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Aquatic fungi of twelve Augustów Lakes with reference to the chemistry of the environment[1]

BAZYLI CZECZUGA

Department of General Biology, Medical Academy,
Kilińskiego 1, 15-230 Białystok 8, Poland

Czeczuga B.: *Aquatic fungi of twelve Augustów Lakes with reference to the chemistry of the environment*[1]. Acta Mycol. 29 (2): 217-227, 1994.

Seventy five species of fungi were found in the Augustów Lakes. The following fungi unknown from Poland were recorded: *Rhizophydium pollinis-pini, Chytriomyces cosmarii, C. poculatus, Lagenidium humanum, Aphanomyces astaci, Leptolegeniella piligena, Achlya klebsiana, Cladolegnia unispora, Zoophagus pectosporus, Rhodosporidium toruloides* and *Vargamyces aquaticus*.

INTRODUCTION

Studies on aquatic fungi carried out in the waters of Poland to date concerned mainly running water (Stpiczyńska-Tober, 1965). In the central region of Poland the hydromycoflora of some ponds and marshes was analysed (Staniak, 1971) as well. In the 1980's studies on aquatic fungi from various types of water bodies within north-eastern Poland were conducted taking into account the physical and chemical properties of water. We have investigated to date several rivers in this region such as the Narew, Biebrza and Czarna Hańcza Rivers (Czeczuga, Próba, 1987; Czeczuga et al., 1990 a, b). The studies have also been conducted in springs differing from the limnological point of view and in ponds (Czeczuga et al., 1988, 1989). Those studies revealed the presence of a number of fungus species unknown to Poland and also widened the types of biotypes in which some aquatic fungus species previously encountered occurred. In view of the variety of types of lakes present in the north-eastern region of Poland, and the lack of any hydromycological investigations of the Polish lakes, we have been studying the presence of aquatic fungi in lakes for some years with reference to the chemical properties of the waters of these lakes.

[1] Part 29 in the series "Studies of Aquatic Fungi"

One group of lakes in the north-eastern region of Poland is that of the Augustów Lakes, which have a varied limnological character (Lityński, 1925; Stangenberg, 1934).

The results obtained enrich our knowledge on the hydromycology of Polish waters in relation to their differentiated environment.

THE CHARACTERISTICS OF THE LAKES

The studies were carried out in 12 lakes belonging to the so-called group of Augustów Lakes located in the Augustów Forest. The morphological data on these lakes are presented in Table 1. These lakes are of a tunnel-valley character with the exception of Lake Kolno which is of the pond type. Most of them are surrounded by forest stands except for the northern parts of Lakes Blizno, Blizenko, and Tobołowo which are surrounded by cultivated fields, and Lake Białe and Necko, the water of which is contiguous to Augustów town. Lake Kolno, on the other hand, is completely surrounded by marshy meadows.

Table 1

Characteristics of the investigated lakes

Lake	Area ha	Depth in m (max.)
Białe	481.7	31.0
Blizenko	39.0	16.5
Blizno	241.1	28.8
Kalejty	160.0	12.0
Kolno	269.3	1.5
Necko	411.3	25.0
Rospuda	107.2	9.5
Sajenek	35.6	12.6
Sajno	527.2	27.0
Serwy	462.3	41.5
Studzienicze	249.7	31.0
Tobołowo	87.0	9.5

METHODS

Samples of water were collected once a month over the years 1986-1987 for hydrochemical analysis and for studies on species composition of aquatic fungi. For determinations of the different chemical elements in the water the methods recommended by Standard Methods (Golterman, Clymo, 1971) were employed is in Czeczuga, Próba (1980).

The zoosporic fungi in the water were determined a method based on direct microscopic examination of the water and materials collected from the water as well as by the bait method (onion, skin, hemp-seeds, clover-seeds, snake skin, hairs and fillings of horn) applied in environmental studies and in the laboratory. The methods were described by Fuller, Jaworski (1986). In addition (for *Hyphomycetes*), the foam collected from the surface of eddies in running water or at the edges of stagnant waters was examined directly by means of a microscope. The samples were fixed in formalin-acetic-alcohol immediately after collection and brought to the laboratory.

