			1.32	0.78
Centropyxis spinosa (Cash) Deflandre	1.30	1.61						
Centropyxis sylvatica (Deflandre) Thomas		3.23	3.85		1.92	3.80	13.82	33.59
Cyclopyxis eurystoma Deflandre	36.36	1.61			6.73	9.49	1.32	1.95
Cyclopyxis kahli Deflandre				11.10				
Plagiopyxis callida Deflandre				5.56		0.63		
Plagiopyxis declivis Thomas					1.92	2.53	0.66	1.57
Plagiopyxis intermedia Bonnet						3.16		
Plagiopyxis oblonga Bonnet & Thomas		1.61						
Difflugia bryophila (Penard) Jung						0.63		1.57
* *Difflugia cylindrus* (Thomas) Ogden		3.23				0.63		0.78
* *Difflugia difficilis* Thomas		1.61					0.66	
* *Difflugia dujardini* Chardez	1.30							
Difflugia globulosa Dujardin						1.90	2.63	
Difflugia linearis (Penard) Gauthier-Lièvre & Thomas	1.30				0.96		2.63	1.17
* *Difflugia longicollis* Penard		1.61						0.39
Difflugia lucida Penard						0.63		0.78
Difflugia penardi Hopkinson						8.22	2.63	0.39
* *Difflugia penardi v. ogiva* Deflandre				5.56				
Difflugia pyriformis Perty	1.30	3.23		5.56	0.96		1.97	1.95

Table 1. continued

Locality	A				B			C
No. of sample	1	2	3	4	1	2	3	1
Scale of humidity (according to Jung)	VII-VIII		VI	IV	VII-VIII	III-IV	II-III	
Taxon								
Nebela bohemica Taránek								3.91
Nebela collaris Leidy				5.56		1.27		
Nebela dentistoma Penard	2.60	6.45		5.56				0.39
Nebela militaris Penard	1.30							
Nebela lageniformis Penard	1.30	1.61		5.56	1.92	3.16		2.34
Nebela tincta Leidy	1.30	1.61				0.63		0.39
Quadrulella symmetrica (Wallich) Schulz		1.61					1.97	1.95
Quadrulella symmetrica v. longicollis Taránek						0.63		
Heleopera rosea Penard								3.52
Phryganella acropodia (Hertwig & Lesser) Hopkinson		11.29	34.60	11.10				1.17
* *Cryptodifflugia penardi* Grospietsch					0.96			
Euglypha cristata Leidy							0.66	0.39
Euglypha filifera Penard	7.78	9.68	3.85	5.56	2.88	1.90		
Euglypha laevis Perty	10.39	3.23	3.85		9.62	3.80	1.97	4.30
Euglypha strigosa f. glabra Wailes					0.96			
Assulina muscorum Greeff					1.92	3.80		1.17
Corythion dubium Taránek	10.39	3.23			8.66	3.80		
Trinema complanatum Penard		1.61			12.51	17.73		
Trinema enchelys Ehrenberg		1.61		5.56		1.27		0.39
Trinema lineare Penard	5.19	22.59	3.85		16.36	10.14	5.92	14.46
* *Pseudodifflugia globulosa* Štepánek					0.96		0.66	
Pseudodifflugia gracilis Schlumberger					0.96	0.63	4.60	3.13
* *Pseudodifflugia gracilis v. terricola* Bonnet & Thomas						5.06		
* *Campascus minutus* Penard							0.66	
Cyphoderia ampulla (Ehrenberg) Leidy				11.10				0.39

Table 2. Abundance (in %) of the most common genera according to their number of taxa.

Locality	A	B	C
Arcella	8.11	2.32	2.94
Centropyxis	29.73	23.25	26.47
Difflugia	18.92	18.60	20.59
Nebela	13.51	6.98	11.76
Euglypha	5.40	6.92	5.88
Trinema	8.11	6.98	5.88

Locality - B.

A total of 43 taxa were identified. The index of diversity was H'=4.21 and the index of equitability was E=0.09.

Different growths of the same moss *Drepanocladus* sp. collected at localities differing by the degree of humidity (samples 1, 2) revealed different communities. Some taxa were common for both samples, but differed in individual abundance, for example *Centropyxis aerophila, Euglypha laevis,* and *Trinema complanatum.* Other taxa were found in only one sample, for example *Difflugia penardi.* In the sample of sediment from the stream (sample 3), the following taxa were found: *Centropyxis aculeata* v. *oblonga* (D=26.31 %), *Microchlamys patella* (D=19.74 %) and *Centropyxis sylvatica* (D=13.82 %). (Table 1).

Locality - C.

A total of 34 taxa were identified. The index of diversity was H'=4.04 and the index of equitability E=0.01.

In sample (1) the taxon *Centropyxis aculeata* was dominant with *Trinema lineare* being abundant also (Table 1).

The highest representation of taxa from localities A, B and C was found in the genera *Centropyxis* and *Difflugia* (Table 2).

Beyens et al. (1988) who processed extensive material (moss, lichens, sapropel, plankton) from the Shetlands and Faeröer Islands which are situated on approximately the same latitude as our localities, discovered differing abundances of the genus *Difflugia* and *Centropyxis.* On the Shetland Islands *Difflugia* reached up to 40 %, but on the Faeröer Islands only approximately 26 %. The genus *Centropyxis* reached about 5 % on the Shetland Islands, while over 10 % on the Faeröer Islands. In their opinion, the lower abundance of *Difflugia* on the Faeröer mirrors the change of the habitats inhabited by testate amoebae. This change is caused by the geographical position of the islands. The fauna of testate amoebae can be understood as the linking point between temperate and boreal fauna (Beyens et al. 1988).

