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Studies of aquatic fungi
17. Aquatic fungi of Lake Hańcza in the Suwałki Scenic Park and of some adjacent lakes (northeastern Poland)

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Abstract - Fifty-one species of fungi were found in the oligotrophic Lake Hańcza and some adjacent lakes. The following fungi unknown from Poland were found in these lakes: *Micromyces zygogonii*, *Blastocladia pringsheimii*, *Lagenidium marchalianum*, *Calyptralegnia achlyoides*, *Apodachlya pyrifera*, and *Tricladium giganteum*.

Key words: lakes, hydrochemistry, mycology, aquatic fungi.

1. Introduction

The Suwałki Scenic Park lies in the river-basin of Czarna Hańcza and Szeszupa. The area has a very hilly landscape and it is rich in waters. Apart from rivers and streams there are here more than 20 larger lakes and several small lakes and ponds. The lands of the Park also have an abundance of extensive systems of springs. Peat bogs are found in the neighbourhood of most of the lakes and numerous depressions without outlets. Another characteristic of these lakes is that, although they lie next to each other their water levels above the sea are different.

A distinctive feature of these lakes is the oligotrophic Lake Hańcza, the deepest lake in Poland. The greater part of its shores are strewn with boulders, most of them have no higher emergent vegetation, but underwater meadows grow down to a considerable (Koźmiński 1932).

In the investigations of aquatic fungi in various types of waters in the north-eastern region of Poland, so far mainly running waters have been studied, among others the River Szeszupa (Czeczuga et al. 1988a) and Czarna Hańcza (Czeczuga et al. 1990a). In view of the variety of lakes in this area it was decided to analyse the presence of fungi in Lake Hańcza and in eight adjacent lakes with reference to the hydrochemical data of the water in which they occur. These data provide additional information on the biology of some aquatic fungus species and widen our knowledge of the biogeography of these species since new locations have been found.

2. Study area

Some morphological features of the investigated lakes are presented in Table I.

Table I. Characteristic of the investigated lakes

Lake	Altitude (m)	Area (ha)	Maximum depth (m)
1. Hańcza	227.2	311.4	108.5
2. Jaczno	163.0	34.0	19.0
3. Jegliniszki	233.0	16.0	2.4
4. Kamenduł	160.0	19.0	10.0
5. Krejwel	146.7	10.0	6.0
6. Perty	148.8	21.6	30.0
7. Szelment	176.0	356.1	45.0
8. Szurpiły	183.1	80.9	46.2
9. Wiżajny	241.7	293.1	5.3

Lake Hańcza is situated in the Suwałki administrative district latitude 54° 15.9' and longitude 22° 48.9', in the drainage basin of the River Niemen (River Czarna Hańcza). According to Ruhle (1932), the altitude of the lake is 227.2 m (Table I). Its maximum length is 4535 m, maximum width 1175 m, and average depth 42 m. The shoreline of the lake is well developed (11 750 m). The character of the habitat and the participation in the different groups of the flora and fauna of Lake Hańcza were described by Malanowski (1960), Głowaciński (1968) and Czeczuga and Grądzki (1970). Chemical examination of the water and studies in fungi were carried out at working stations.

On Lake Hańcza, because of its oligotrophic character, six stations differing in their biotops were selected (fig. 1):

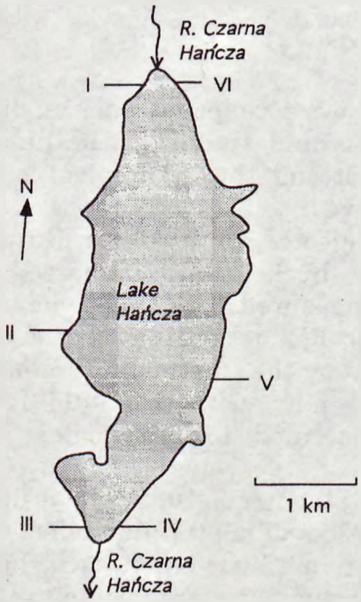

Fig. 1. Localization of sampling stations of Lake Hańcza

Station I. Western bank, close to the inflow of the River Czarna Hańcza. The bank is marshy, with a depth reaching to about 0.5 m. The bottom is muddy.

Station II. Western bank. The bank and the bottom are covered with stones. Depth about 0.75 m.