For determination of the fungi the following keys were used: Skirgiełło (1954), Batko (1975), Sparrow (1960), Dudka (1974), Ingold (1975), Blagodatskaja et al. (1980), Kreger van Rij (1984).

RESULTS

Hydrochemical Investigations. The results of the chemical analysis of the water of the lakes investigated in spring and autumn are presented in Table 2. The water in investigated the lakes gave a slight alkaline reaction. Considerable amounts of oxygen dissolved in water were noted in all the lakes. On the other hand, the oxygen demand (BOD_5) was the lowest in autumn in Lake Białe and Sajenek, and the highest in Lakes Serwy and Studzieniczne also in autumn. The oxygen consumption varied a within a wide range as did the content of all three forms of nitrogen.

No ammonia occurred at all in Lakes Białe (in spring), Serwy and Studzieniczne (in spring and autumn) whereas the highest concentration of this compound was noted in Lake Sajenek in autumn.

Nitrite nitrogen did not occur in Lakes Białe and Studzieniczne either in spring, whereas, in autumn, the highest concentration of this for of nitrogen was found in Lakes Rospuda and Studzieniczne. In autumn, the investigations did not reveal the presence of nitrate nitrogen in the waters of most of the lakes. In spring, the highest amount of this form of nitrogen was noted in Lake Kolno.

Phosphates occurred in the water of all the lakes studied. The lowest amount of these biogens was noted in Lake Tobołowo in autumn whereas the highest concentration in Lake Sajenek of these compounds occurred in autumn.

Sulphates in the water of these lakes were found to be of average values. Comparatively small amounts of chlorides were found in the analysed waters.

The calcium concentration varied considerably. The lowest value of Ca was noted in Lake Serwy in autumn while the highest concentration of this compound was found in Lake Necko in autumn as well.

Comparatively low values of magnesium were observed in the investigated waters. In addition, not all the lakes contained detectable amounts of iron and manganese.