Jung (1936) also pointed out that one of the determining factors influencing the community of testate amoebae is the degree of humidity of the substrate, especially in mosses and lichens. This author proposed a scale of humidity (I to VIII) based on the relative water content. This problem has been dealt with by Graaf (1956), Schönborn (1952), Beyens et al. (1986) and other authors.

The communities of testate amoebae from our material can be classified as follows: B3 into the groups II-III; B2 into the groups III-IV; A4 into the group IV; A3 into the group VI; A1, B1 into the groups VII-VIII.

In the material we processed, we found species of testate amoebae which have not been previously reported from northern Europe, including Norway. There species are: *Pyxidicula cymbalum, Centropyxis patula, Difflugia cylindrus, D. difficilis, D. dujardini, D. longicollis, D. penardi* v. *ogiva, Cryptodifflugia penardi, Pseudodifflugia globulosa, P.gracilis* v. *terricola* and *Campascus minutus.*

ACKNOWLEDGEMENT

I would like to thank Dr. J. Zukal and Mgr. P. Kanuch for the sampling of material and providing valuable ecological data, Dr. I. Novotny for identification of the mosses and A. Douglas from the U.K. for the correction of the English text of this paper.

SAMMENDRAG

Nye funn av skallamøber i Norge

I alt 8 prøver av mose, levermose og sedimenter fra en lokalitet ved Ulvsvang, Nordland og to lokaliteter ved Finsevann, Hordaland ble analysert. Prøvene ble tatt i og ved bekker og vann. Totalt ble 59 taxa identifisert, herav 39 ved Ulvsvang og henholdsvis 43 og 34 i de to lokalitetene ved Finsevann. Slektene Centropyxis og Difflugia var representert med flest arter. Elleve arter ble funnet for første gang ikke bare for Norge, men for hele den subrktiske delen av Nord-Europa.

REFERENCES

Awerintzew, S. 1907a. Über die Süsswasser-Protozoen der Insel Waigatsch. - Zool. Anz. 31: 306-312.

Awerintzew, S. 1907b. Über einige Süsswasser-Protozoen der Bäreninsel. - Zool. Anz. 31: 243-247.

Balík, V. 1994. On the soil Testate Amoebae Fauna (Protozoa: Rhizopoda) of the Spitsbergen Islands (Svalbard). - Arch. Protistenkd. 144: 365-372.

Beyens, L., Chardez, D. & De Landtsheer, R., with collaboration of De Bock, P. & Jacques, E. 1986. Testate Amoebae Populations from Moss and Lichens Habitats in Arctic Polar. - Biol. 5: 165-173.

Beyens, L., Chardez D., De Baere D., with collaboration of P. De Bock & E.Jacques. 1988. Some Data on the Testate Amoebae from the Shetland Islands and the Faeröer. - Arch. Protistenkd. 136: 79-96.

Decloitre, L. 1962: Sur quelques Thécamoebiens récoltés en Norvege. - Hydrobiologia 19: 179-182.

Graaf de, F. 1956. Studies on Rotatoria and Rhizopoda from the Netherlands. - Biologisch Jaarboek Dodonaea. 23: 145-217.

Grospietsch, T. 1954. Studien über die Rhizopodenfauna von Swedisch-Lapplands. - Arch. Hydrobiol. 49: 546-580.

Harnisch, O. 1937. Neue Daten zur Testaceen Rhizopodenfauna nicht moor-bildender Sphagnete. - Zool. Anz. 120: 129-137.

Harnisch, O. 1938: Weitere Daten zur Rhizopodenfauna Lapplands. - Zool. Anz. 124: 138-150.

Jung, W. 1936: Thekamoeben usprünglicher lebender deutscher Hochmoore. - Abh. Landes mus. Westfalen. 7: 3-87.

Levander, R. 1901. Beiträge zur Fauna und Algenflora der süssen Gewässer an der Murmanküste. - Acta Soc. Faun. Fenn. 20: 1-35.

Opravilová, V. 1989. Some Information on Testate Amoebae from Spitsbergen. - Fauna Norv. Ser. A 10: 33-37.

Schönborn, W. 1962. Zur Ökologie der sphagnicolen, bryokolen und terricolen Testaceen. - Limnologica (Berlin). l: 231-254.

Schönborn, W. 1966. Untersuchungen über die Testaceen Schwedisch-Lapplands. Ein Beitrag zur Systematik und Ökologie der beschalten Rhizopoden. - Limnologica (Berlin). 4: 517-559.

Schönborn, W. 1973. Paläolimnologische Studien an Testaceen aus Bohrkernen des Latnjajaure (Abisko-Gebiet; Schwedisch-Lappland). - Hydrobiologia. 42: 63-75.

Schönborn, W. 1975. Studien über die Testaceenbesiedlung der Seen und Tümpel des Abisko-Gebietes (Schwedisch-Lappland). - Hydrobiologia. 46: 115-139.

Thomasson, K. 1952: Beiträge zur Kenntnis des Planktons einiger Seen im nordschwedischen Hochgebirge. - Schweiz. Z. Hydrobiol. 14: 257-288.