Station III. Western bank, close to the outlet of the River Czarna Hańcza. The samples were taken 50 m above the river. The bank and the bottom are covered with stones. Depth about 0.5 m.

Station IV. Eastern bank close to the outlet of the River Czarna Hańcza. The samples were taken 60 m above the river near the village of Blaskowizma. The bank and the bottom are covered with stones, depth about 0.4 m.

Station V. Eastern bank. The bank and the bottom are covered with sand. Depth about 0.5 m.

Station VI. Eastern bank close to the inflow of the River Czarna Hańcza. The samples were taken 40 m above the river. The bottom is muddy and the bank is a marshy forest area with predominance of alder. Depth about 0.3 m.

In the other 8 lakes the samples were collected at a single station (on the bank, depth about 0.25-0.50 m) typical of the given lake.

3. Material and methods

Samples of water were collected once a month (1984-1985) for hydrochemical analysis and studies of the fungus flora. In addition to water from the bottom, these samples contained bits of wood, stones, and fallen leaves.

The water was collected in a 5-litre Ruttner bucket from the depth at which the bucket was immersed. In the water, the temperature was measured and 17 chemical variables were determined (Table II). For determinations of the different chemical variables in the water the methods recommended by Standard Methods (Golterman, Clymo 1969) were employed, the details of which described in an earlier paper (Czeczuga, Próba 1980).

The fungi in the water were studied by a method based on direct microscopic examination of materials collected from the water as well as using the bait method (onion skin, hemp seeds and clover seeds) applied in environmental studies and in the laboratory. These methods are described in detail in Czeczuga et al. (1986). In addition, the foam collected from the surface of eddies in running water or at the edges of stagnant water was examined directly under the microscope (Arnold 1968).

The water chemistry data and aquatic fungal flora of these lakes were processed by the average linkage method (Hugh, Gauch 1982).

4. Results

The results of chemical analysis of the water of Lake Hańcza and the other investigated lakes are presented in Table II. Water quality differed distinctly between the studied lakes. Let us consider only the oxidability and such biogenic elements as nitrogen and phosphorus. In Lake Hańcza the minimum values of all these parameters were noted, while the oxidability, nitrite, and phosphate concentrations were highest in Lake Wiżajny. The greater amount of ammonium salt were noted in Lake Szurpiły while the highest concentration of nitrate occurred in Lake Perty.

In the lakes studied, the presence of 51 species of aquatic fungi was determined (Table III). Most of these species have previously

Table II. Chemical composition of the water of the investigated lakes (in mg dm^{-3})

Parameter	Lake							
	Hańcza		Jaczno		Jegliniszki		Kamenduł	
Temperature (°C)	13.4	(4.5-22.0)	15.2	(9.1-22.5)	15.6	(4.5-24.0)	15.4	(4.5-23.0)
pH	8.1	(7.8-8.6)	8.0	(7.6-8.5)	7.8	(7.5-8.4)	7.9	(7.6-8.1)
Oxidability	5.15	(2.5-9.2)	5.3	(3.0-10.2)	8.4	(6.4-10.0)	5.3	(2.0-12.8)
CO_2	6.1	(2.2-8.2)	9.2	(0.0-15.4)	5.9	(3.3-11.0)	8.8	(2.2-15.4)
Alkalinity (mval dm^{-3})	2.4	(2.1-3.5)	4.7	(4.1-5.3)	8.4	(2.1-3.8)	4.6	(3.9-5.8)
$N(NH_3)$	0.13	(0.0-0.37)	0.27	(0.0-0.93)	0.18	(0.1-0.4)	0.24	(0.0-0.75)
$N(NO_2)$	0.0012	(0.0-0.005)	0.0036	(0.0-0.008)	0.0016	(0.0-0.003)	0.0039	(0.0-0.01)
$N(NO_3)$	0.03	(0.0-0.10)	0.05	(0.0-0.15)	0.04	(0.0-0.10)	0.03	(0.0-0.10)
$P(PO_4)$	0.18	(0.0-0.31)	0.35	(0.0-1.14)	0.28	(0.04-0.86)	0.26	(0.1-0.45)
$S(SO_4)$	15.7	(7.82-21.80)	16.0	(12.0-28.18)	16.6	(8.2-27.6)	13.0	(4.5-18.1)
Cl	13.3	(6.0-24.0)	19.2	(7.0-79.0)	17.8	(8.0-44.0)	11.1	(6.0-16.0)
Total hardness in Ca	29.7	(20.16-41.76)	32.2	(20.88-48.96)	28.4	(19.4-33.8)	31.2	(18.0-39.6)
Total hardness in Mg	12.1	(8.17-19.78)	33.1	(15.9-46.9)	12.0	(2.9-26.7)	31.3	(14.6-43.4)
Fe	0.0	(0.0-0.0)	0.0	(0.0-0.0)	0.01	(0.0-0.1)	0.0	(0.0-0.0)
Mn	0.003	(0.0-0.03)	0.003	(0.0-0.03)	0.002	(0.0-0.03)	0.002	(0.0-0.03)
Dry residue	175.4	(129-226)	311.2	(231-452)	203.4	(167-260)	299.6	(291-341)
Dissolved solids	161.1	(126-193)	266.1	(227-293)	176.0	(144-245)	258.7	(208-296)
Suspended solids	114.0	(0.0-64.0)	33.9	(4.0-52.0)	27.4	(3.0-73.0)	40.9	(8.0-77.0)

