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Hydromycoflora of thirty-one lakes in Ełk Lake District and adjacent waters with reference to the chemistry of the environment*

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C z e c z u g a B.: *Hydromycoflora of thirty-one lakes in Ełk Lake District and adjacent waters with reference to the chemistry of the environment.* Acta Mycol. 30 (1): 49-63, 1995.

The mycoflora of Lake Ełk and thirty-one adjacent lakes and six rivers was studied. Samples of water were collected in 1987-1991 for hydrochemical analysis and determination of fungi species. In total 123 species of fungi were found in these water bodies, including 9 species reported for the first time from Poland.

Key words: Hydromycoflora, aquatic fungi, lakes, rivers.

INTRODUCTION

Among aquatic fungi there are some very common species which are found in almost every water basin any time of the year. However, there are also very rare species which are sporadically encountered in few water reservoirs. The distribution and biology of some fungi have not been thoroughly studied to date (S p a r r o w, 1960; K a r l i n g, 1977). Therefore, it seems necessary to determine the types of water bodies in which there species occur and their chemistry.

The determination of these phenomena is possible only by means of hydromycological studies of numerous ecological sites on extensive area.

This study is part of large-scale investigations conducted in the north-eastern region of Poland. Previous studies have provided some inhibition about new sites of very rare aquatic fungi, which have not been encurritered in Poland so far (C z e c z u g a, P r ó b a, 1980; C z e c z u g a et al., 1989).

The data on the hydromycoflora of Ełk lakes and adjacent waters enrich our knowledge of biology of many aquatic fungi species and provide information about new species, which have not been found in water bodies in Poland to date.

* Part 35 in the series "Studies of Aquatic Fungi"

THE STUDY AREA

The studies were carried out in 31 lakes and 6 rivers belonging to the so-called group of Ełk Lakes located in the south-eastern part of the Mazurian Lake District. These lakes were formed as a result of the melting of huge lentides, the soterrmed dead ice (C z e c z u g a, 1987). The morphological data of these water bodies are provided in Table 1. These lakes are of tunnel-valley character with the exception of Lake Kroszewo, Polne, Toczyłowo and Tajno which are of pond type. Most of them are surrounded by forest, ploughlands and marshy meadows.

The investigated rivers connect of some of these lakes whereas the longest River Ełk falls into the lower course of the river Biebrza as its right-bank tributary.

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METHODS

Samples of water were collected once a month over the years 1987-1991 for hydrochemical analysis and studies of species composition of aquatic fungi. For the determinations of chemical properties of water, the methods recommended by Standard Methods (G o l t e r m a n, C l y m o, 1969) were employed; the details of these methods were described in a previous paper (C z e c z u g a, P r ó b a, 1980).

In the water zoosporic fungi were studied by direct microscopic examination of water samples collected from materials in the water as well as by bait method F u l l e r and J a w o r s k i (1986) (onion, skin, hemp-seeds, clover-seeds, hairs and fillings of horn). In addition (for *Hyphomycetes*) the foam collected from the surface of eddies in running water or at the edges of stagnant water was examined directly under a microscope. The samples were fixed in formalin-acetic-alcohol immediately after collection and transported to the laboratory.

For the identification of the fungi the following keys were used: (S k i r g i e ł ł o, 1954; S p a r r o w, 1960; B a t k o, 1975; I n g o l d, 1975; K a r l i n g, 1977 and D u d k a, 1974, 1985).

RESULTS

The results of the chemical analysis of water are presented in Table 2. The lowest mean oxidability was noted in Lake Białe Rajgrodzkie and the highest in Lake Nieciecz. The ammonium nitrogen content was the lowest in Lake Białe Rajgrodzkie and River Ełk (site c) and highest in Lake Haleckie. The lowest concentration of undetectable amounts) nitrite nitrogen was nobed in Lakes Lipińskie, Mierucie, Rekelt, Skomętno, Straduny, Sunowo, Szostak and Rivers Ełk (site a), Różanka and Święcek, whereas the highest in Lake Dręństwo. Nitrate nitrogen on the other hand, was not found at all in Lake Straduny. The highest concentration of this form of nitrogen was noted in Lake Skomętno.