Table 2

Chemical properties of waters in the lakes (mg l^{-1}) studies

Specification	Lakes											
	Białe a-b	Blizenko a-b	Blizno a-b	Kalejty a-b	Kolno a-b	Necko a-b	Rospuda a-b	Sajenek a-b	Sajno a-b	Serwy a-b	Studzien. a-b	Tobołowo a-b
Temperature °C	14.0-6.4	16.4-5.8	10.0-6.1	12.4-4.8	16.8-6.4	14.0-6.5	15.2-4.9	16.4-5.2	14.8-6.6	10.5-6.8	10.5-5.8	14.4-4.8
pH	8.2-8.0	8.0-7.9	8.0-7.9	8.0-8.1	8.8-8.2	7.9-8.0	7.9-8.0	7.9-7.8	7.9-8.0	8.2-7.9	8.4-8.0	8.0-8.1
O_2	20.8-14.8	20.2-16.6	16.4-14.4	12.8-15.6	15.2-18.0	15.0-14.8	14.2-15.0	16.4-12.4	12.6-13.2	24.4-14.0	19.0-14.2	14.8-17.8
BOD_5	7.8-1.0	5.0-4.2	2.8-3.6	1.4-2.0	3.8-4.2	1.4-2.2	1.2-1.8	0.2-1.0	1.6-2.2	9.8-0.0	2.4-0.0	3.6-4.8
Oxidability	5.4-4.4	4.2-3.8	6.2-4.0	3.8-4.04.2-	12.6-8.40	4.2-5.8	5.6-6.6	3.0-3.2	3.2-5.6	2.6-4.4	4.6-4.4	4.0-5.4
CO_2	2.2-4.4	5.0-5.5	1.8-6.6	5.5	0.0-2.4	6.2-8.8	6.4-7.7	6.2-7.7	6.0-5.5	4.4-6.6	2.4-5.5	3.6-5.5
Alkalinity in $CaCO_3$ (in mval l^{-1})	2.8-2.6	2.4-2.7	2.4-3.1	3.0-2.1	2.7-3.2	3.8-4.0	4.0-4.3	2.8-2.9	3.0-3.5	2.7-2.6	2.7-2.6	2.2-2.5
$N(NH_3)$	0.0-0.06	0.0-0.14	0.0-0.2	0.10-0.01	0.33-0.08	0.08-0.11	0.00-0.09	0.14-0.37	0.20-0.04	0.0-0.0	0.0-0.0	0.00-0.05
$N(NO_2)$	0.000-0.004	.000-.005	0.001-0.003	.000-.003	0.006-0.010	.000-.006	0.000-0.011	.000-.005	0.000-0.006	.008-.006	0.000-0.011	.000-0.03
$N(NO_3)$	0.04-0.0	0.0-0.01	0.02-0.00	0.01-0.00	0.07-0.04	0.02-0.00	0.00-0.01	0.00-0.01	0.00-0.02	0.04-0.00	0.04-0.00	0.01-0.00
PO_4	0.11-0.40	0.10-0.14	0.10-0.14	0.08-0.12	0.26-0.32	0.20-0.35	0.36-0.47	0.54-0.94	0.42-0.68	0.12-0.47	0.12-0.38	0.12-0.04
Cl	13.0-15.0	14.2-15.0	14.0-15.0	12.0-15.0	18.0-20.0	18.0-21.0	18.0-23.0	14.2-17.0	14.6-18.4	14.0-16.0	14.0-13.0	12.8-16.2
Total hardness in Ca	33.84-28.08	30.00-33.12	40.0-43.92	28.20-27.36	44.62-46.20	42.80-59.76	35.0-35.5	38.2-41.8	40.2-53.3	41.8-27.4	40.3-28.1	28.4-30.4
Total hardness in Mg	6.45-14.62	8.10-12.9	10.4-12.9	8.20-9.46	11.18-14.60	12.4-14.6	14.2-19.4	8.4-9.5	10.4-14.6	9.03-18.6	8.20-15.5	12.6-15.5
SO_4	23.86-21.80	15.22-18.35	24.08-26.74	21.10-25.92	27.56-23.50	22.08-20.57	26.18-24.27	20.04-17.28	23.00-27.97	16.45-25.92	20.98-27.97	19.04-21.80
Fe	0.2-0.0	0.1-0.0	0.1-0.0	0.2-0.0	0.4-0.1	0.1-0.0	0.02-0.15	0.0-0.0	0.0-0.0	0.15-0.00	0.2-0.0	0.0-0.0
Mn	0.6-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.15-0.00	0.0-0.0	0.0-0.0	0.0-0.0	0.0-0.0	0.06-0.00	0.09-0.00	0.0-0.0
Dry residue	181-257	150-199	182-203	164-195	279-302	186-295	210-296	184-210	200-206	213-172	220-194	202-178
Dissolved solids	169-140	108-136	140-176	150-147	258-250	164-280	195-266	152-159	144-197	203-148	197-128	164-170
Suspended solids	12-117	42-63	42-27	14-48	12-52	22-15	15-30	32-51	56-9	10-24	23-66	38-8