Table II. *Continued*

Parameter	Lake									
	Krejwel		Perty		Szelment		Szurpiły		Wiżajny	
Temperature (°C)	16.8	(4.5-23.5)	15.5	(4.5-23.0)	15.2	(4.5-22.8)	15.4	(4.5-22.5)	15.4	(4.5-23.0)
pH	7.2	(7.7-8.3)	8.0	(7.7-8.6)	7.9	(7.8-8.0)	7.9	(7.6-8.4)	8.2	(7.9-8.8)
Oxidability	6.2	(3.4-8.4)	5.9	(4.2-8.6)	8.0	(6.4-9.6)	5.3	(3.8-10.0)	9.6	(7.5-11.8)
CO_2	9.1	(4.4-17.6)	8.3	(0.0-22.0)	3.3	(2.2-4.4)	7.1	(2.2-11.0)	8.6	(0.0-17.6)
Alkalinity (mval dm^{-3})	4.7	(4.1-5.3)	3.6	(2.7-5.3)	2.8	(2.7-3.0)	3.9	(3.4-4.8)	2.5	(1.6-3.9)
$N(NH_3)$	0.19	(0.0-0.37)	0.15	(0.03-0.40)	0.20	(0.07-0.4)	0.44	(0.0-1.94)	0.27	(0.03-0.76)
$N(NO_2)$	0.0039	(0.0-0.01)	0.0021	(0.0-0.006)	0.0020	(0.0-0.003)	0.0025	(0.0-0.008)	0.0040	(0.0-0.008)
$N(NO_3)$	0.06	(0.0-0.13)	0.07	(0.0-0.09)	0.03	(0.0-0.08)	0.03	(0.0-0.08)	0.05	(0.0-0.1)
$P(PO_4)$	0.42	(0.0-1.0)	0.21	(0.1-0.38)	0.43	(0.18-0.68)	0.44	(0.0-0.87)	0.57	(0.0-2.2)
$S(SO_4)$	15.9	(5.8-28.4)	12.4	(2.1-21.0)	21.0	(21.0-22.5)	16.4	(10.3-22.2)	20.8	(14.0-32.0)
Cl	14.4	(6.0-32.0)	13.6	(7.0-18.0)	17.5	(17.0-18.0)	10.4	(7.0-13.0)	19.5	(9.0-42.0)
Total hardness in Ca	37.8	(25.9-49.7)	26.7	(20.2-29.7)	36.9	(35.3-36.7)	33.4	(23.6-49.7)	29.8	(20.1-38.9)
Total hardness in Mg	24.0	(16.8-33.5)	21.8	(12.5-31.8)	15.1	(14.6-15.5)	21.6	(11.2-30.5)	15.8	(7.3-27.1)
Fe	0.02	(0.0-0.17)	0.02	(0.0-0.17)	0.0	(0.0-0.0)	0.0	(0.0-0.0)	0.01	(0.0-0.08)
Mn	0.001	(0.0-0.08)	0.001	(0.0-0.03)	0.0	(0.0-0.0)	0.001	(0.0-0.03)	0.001	(0.0-0.03)
Dry residue	313.0	(258-421)	231.5	(221-294)	231.5	(222-241)	322.0	(202-314)	271.0	(184-349)
Dissolved solids	267.5	(236-307)	199.5	(191-221)	199.5	(191-208)	217.8	(196-287)	193.0	(162-237)
Suspended solids	47.1	(1.0-145)	32.0	(0.0-80)	32.0	(14-50)	25.2	(3-50)	33.1	(8-93)