Table 1

Morphological characteristic of the investigated water bodies

Lake	Area in ha	Maximum depth, in m	Mean depth, in m	Number of sites
1. Białe Rajgrodzkie	135.4	35.1	10.5	2
2. Borowe	224.0	32.0	5.7	3
3. Długochwały	43.9	6.7	2.6	2
4. Dręństwo	550.2	25.3	7.0	3
5. Druglin	503.3	6.4	2.4	4
6. Dybowskie	149.8	17.0	4.7	2
7. Ełk	385.0	55.8	15.0	8
8. Gawlik	392.0	10.5	–	2
9. Golubskie	47.0	4.2	1.9	1
10. Grabnik	22.2	5.6	2.6	1
11. Haleckie	90.0	7.2	3.3	1
12. Henzelewo	128.9	13.3	3.3	2
13. Kroszewo	32.5	1.5	–	1
14. Krzywe Rajgrodzkie	88.4	8.2	–	1
15. Laśmiady	942.9	43.7	9.5	3
16. Lipińskie	272.1	23.0	3.5	3
17. Mierucie	23.0	2.4	–	1
18. Nieciecz	40.0	7.7	–	1
19. Polne (near lake Mierucie)	1.0	0.5	–	1
20. Rajgrodzkie	1500.0	51.8	14.3	7
21. Regielskie	87.5	11.0	3.8	2
22. Reklet	58.7	5.5	2.3	1
23. Skomętno	209.6	7.0	2.0	3
24. Straduny	53.0	4.9	2.4	2
25. Sunowo	168.1	20.6	9.3	3
26. Szóstak	490.1	28.4	9.1	4
27. Selmęt Wielki	1202.0	21.9	7.8	11
28. Tajno	216.4	6.6	5.0	3
29. Toczyłowo	95.0	9.9	8.2	2
30. Woszczelskie	147.0	10.6	3.4	2
31. Wydmińskie	337.0	9.8	3.1	3
River	**Lenght, in km**	**Number of sites**		
32. Ełk – flow to River Biebrza	113.6	5		
a – site in Straduny				
b – site before Lake Ełk				
c – after Lake Ełk				
d – site in Nowa Wieś Ełcka				
e – site near Grajewo				
33. Golubica – flow to Lake Selmęt Wielki	5.0	1 (near Lake Selmęt Wielki)		
34. Lega – flow to Lake Selmęt Wielki	110.5	4 (Pańki, Sedranki, Możne, Nowy Młyn)		
35. Małkinia – flow to Lake Rajgrodzkie	11.5	2		
a – site in Stacze				
b – site in Sypitki				
36. Różanka – flow to River Święcek	7.2	1 (near River Święcek)		
37. Święcek – flow Lake Roś	19.5	2 (near Lakes: Długochwały and Roś)		

Table 2

Chemical properties of water particular sites (in mg l^{-1})

Properties \ No of water body (see Table 1)	1	2	3	4	5	6	7	8	9	10
Temperature °C	12.30	14.20	15.20	11.30	13.30	14.40	12.50	17.80	14.00	15.10
pH	7.40	8.40	8.80	7.30	8.80	8.90	7.20	8.00	8.20	8.90
Oxidability	4.40	13.70	10.00	8.20	15.10	10.30	8.50	10.20	12.40	9.50
CO_2	17.60	9.90	14.30	17.60	23.20	33.00	17.80	13.20	15.60	15.40
Alkalinity in $CaCO_3$*	3.10	2.00	4.70	3.20	3.70	3.50	3.60	3.40	3.50	4.00
$N\text{-}NH_3$	0.12	0.94	0.79	0.33	0.86	1.21	0.25	0.92	0.14	0.94
$N\text{-}N0_2$	0.117	0.01	0.01	0.186	0.01	0.01	0.01	0.01	0.01	0.01
$N\text{-}NO_3$	0.17	0.06	0.08	0.03	0.03	0.04	0.02	0.08	0.07	0.03
PO_4	1.61	0.42	2.45	3.19	3.12	0.32	3.85	0.04	1.90	1.47
Cl	37.00	42.00	71.00	39.00	73.00	68.00	40.00	30.00	43.00	62.00
Total hardness in Ca	25.20	33.80	86.40	54.00	44.60	41.80	48.50	28.10	55.40	56.90
Total hardness in Mg	31.80	12.00	25.30	24.10	34.80	31.60	21.40	38.30	12.90	22.40
SO_4	12.70	8.70	33.70	34.60	35.00	27.20	29.60	49.80	16.10	16.00
Fe	1.38	0.18	0.32	1.72	0.14	0.12	1.62	0.15	0.15	0.68
Mn	–	–	–	–	–	–	–	–	0.10	–
Dry residue	280	223	549	364	413	412	334	382	319	343
Dissolved solids	276	195	545	357	384	405	305	379	307	341
Suspended solid	4	28	4	7	29	7	29	3	12	2