a – April, b – October

Mycological Studies. In the waters of the twelve Augustów Lakes, the presence of 75 aquatic fungus species was determined (Tab. 3); they belonged to *Chytridiomycetes* (18 species), *Hyphochytriomycetes* (1), *Oomycetes* (40), *Endomycetes* (4), *Ascomycetes* (2) and *Hyphomycetes* (10 species). It was of interest to find in the water of some of the Augustów Lakes some aquatic species new to Polish hydromycology, i.e. *Rhizophydium pollinis-pini, Chytriomyces cosmarii, Chytriomyces poculatus, Lagenidium humanum, Aphanomyces astaci, Leptolegniella piligena, Achlya klebsiana, Cladolegnia unispora, Zoophagus pectosporus, Rhodosporidium toruloides* and *Vargamyces aquaticus* (Fig. 1). Furthermore, in the water of Lake Necko comparatively rare fungi occurring in our waters were identified, such as *Chytriomyces annulatus, Mitochytridium regale* and *Karlingia rosea*. In addition, in the waters of Lakes Necko and Studzieniczne, the sewage fungus, *Leptomitus lacteus*, was found and in the water of Lakes Necko and Białe such pathogenic fungi as *Aspergillus fumigatus* and *Trichophyton mentagrophytes* were noted.

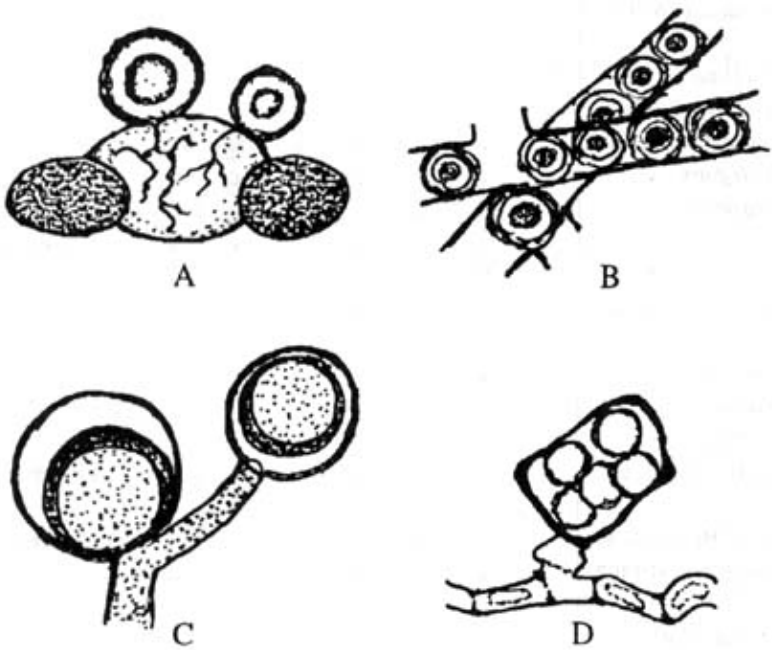

Fig. 1. Some aquatic fungi

A — *Rhizophydium pollinis-pini* – sporangium (10-30 μm) on pine-pollen, B —*Leptolegniella piligena* – hyphae from parthenospores, C — *Cladolegnia unispora* – oogonium (32-64 μm), D — *Rhodosporidium toruloides* – hyphae from chlamydospores (8-16 μm)

DISCUSSION

Some species new to Polish hydromycology and those which are quite were found in the waters of the Augustów Lakes. Of particular interest was the occurrence of *Rhizophydium pollinis-pini* in the water of Lake Kolno in spring. This species is new to the Polish mycoflora. It is, a parasite of flowering plant pollens and

Table 3

Aquatic fungi found in particular lakes (a – spring, b – summer, c – autumn)