Table III. Aquatic fungi found at particular lakes: 1 - Hańcza; 2 - Jaczno; 3 - Jegliniszki; 4 - Kamenduł; 5 - Krejwel; 6 - Perty; 7 - Szelment; 8 - Szurpiły; 9 - Wiżajny. s - spring; a - autumn

Taxa	Lake								
	1	2	3	4	5	6	7	8	9
Chytridiomycetes									
Olpidium gregarium (Now.) Schroeter			sa						
Micromyces zygogonii Dangeard					a				
Chytridium xylophilum Cornu	a	a	a	a	a		a		a
Karlingia polonica Hassan					a				
– *rosea* (De Barry et Worn.) Johanson			a						
Polychytrium aggregatum Ajello	sa								
Nowakowskiella elegans (Now.) Schroeter				sa					
– *macrospora* Karling	sa	sa				sa	a		
Monoblepharis hypogyna Perrott	a								
Blastocladia pringsheimii Reinsch						a			
Oomycetes									
Lagenidium marchalianum De Wildeman			a						
Rozellopsis inflata (Butler) Karling	sa								
Olpidiopsis aphanomycis Cornu	a								
– *saprolegniae* (Braun) Cornu	s								
Aphanomyces irregularis Scott					s				a
– *laevis* De Barry									a
Achlya colorata Pringsheim					a				
– *debaryana* Humprey			a						
– *glomerata* Coker				a					
– *papillosa* Humprey								a	
– *polyandra* Hildebrandt	sa					a			
– *radiosa* Maurizio		a							
Isoachlya anisospora (De Bary) Coker			a		sa	a			sa
Saprolegnia ferax (Gr.) Thurnet	sa	sa	sa	a	sa	sa	sa	sa	
– *hypogyna* (Pring.) De Bary					sa				
Dictyuchus monosporus Leitgeb.	a		a	sa			sa		sa
Calyptralegnia achlyoides (Coker et Couch) Coker									a
Apodachlya pyrifera Zopf								a	
Pythiogeton nigricans Batko			sa					s	
– *uniforme* Lund									sa
Pythium debaryanum Hesse				sa			s		
– *middletonii* Sparrow	s								
– *monospermum* Pringsheim			s					s	
– *rostratum* Butler	a	sa							sa
– *ultimum* Trow								a	
Zoophagus insidians Sommerstorff	a	a		a	a		a		
Endomycetes									
Candida tropicalis (Robin.) Berkh.		a						a	
Trichosporon cutaneum (De Beurmann et al.) Ota	s	s		s	a		a		
Ascomycetes									
Apostemidium guernisaci (Crouan) Boud				s					
Hyphomycetes									
Camposporium aquaticum Dudka	sa							a	
Fusarium aquaeductum (Radlk. et Rabenh.) Lagerheim	a			a			a	a	a
Bacillispora aquatica Nilsson				a	a		a	a	a
Anguillospora gigantea Ranzoni	a	sa							
– *longissima* (De Wildeman) Ingold	a				a	a	a		a
Clavariopsis aquatica De Wildeman	a								
Triscelophorus monosporus Ingold	a					a			
Tetracladium marchalianum De Wildeman	s			a		a	a		a
– *maxilliformis* (Rostrupa) Ingold				a					
Tricladium giganteum Iqbal	a								
Lemmoniera aquatica De Wildeman		a	a	a	a		a		a
Robillarda phragmitis Cunnel			s						
Total	22	10	12	14	13	8	12	10	13

been observed in various types of water body, but such species as *Monoblepharis hypogyna*, *Anguillospora gigantea*, and *Apostemidium guernisaci* are rare in the hydromycoflora of Poland. The species *Micromyces zygogonii*, *Blastocladia pringsheimii*, *Lagenidium marchalianum*, *Calyptralegnia achlyoides*, *Apodachlya pyrifera*, and *Tricladium giganteum* are new to the Polish hydromycoflora (fig. 2). In Lake Hańcza the richest in aquatic fungi was Station V where 15 species were noted, whereas at Station I only 6 species were found (Table IV). In Lake Hańcza 2 rare species of aquatic fungi (*Monoblepharis hypogyna*, *Anguillospora gigantea*) and one new (*Tricladium giganteum*) were recorded.