* in mval/l

cont. Table 2

Properties \ No of water body (see Table 1)	11	12	13	14	15	16	17	18	19	20
Temperature °C	12.40	14.80	10.90	12.00	14.70	14.60	15.00	9.20	15.30	11.90
pH	7.20	8.70	7.50	7.40	8.80	8.50	8.70	7.20	8.40	7.60
Oxidability	53.00	11.80	13.70	10.90	8.70	14.60	20.10	156.20	14.10	7.40
CO_2	22.00	12.10	28.60	15.40	33.00	19.80	19.80	99.00	25.30	24.20
Alkalinity in $CaCO_3$*	2.20	3.70	4.20	3.60	3.50	2.70	3.40	4.90	3.10	3.40
$N\text{-}NH_3$	2.38	0.86	0.34	0.25	0.79	1.02	1.84	0.59	0.72	0.31
$N\text{-}N0_2$	0.02	0.01	0.138	0.01	0.01	0.00	0.00	0.01	0.01	0.01
$N\text{-}NO_3$	0.04	0.03	0.16	0.14	0.12	0.06	0.12	0.12	0.08	0.12
PO_4	1.10	1.49	2.34	1.64	0.27	0.55	1.62	5.60	1.65	1.33
Cl	33.00	48.00	49.00	43.00	42.00	49.00	78.00	31.00	48.00	43.00
Total hardness in Ca	28.80	61.90	16.60	46.10	59.20	48.20	51.10	89.30	43.20	29.50
Total hardness in Mg	10.80	12.50	62.40	24.90	13.30	17.20	55.50	24.10	67.50	35.30
SO_4	30.40	32.50	31.80	30.40	26.70	28.00	44.40	10.70	14.00	32.90
Fe	0.30	0.18	1.64	1.40	0.68	0.10	0.45	1.97	0.72	1.08
Mn	0.00	–	–	–	–	–	–	–	–	–
Dry residue	261	376	473	309	323	334	553	2834	345	362
Dissolved solids	213	289	442	302	302	317	554	366	344	341
Suspended solid	48	87	31	7	21	17	9	2468	1	21

* in mval/l

cont. Table 2

No of water body (see Table 1) / Properties	21	22	23	24	25	26	27	28	29	30	31
Temperature °C	14.40	15.50	11.50	–	16.00	16.20	12.50	11.70	12.10	12.80	15.20
pH	8.40	8.80	7.30	8.10	8.70	8.70	7.30	7.50	6.20	8.70	8.80
Oxidability	17.50	7.60	27.00	8.20	9.50	8.30	8.90	27.80	11.70	17.50	11.40
CO_2	42.90	22.00	46.20	11.00	16.50	14.30	24.20	15.40	17.60	42.90	33.00
Alkalinity in $CaCO_3$*	3.70	3.20	5.00	3.70	3.50	2.80	3.50	3.90	4.10	3.70	3.20
$N\text{-}NH_3$	1.07	0.84	0.40	0.14	0.86	0.57	0.33	0.44	0.83	1.07	0.84
$N\text{-}N0_2$	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
$N\text{-}NO_3$	0.03	0.06	0.18	0.00	0.12	0.04	0.11	0.08	0.08	0.03	0.06
PO_4	1.20	1.14	3.68	0.04	2.18	0.35	5.40	3.25	4.15	1.21	1.54
Cl	55.00	48.00	44.00	26.00	59.00	46.00	47.00	45.00	44.00	55.00	56.00
Total hardness in Ca	61.20	56.20	20.20	57.60	48.20	50.40	64.80	39.60	79.20	61.20	58.30
Total hardness in Mg	21.10	21.30	61.50	15.10	24.50	14.60	21.50	41.30	22.40	21.10	21.50
SO_4	16.00	30.10	28.40	32.20	21.40	25.50	40.70	33.30	40.70	16.20	41.60
Fe	0.18	0.68	2.55	0.34	0.13	0.18	1.55	2.42	1.74	0.57	0.12
Mn	–	–	–	0.00	–	–	–	–	–	–	–
Dry residue	303	334	487	331	448	303	403	503	447	359	398
Dissolved solids	242	330	438	269	417	262	369	401	442	342	398
Suspended solid	61	4	49	62	31	51	34	102	5	17	0

* in mval/l

cont. Table 2

No of water body (see Table 1) / Properties	32					33	34	35		36	37
	a	b	c	d	e			a	b		
Temperature °C	11.60	10.80	10.60	11.80	12.10	10.00	11.00	12.80	12.10	12.00	13.00
pH	8.10	7.10	8.00	6.80	7.40	7.10	7.40	7.30	7.40	7.90	8.00
Oxidability	8.30	7.50	6.90	7.10	7.00	6.40	14.50	8.60	12.80	13.00	10.80
CO_2	11.00	19.80	8.80	15.40	19.80	35.20	39.60	30.80	15.40	11.00	6.60
Alkalinity in $CaCO_3$*	3.70	3.40	3.80	3.30	3.80	4.20	4.40	3.50	3.40	3.70	1.90
$N\text{-}NH_3$	0.14	0.25	0.12	0.31	0.19	0.31	0.35	0.25	0.25	1.14	0.87
$N\text{-}N0_2$	0.00	0.01	0.00	0.01	0.01	0.06	0.04	0.02	0.02	0.00	0.00
$N\text{-}NO_3$	0.06	0.12	0.06	0.03	0.11	0.10	0.24	0.14	0.10	0.08	0.07
PO_4	0.12	1.95	1.51	1.53	2.39	6.02	3.48	5.45	5.51	0.28	0.31
Cl	24.00	40.00	28.00	38.00	44.00	39.00	42.00	44.00	44.00	38.00	26.00
Total hardness in Ca	57.60	47.50	42.50	51.10	69.80	88.60	90.00	68.40	63.50	36.00	49.70
Total hardness in Mg	18.10	24.00	22.80	17.20	18.90	20.50	21.50	21.90	20.60	9.90	8.60
SO_4	27.60	23.50	32.50	25.10	26.70	44.00	32.10	38.30	28.40	30.40	14.40
Fe	0.10	1.18	0.00	1.41	1.58	1.71	1.60	1.52	1.81	0.25	0.41
Mn	0.00	–	–	–	–	–	–	–	–	–	–
Dry residue	227	326	264	301	420	485	477	399	384	382	194
Dissolved solids	255	315	262	286	381	461	422	389	376	365	172
Suspended solid	22	11	2	15	39	24	55	10	8	17	22

* in mval/l

The lowest concentration of phosphorus was found in Lake Gawlik; the highest – in the waters of Rivers Golubica and Małkinia and Lakes Niecieczo and Selmęt Wielki. The remaining chemical properties of water variet greatly.

The water of Lake Woszczelskie in June 12, 1992 was red. It had the highest content of cells of three species of purpuric bacteria – *Lamprocystis roseopersicina* (Kutzing) Schroeter, *Thiopedia rasea* Winogradsky and *Thiocystis violacea* Winogradsky.

In total 123 species of aquatic fungi were found in the water bodies (Table 3): 36 species belonging to *Chytrydiomycetes*, 2 to *Hyphochytriomycetes*, 55 to *Oomycetes*, 2 to *Zygomycetes*, 2 to *Ascomycetes*, 3 to *Endomycetes* and 23 species to *Hyphomycetes*. It was noteworthy that some aquatic fungi species were new to the Polish hydromycoflora such as: *Cladolegnia asterophora*, *Olpidium pendulum*, *Achlya oblongata*, *Curvularia lunata* (Fig. 1) and from *Hyphomycetes* – *Cylindrocarpon aquaticum*, *Descalsia cruciata* and *Tricladium patulum*. Rare species in the mycoflora of Poland included *Lageniudium rabenhorstii*, *Skirgiella septigena*, *Dangeardia laevis*, *Septolipidium lineare*, *Zoophthora conica* and *Z. curvispora*.

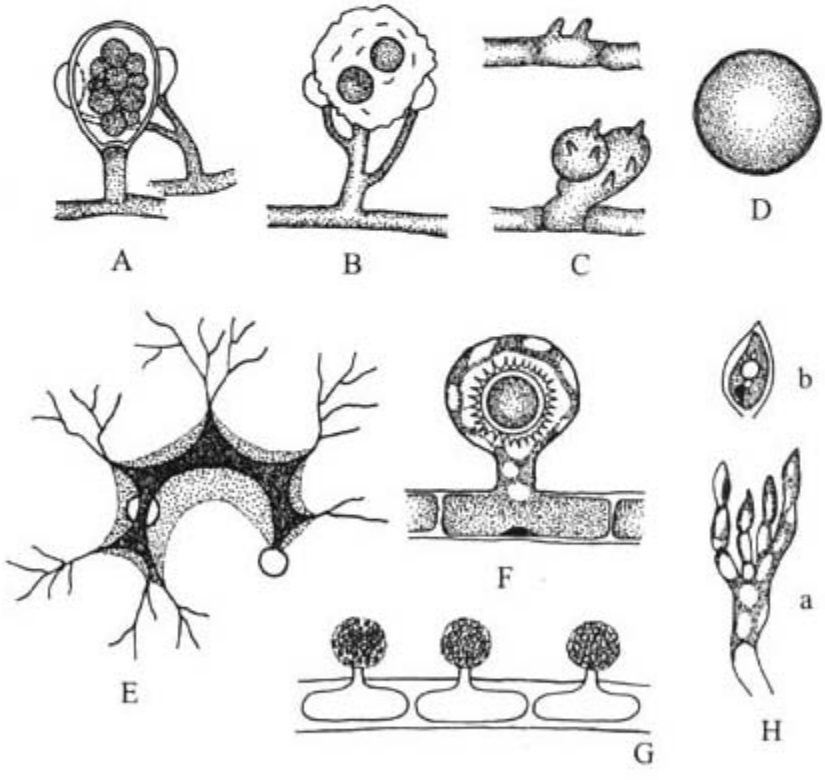

Fig. 1. Some aquatic fungi

A — *Achlya oblongata* – gametangium (54-176 x 44-120 μm); B — *Cladolegnia asterophora* – gametangium (32-46 μm); C — *Curvularia lunata* – part of thallus; D — *Olpidium pendulum* – sporangium (24-28 μm); E — *Phlyctorhiza endogena* – thallus in insect axuviae; F — *Skirgiella septigena* – spore (16-22 μm) in thallus; G — *Septolpidium lineare* – thallus (8 x 24 μm) in algae celol; H — *Zoophthora conica* – a - part of thallus from conidiophore, b - conidium.