Table IV. Aquatic fungi found at particular stations of Lake Hańcza. s - spring; a - autumn

Taxa	Station					
	I	II	III	IV	V	VI
Chytridiomycetes						
Chytridium xylophilum Cornu		a	s	a	a	a
Polychytrium aggregatum Ajello		a		sa	s	sa
Nowakowskiella macrospora Karling			sa	a	sa	
Monoblepharis hypogyna Perrott				a	a	
Oomycetes						
Rozellopsis inflata (Butler) Karling		sa		a		
Olpidiopsis aphanomycis Cornu				a		
– *saprolegniae* (Braun) Cornu)			s	s		
Achlya polyandra Hildebrandt	s	s	sa		a	s
Saprolegnia ferax (Gr.) Thurnet	sa	a	a	sa	a	sa
Dictyuchus monosporus Leitgeb	a				a	
Phytium middletonii Sparrow				s	s	
– *rostratum* Butler		a				a
Zoophagus insidians Sommerstorff	a	a			a	
Endomycetes						
Trichosporon cutaneum (De Beurm.) Ota			a	s	s	
Hyphomycetes						
Anguillospora gigantea Ranzoni	a				a	
– *longissima* (De Wildeman) Ingold		a			a	a
Clavariopsis aquatica De Wildeman						a
Camposporium aquaticum Dudka		sa		a	a	
Fusarium aquaeductum (Radlk. et Rabenh.) Lagerheim	a					
Tricladium giganteum Iqbal						a
Tetracladium marchalianum De Wildeman			s		s	
Triscelophorus monosporus Ingold					a	
Total	6	9	7	11	15	8

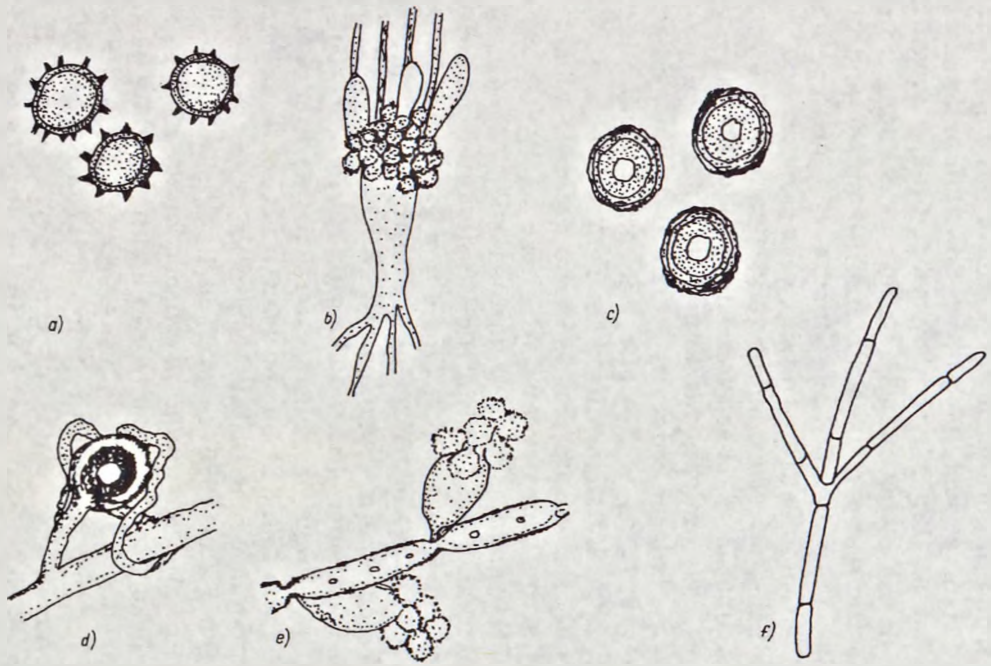

Fig. 2. Aquatic fungi: a - *Micromyces zygogonii* (spore 12.0-13.0 µm); b - *Blastocladia pringsheimii*; c - *Lagenidium marchalianum* (spore 12.0-19.0 µm); d - *Calyptralegnia achlyoides* - gametangy; e - *Apodachlya pyrifera*; f - *Tricladium giganteum* (conidia: rachis 195-220 x 5-7 µm; arm 85-175 x 4-5 µm)