Table 3

Aquatic fungi in particular water bodies (except for Lake Ełk)

Class and species	Water bodies (see Table 1)
Chytridiomycetes	
Asterophlyctis irregularis Karling	7
Blastocladia ramosa Thaxter	6
B. rostrata Minden	32d
Blastocladiopsis parva (Whiffen) Sparrow	1, 2, 5, 7, 12, 15, 20, 23, 25, 26, 27, 29, 32e, 35a
Catenaria anguillulae Sorokin	5, 7, 13, 14, 21, 27, 32b, d; 34
C. sphaerocarpa Karling	14, 27, 29
C. verrucosa Karling	7, 17, 19, 22, 30
Catenophlyctis variabilis (Karling) Karling	7, 30
Chytridium xylophilum Cornu	3, 7, 10, 12, 17, 20, 21, 22, 23, 24, 25, 27, 32b, d, e; 35a
Chytriomyces poculatus Willoughby et Townley	13, 17
Chytriomycetes annulatus Dogma	7, 9, 20, 29, 31e, 32b
Dangeardia laevis Sparrow et Barr	7
Dictyomorpha dioica (Couch) Mullins	27
Diplophlyctis complicata (Willoughby) Batko	4
Karlingia chitinophila Karling	30
K. polonica Hassan	32d
K. rosea (de Bary et Woronin) Johanson	27, 30, 31, 34, 35d
Nowakowskiella elegans (Nowak.) Schroeter	3, 7, 9, 10, 16, 18, 27, 31, 32a, d, e; 33, 35a, 36b
Nowakowskiella macrospora Karling	1, 2, 3, 4, 7, 27, 28, 32d
Olpidium granulatum Karling	7, 14, 20, 27, 32a, d
O. pendulum Zopf	31
Phlyctidium apophysatum Canter	20
Phlyctochytrium aureliae Ajello	7, 16, 26
Phlyctorhiza endogena Hanson	33
Polychytrium aggregatum Ajello	7, 16, 24, 27, 32d, 35a
Polyphagus euglenae Nowakowski	5, 7, 11, 32d, e
Rhizidiomyces bivellatus Nabel	20
Rhzophydium apiculatum Karling	3, 4, 7, 20
R. carpophilum (Zopf) Fisher	7, 14, 27, 32d
R. keratinophilum Karling	1, 3, 4, 5, 7, 13, 20, 23, 32b, e; 35a
R. nodulosum Karling	27, 29
R. poligenum Ookubo et Kobayashi	27, 32e
Rhizophydium pollinis-pini (Braun) Zopf	3, 7, 17, 18, 23, 25, 27, 30
Septolpidium lineare Sparrow	18
Siphonaria variabilis Petersen	4, 7, 20, 32d
Skirgiella septigena (Cornu) Batko	7
Hyphochytriomycetes	
Hypochytrium catenoides Karling	5, 7, 10, 14, 22, 25, 27, 30, 31
Rhizidiomyces bivellatus Nabel	20
Oomycetes	
Achlya americana Humphrey	32a
A. debaryana Humphrey	7, 12, 20, 27, 32d
A. dubia Coker	32d
A. flagellata Coker	7, 29, 32a
A. glomerata Coker	7
A. hypogyna Shanor et Conover	27
A. klebsiana Pieters	7
A. megasperma Humphrey	3, 7, 12, 20, 26, 32e
A. oblongata de Barry	7, 31