5. Discussion

One of the rare fungal species noted was *Monoblepharis hypogyna* which belongs to the group of plant saprophytes and is usually found on branches immersed in water. In the present studies it occurred in autumn at Stations IV and V on Lake Hańcza. Previously this species had only been found in autumn in the water of the upper part of the River Czarna Hańcza just before it flows into Lake Hańcza (Czeczuga et al. 1990a). The imperfect fungus *Anguillospora gigantea* grew in the water of Lake Hańcza at Stations I and V in autumn and in the water of Lake Jaczno in summer and autumn. Among the lakes the water of Lake Hańcza was found to have the lowest concentrations of nitrate, nitrite, and phosphate. The water of this lake had the lowest oxidability and alkalinity. However, the water of Lake Jaczno is characterized by a comparatively high concentration of CO_2 and magnesium. *A. gigantea* had previously been found in Lakes Śniardwy, Bełdany, and Mikołajskie (Czeczuga 1991) as well as in the canal connecting Lake Śniardwy with Lake Łuknajno (Czeczuga et al. 1990b). It has been found in only a few water bodies in the world (Dudka 1985), among others in the United States (Ranzoni 1953, Conway 1969), on the Hawalian islands (Anastasion 1964), in Cuba (Marvanova, Marvan 1969), and in the USSR (Dudka 1974).

Another rare imperfect fungus, *Tricladium giganteum*, was found in autumn at Station VI of Lake Hańcza. In the Polish literature it is named *Geniculospora gigantea* (Batko 1975) whereas Dudka (1985) considered it to belong to *Tricladium*. This is the first record of the fungus in Polish waters. It was first reported by Iqbal (1971) who found it on the leaves of *Crataegus monogyna* decaying in water in Great Britain. The next report came from the USSR where Dudka (1985) found it at three sites.

As regards the *Apostemidium guernisaci* found in these studies, it is known to belong to the Ascomycetes and has to date been noted on willow branches immersed in water (Graddon 1965). The station in the present study is the third in the waters of Poland. It was first found in the ponds of the Poryta Jabłoń fish-farm (Czeczuga et al. 1988b) and then in the River Czarna Hańcza (Czeczuga et al. 1990a). In the present investigation it was found in May in Lake Kamenduł.

Micromyces zygogonii, a species new to to the Polish hydromycoflora, is as we know a parasite of filamentous Chlorophyceae. It was found in September in Lake Krejwel. The water of this lake had the lowest pH and highest calcium concentration. The second species new to Poland, *Blastocladia*

pringsheimii, is a common aquatic phitosaprophyte (B a t k o 1975). In the present studies, it occurred in September in Lake Perty, whose water had the lowest sulphate and calcium and the highest nitrate concentrations. The third new species in the waters of Poland, *Lagenidium marchalianum*, is also a parasite of algae but the genus *Oedogonium*. It was observed in October and November in Lake Jagliniszki, whose water had the highest alkalinity. *Calyptralegnia achlyoides* belong to the aquatic and soil saprophytes. It was found in the water of Lake Wiżajny in September. The water here is characterized by a comparatively high pH and oxidability and high nitrite, phosphate, and chloride concentrations. The fourth new species, *Apodachlya pyrifera*, is a saprophyte generally occurring on free branches in water and on decayed stoneworth on which it was observed in the water of Lake Szurpiły in October and November. The water of this lake had the lowest chloride and the highest ammonium salt concentrations.

A noteworthy finding was that of the presence of the yeast *Candida tropicalis* in the water of Lake Jaczno. The ecological and biological aspects of *Candida tropicalis* in the lakes of Estonia was investigated by S o l n t z e v a and V i n o g r a d o v a (1989).

The unusual limnology of the studied water bodies is also reflected by the species composition of the hydromycoflora, with a number of species new to the waters of Poland and some species which are rarely encountered in the world being noted in these lakes.

Comparison of the lakes studied using the average linkage method based on water chemistry data (fig. 3) shows the differences between them to be not so clear. lake Wyżajny, being a pond-type lake, differs from this group. However, differences in the clustering of lakes according to the aquatic fungal flora are visible (fig. 4). This would indicate that the relationship between water chemistry and data concerning fungi is not significant. The author's earlier studies performed a monthly intervals during a three-year-period at several stations of running waters of various chemistry (C z e c z u g a, P r ó b a 1987) revealed a mutual correlation between the number of species and water parameters such as sulphates, alkalinity, calcium, and magnesium content and above all oxidability and BOD_5.