cont. Table 3

A. oligacantha de Barry	2, 7, 9, 10, 26, 27, 33, 34
A. papillosa Humphrey	1, 3, 7, 27, 32b
A. polyandra Hildebrandt	27, 32d
A. radiosa Maurizio	35a
A. recurva Cornu	7, 15
A. rodrigueziana F. T. Wolf	27, 30
Aphanodiction papillatum Huneycutt	7, 9, 21, 23, 33
Aphanomyces astaci Schikora	7, 32d
A. irregularis Scott	1, 2, 3, 5, 6, 7, 9, 12, 14, 16, 17, 19, 20, 21, 22, 25, 26, 27, 28, 30, 31, 32d, e; 34
A. keratinophilus (Ookubo et Kobayashi) Sey. et Joh.	27
A. laevis de Barry	4, 27
A. parasiticus Coker	1, 7, 27
A. scaber de Barry	7
A. stellatus de Bary	3, 7, 15, 20, 25, 27
Apodachlya brachynema (Hildebrand) Pringsheim	7
Cladolegnia asterophora (de Barry) Johanes	32a
C. unispora (Coker et Couch) Johanes	7
Culvularia lunata (Walker) Boedijn	7, 14, 20, 29, 33
Dictyuchus monosporus Leitgeb	1, 3, 5, 7, 10, 11, 13, 21, 27, 29, 30, 32b, e; 33, 35b
Isoachlya anisospora (de Bary) Coker	20, 25, 27, 28, 29, 30, 32d, e; 35b
Lagenidium marchalianum de Wildeman	7
L. rabenhorstii Zopf	27
Leptolegnia caudata de Barry	2, 7, 12, 21
Leptolegniella keratinophila Huneycutt	32d, e; 33
Leptomitus lacteus (Roth) Agardh	6, 7, 20, 27
Mitochytridium regale Hassan	3, 7, 19, 21, 27, 28
Myzocytium microsporum (Karling) Sparrow	32e
M. proliferum Schenk	33
Olpidiopsis saprolegniae (Braun) Cornu	3, 7, 20, 25, 26, 27, 29, 32e, 33
Phythiogeton nigricans Batko	5, 7, 26, 27, 28, 29, 30, 32d, e; 35a, b; 37
Phytium uniforme Lund	32a
P. artotrogus de Barry	13, 18, 25, 27, 32b, e
P. debaryanum Hesse	7
P. rostratum Butler	16, 24, 27
P. ultimum Trow	7, 17, 20, 27
Rhizidium chitinophilum Sparrow	20
Rozellopsis inflata (Butler) Karling	3, 6, 9, 20, 22, 23, 25, 27, 28, 32a, d; 33, 35a, 36
Saprolegnia delica Coker	36
S. diclina Humphrey	24, 27
S. ferax (Gruith) Turnet	1, 2, 3, 7, 11, 12, 14, 15, 17, 18, 20, 25, 27, 28, 29, 32d, e; 33, 34, 35a, 37
S. hypogyna (Pringsheim) de Barry	13, 35b
S. mixta de Barry	32a
S. monoica Pringsheim	7
S. parasitica Coker	7, 12, 14, 19, 21, 22, 26, 27, 32a, 33
Traustotheca clavata (de Barry) Humprey	7
Zoophagus insidians Sommerstorff	1, 7, 12, 16, 19, 20, 21, 22, 25, 27, 28, 32a, b, d
Zygomycetes	
Zoophthora conica (Nowakowski) Batko	7, 15, 27
Z. curvispora (Nowakowski) Batko	15
Ascomycetes	
Apostemidium guernisaci (Crouan.) Boud	7, 27
Aspergillus candidus Link	26

cont. Table 3

Endomycetes	
Candida albicans (Rabin) Berkhout	7
C. tropicalis (Cast.) Berkhout	7, 20
Trichosporon cutaneum (de Beur. et all.) Ota	7, 12, 13, 22, 27, 29, 32d
Hyphomycetes	
Alatospora acuminata Ingold	14, 25, 31
Anguillospora gigantea Ranzoni	7
A. longissima (Sacc. et Sydow) Ingold	1, 2, 3, 7, 9, 13, 16, 20, 22, 24, 26, 27, 30, 32b, d; 34, 36, 37
A. pseudolongissima Ranzoni	18
Arthrobotrys oligospora Fresenius	7, 15, 17, 25, 27, 28, 30, 31, 32b, e; 33
Bacilliospora aquatica Nillsson	2, 4, 6, 7, 37
Cylindrocarpon aquaticum (Nilsson) Marvanova et Descals	22
Dactyllea submersa (Ingold) Nilsson	7, 27, 31
Descalsia cruciata Roldan et Honrubia	12
Fusarium aquaeductum (Radlk. et Rabenh.) Lagerh	6, 7, 18, 20, 22, 32d
Geniculospora inflata (Ingold) Nilsson	7
Heliscus lugdunensis Saccar. et Therry	7, 27
Lemonniera aquatica de Wildeman	1, 7, 14, 15, 20, 27, 29, 30, 32e, d; 34
L. terrestris Tubaki	7, 34
Lunulospora curvula Ingold	7, 27, 34
Robillarda phragmitis Cunnel	7, 25, 27, 31, 32a, d; 34, 37
Tetrachaetum elegans Ingold	7, 27
Tetracladium marchalianum de Wildeman	25, 27
T. setigerum (Grove) Ingold	1, 6, 7, 15, 19
Tricladium patulum Marvanova et al.	7
Tripospermum camelopardus Ingold et al.	12
Triscelosphorus monosporus Ingold	7, 27
Vargamyces aquaticum (Dudka) Toth	3, 32e

Cladolegnia asterophora was observed in the water collected from the River Ełk in Straduny in spring of 1987. More over a new species namely *Olpidium pendulum* was found in Lake Wydminy in spring of 1987. *Achlya oblongata* occurred in from of March to April 1990 in the southern part of Lake Ełk, Rajgrodzkie, Krzywe Rajgrodzkie, Toczyłowo and River Golubica. In Lakes Ełk, Laśmiady and Selmęt Wielki a parasitic fungus *Zoophthora conica* was linown to occur, whereas *Z. curvispora* was only found in Lake Laśmiady. The development of *Cylindrocarpon aquaticum* was observed in Lake Rekelt, *Descalsia cruciata* – in Lake Henzelewo and *Tricladium patulum* – in Lake Ełk. *Skirgiella septigena* was observed in the water of Lake Ełk collected from ice in the central part of the lake in the middle of March 1988. *Lagenidium rabenhorstii* grew in the water of Lake Selmęt Wielki at the site in Szeligi in September 1987. *Dangeardia laevis* was encountered in March 1990 in Lake Ełk, while *Septolipidium lineare* in April of the same year in Lake Nieciecz.

Altogether, 44 species of aquatic fungi were found over the period of one year in the southern part of Lake Ełk (Table 4). Most species appeared in one month, altough such species as *Aphanomyces irregularis, Achlya megasperma, Saprolegnia ferax, Fusarium aquaeductum* and *A. irregularis* and *S. ferax* were found more frequently. *Achlya megasperma* occurred only from September to December.

Table 4

Hydromycoflora in south part of Lake Ełk in particular months

Class and species	Month
Chytridiomycetes	
Asterophlyctis irregularis Karling	IX
Blastocladiopsis parva (Whiffen) Sparrow	I, V
Catenaria anguillulae Sorokin	VI
C. verrucosa Karling	VI
Catenophlyctis variabilis (Karling) Karling	VII
Dangeardia laevis Sparrow et Barr	III
Nowakowskiella elegans (Nowak.) Schroeter	III, IV, VI
Olpidium granulatum Karling	XII
Phlyctochytrium aureliae Ajello	III, X
Polychytrium aggregatum Ajello	IV, X
Rhizophydium keratinophilum Karling	IV, V
R. pollinis-pini (Braun) Zopf	IV, VI
Hyphochytriomycetes	
Hyphochytrium catenoides Karling	X
Oomycetes	
Achlya megasperma Humprey	IX, X, XI, XII
A. oblongata de Barry	III, IV
A. oligacantha de Barry	I, III, V
A. recurva Cornu	V
Aphanomyces irregularis Scott	I, III, IV, V, VII, VIII, IX, X, XI, XII
A. parasiticus Coker	XII
A. scaber de Barry	XI
A. stellatus de Barry	I, IX
Apodachlya brachynema (Hildebr.) Pringsheim	X
Cladolegnia unispora (Coker et Couch) Joh.	II
Dictyuchus monosporus Leitgeb	VII, IX, X
Leptomitus lacteus (Roth) Agardh	IV
Mitochytridium regale Hassan	V
Olpidiopsis saprolegniae (Braun) Cornu	III, V
Pythiogeton nigricans Batko	IX
Pythium debaryanum Hesse	II
Saprolegnia ferax (Gruith) Turnet	III, V, VII, X, XI, XII
S. monoica Pringsheim	IX
S. parasitica Coker	II
Zoophagus insidians Sommerstorff	IX
Zygomycetes	
Zoophthora conica (Nowakowski) Batko	VI
Endomycetes	
Candida albicans (Rabin) Berkhout	V
Trichosporon cutaneum (de Beur. et all) Ota	II
Hyphomycetes	
Anguillospora longissima (Sacc. et Sydow) Ingold	XII
Arthrobotrys oligospora Fresenius	IV, VI
Bacillispora aquatica Nilsson	VIII
Fusarium aquaeductum (Radkl. et Rab.) Lagerheim	I, VIII, X, XII
Lemonniera aquatica de Wildeman	IX, XI
Robillarda phragmitis Cunne	XII
Tetrachaetum elegans Ingold	IX
T. setigerum (Grove) Ingold	I

Month	Number of species
I	6
II	4
III	8
IV	9
V	9
VI	6
VII	4
VIII	3
IX	10
X	8
XI	5
XII	8

cont. Table 4

Season	Number of species
Winter (XII, I, II)*	6.0
Spring (III, IV, V)	8.7
Summer (VI, VII, VIII)	4.3
Autumn (IX, X, XI)	7.7

* Samples were collected in third decade of each month

DISCUSSION

Species which are new the hydromycoflora of Poland belong to aquatic saprophytes (S p a r r o w, 1960). *Olpidium pendulum* has been encountered in watery soil and in water on decaying vegetal remnants (J o h n s o n, 1969). *Cladolegnia asterophora*, which is an aquatic and soil saprophyte, has been most frequently reported in winter, from soil only at temperatures below zero. In our investigations water samples were collected from the River Ełk on 25th March, when fields were covered with snow and lakes with ice. *Achlya oblongata* regarded as a parasite of injured fish is rather known as an aquatic zoo- and rarely phytosaprophyte (J o h n s o n, 1956). Whereas *Culvularia lunata* belongs to the group of keratinophilic fungi (N i t y a n d a et al., 1962; E n g l i s h, 1965). *Candida albicans* was observed in the water of Lake Ełk. However this species of yeast is also inclassified to within keratinophilic fungi (K a p i c a, B l a n k, 1957; C z e c z u g a, M u s z y ń s k a, 1994).