The content of organic compounds in water was long ago found (S p a r r o w 1968) to be one of the most significant environmental factors for aquatic fungi. Their raised content in water quite frequently limits the occurrence of fungi. However, only a few species of aquatic zoosporic (B a t k o 1975) and conidial fungi (B ä r l o c h e r 1992) develop, absorbing organic substances

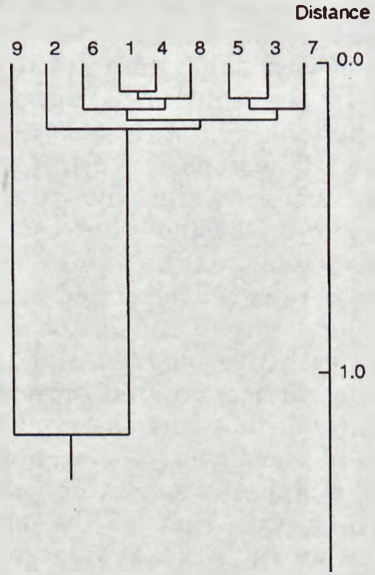

Fig. 3. Clustering of lakes according to water chemistry data (metric distance is 1 gamma correlation coefficient; 1-9 - lakes, see Table I

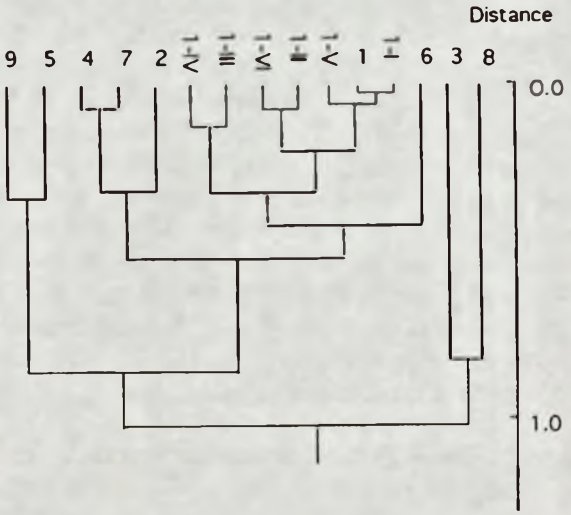

Fig. 4. Clustering of lakes according to aquatic fungi flora (indication as on fig. 3); I-IV - stations of Lake Hańcza (see fig. 1)

directly from the water. This group includes, inter alia, *Leptomitus lacteus* (zoosporic) and yeast (conidial). For the majority of species, however, water is their habitat and the solid base, necrotic for some and live for others, is their source of food. Therefore, in a number of cases, factors connected with the solid base serving as food for various physiological groups, and not with water, limit the growth and activity of particular species of aquatic fungi (Czeczuga, Muszyńska 1994). Thus, the composition of fungal species in a given water body in the period of study can be described as the resultant of the constantly changing arrangement of two environmental factor groups - one stimulating the development and the other limiting the occurrence of particular species.

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6. Polish summary

Grzyby wodne w Jeziorze Hańcza w Suwalskim Parku Krajobrazowym i w niektórych jeziorach przyległych (północno-wschodnia Polska)

Próby pobierano raz w miesiącu w latach 1984-1985 z 9 jezior Suwalskiego Parku Krajobrazowego (tabela I). Skład chemiczny wody poszczególnych jezior podano w tabeli II.

Stwierdzono występowanie 51 gatunków grzybów wodnych należących do klasy Chytridiomycetes (10), Oomycetes (26), Endomycetes (2), Ascomycetes (1) oraz Hyphomycetes (12 gatunków) (tabela III). Takie gatunki jak *Micromyces zygogonii* Dangeard (ryc. 2a), *Blastocladia pringsheimii* Reinsch (ryc. 2b), *Lagenidium marchalianum* De Wildeman (ryc. 2c), *Calyptralegnia achlyoides* (Coker et Couch) Coker (ryc. 2d), *Apodachlya pyrifera* Zopf (ryc. 2e) i *Tricladium giganteum* Iqbal (ryc. 2f) są nowe dla mikoflory Polski.

Zmiany w występowaniu grzybów wodnych w jeziorze Hańcza na różnych stanowiskach (ryc. 1) przedstawiono w tabeli IV. Ponadto dokonano analizy porównawczej danych chemicznych wody badanych jezior (ryc. 3) oraz składu gatunkowego grzybów (ryc. 4).

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