The results obtained reveoled that in Lake Rekelt a representative of *Hyphomycetes* – *Cylindrocarpon aquaticum* – was found in September, and in Lake Henzelewo another representative of the same group of *Hyphomycetes* fungi – *Descalsia cruciata* – was observed at the same time. *Cylindrocarpon aquaticum* described by N i l l s s o n (1962) as *Bacillispora aquatica* was classified by M a r v a n o v a and D e s c a l s (1987) as another species of the fungus. *Descalsia cruciata* was for the first time isolated by R o l d a n and H o n r u b i a (1989) from foam in Canda de los Mojones stream, Riopar, Albacete, Spain in December 1987. The report on its presence in Lake Henzelewo in Mazury establishes the second site in the world and extends the group of water bodies where it can be found.

Particular attention should be poid to a relatively rare *Hyphomycetes* representative – *Tricladium patulum* – which was found in the coastal region of the western bank of the southern side of Lake Ełk in May 1991. It was first described on ash – tree leaves (*Fraxinus excelsior*) or decaying in running water in Czechoslovakia (M a r v a n o v a, M a r v a n, 1963). Subsequently it was reported from Japan (T u b a k i, 1966), Great Britain (A b d u l l a h et al., 1981) and from two sites in the

Asiatic part of the former Soviet Union (D u d k a, 1985). The analysis of the water at this site in May, when samples were collected from Lake Ełk, revealed the lowest total alkanity and nitrate nitrogen concentration, but the highest nitrate and sulphate contents.

Two other rare species of the Polish hydromycoflora belong to the group of parasitic species. *Skirgiella septigena*, a parasite of other species of aquatic fungi, has been hitherto encountered in the mycelium of species of the genera *Achlya* and *Saprolegnia*. While studying the occurrence of aquatic fungi in various water bodies of northeastern Poland *Skirgiella septigena* has only been found in the melting snow water in mixed forest (C z e c z u g a, 1992). It should be noted that Lake Ełk, where *Skirgiella septigena* was found in March 1988, was covered with ice. *Lagenidium rabenhorstii* is a parasite of filiform algae of *Chlorophyceae*, especially of species of the genera *Spirogyra*, *Zygnema* and *Oedogonium*. It has been observed from early spring to mid summer. In Lake Selmęt Wielki, *Lagenidium rabenhorstii* was found on 17 September 1987. Our studies of the hydromycoflora of northeastern Poland revealed that *Lagenidium rabenhorstii* occurred only in the River Bohdanka, a right tributary of the River Narew (C z e c z u g a, 1994).

Dangeardia laevis and *Septolpidium lineare* are parasites of algae. The former in most cases paralyse the cells of species of the genus *Glenodinium*, the latter – the cells of *Synedra* (S p a r r o w, 1936). *Dangeardia laevis* was observed in spring and autumn in the River Narew (C z e c z u g a, W o r o n o w i c z, 1994). Special attention should be poid to *Zoophthora conica* a parasite of *Tendipediae* – which was found in the waters of Lakes Ełk, Selmęt Wielki and Laśmiady whereas *Zoophthora curvispora* parasite of *Simuliidae* – occurred in Lake Laśmiady. *Zoophthora conica* was found in May 1991 in the southern part of the western bank of Lake Ełk and at the site in Mrozy in Lake Selmęt Wielki. Hydrochemical analysis of the water in Lake Selmęt Wielki at the Mrozy site revealed the lowest chemical oxygen demand and sulphate content, compared with other sites in this Lake. In Lake Ełk *Zoophthora conica* also occurred in June in the eastern region of the southern part. *Zoophthora curvispora* was encountered in Lake Laśmiady in June 1991. The chemical properties of water of Lake Laśmiady did not differ considerably from those thewalens of other lakes of this group. The development of both *Zoophthora conica* and *Z. curvispora* was observed on dead insects collected in foam of the water adjacent to a sandy beach.

Monthly investigations of the same site of Lake Ełk showed that the highest mean number of sepcies occurred in spring (8.7) and autumn (7.7), whereas the lowest in summer (4.3). A similar phenomenon ,was observed in Lake Łuknajno (C z e c z u g a et al., 1990) and Śniardwy (C z e c z u g a, 1991).

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