Fungi	Lakes (see Table 1)											
	1	2	3	4	5	6	7	8	9	10	11	12
Chytridiomyces												
Olpidium gregarium (Nowak.) Schroeter	.	.	.	.	.	.	.	.	.	c	.	.
O. entophytum (Braun) Rabenh.	b	.	.	.	.	.	.	.	.	.	.	.
Rhizophydium keratinophilum Karl.	c	.	.	.	.	c	.	.	.	.	.	.
R. pollinis-pini (Braun) Zopf	.	.	.	.	a	.	.	.	.	.	.	.
Chytridium xylophilum Corny	.	c	c	c	ac	.	.	.	a	.	.	a
Chytriomyces annulatus Dogma	c	.	.	.	.	.	.	.	.	.	.	.
C. cosmarii Karl.	.	.	.	.	.	c	.	.	.	.	.	.
C. poculatus Sparrow	ac	.	.	.	.	.	.	.	.	.	.	.
Mitochytridium regale Hassan	.	.	.	.	.	c	.	.	.	.	.	.
Diplophlictis complicata (Will.) Batko	c	.	.	.	.	.	.	.	.	.	.	.
Karlingia polonica Hassan	b	.	.	.	.	.	.	.	.	.	.	.
K. rosea (de Bary et Wor.) Johan.	.	.	.	.	.	b	.	.	.	.	.	.
Polychytrium aggregatum Ajello	.	.	.	.	c	ac	.	.	.	.	.	.
Nowakowskiella elegans (Nowak.) Schroeter	.	.	.	.	c	c	.	.	.	.	ac	.
N. macrospora Karl.	.	.	.	.	c	.	.	.	.	.	.	.
Blastocladia rostrata Minden	.	c	.	.	.	.	.	.	.	.	.	.
Blactocladiopsis parva (Whiffen) Sparrow	.	.	.	c	.	.	.	.	c	.	.	c
Monoblepharis macrandra (Lagerh.) Woronin	c	.	.	.	.	c	.	.	.	.	.	.
Hyphochytriomycetes												
Hyphochytrium catenoides Karl.	c	.	.	.	.	.	.	.	c	.	.	.
Oomycetes												
Rozellopsis inflanta (Butler) Karl.	.	.	c	.	.	.	.	.	.	c	.	.
Olpidiopsis saprolegeniae (Braun) Cornu	.	.	.	c	.	b	c	c	.	.	.	c
Lagenidium humanum Karl.	c	.	.	.	.	.	.	.	.	.	.	.
L. marchalianum de Wild.	c	.	.	.	.	.	.	.	.	.	.	.
Myzocytium proliferum Schenk	.	.	.	.	.	c	.	.	.	.	.	.
Aphanomyces astaci Schikora	ac	.	.	.	.	.	.	.	.	.	.	.
A. irregularis Scott	c	.	c	.	.	c	c	c	c	.	.	.
A. leavis de Bary	a	.	.	.	.	.	.	.	.	.	.	.
A. stellatus de Bary	.	.	.	.	.	.	.	.	c	.	.	.
Aphanodiction papillatum Hun.	c	.	.	.	.	.	.	.	.	.	.	.
Leptolegniella keratinophila Hun.	c	.	.	.	.	.	.	.	.	.	.	.
L. piligena Ook. et Kob.	c	.	.	.	.	c	.	.	.	.	.	.
Achyla dubia Coker	c	.	.	.	.	.	.	.	.	.	.	.
A. glomerata Coker	.	.	.	a	.	.	.	.	a	.	.	.
A. hypogyna Coker et Pemb.	.	.	.	.	.	.	c	.	.	.	.	c
A. klebsiana Pieters	c	.	.	.	.	.	.	.	.	.	.	.
A. megasperma Hump.	.	.	.	.	.	c	.	.	.	.	.	.
A. oligacantha de Bary	.	.	a	.	.	.	.	.	a	.	.	.

cont. of Table 3

A. papillosa Humph.	c	.	.	.	.	.	.	.	c	.	.	.
A. polyandra Hild.	.	.	.	.	c	.	.	.	.	.	.	.
A. prolifera Nees	.	.	.	.	.	.	c	.	c	.	.	.
A. racemosa Hild.	ac	.	.	.	.	.	.	.	.	.	a	.
Cladolegnia eccentrica (Coker)	.	.	.	.	.	.	.	.	c	.	.	.
Cladolegnia unispora (Coker et Couch) Joh.	.	.	.	.	.	.	.	.	a	.	.	.
Isoachyla anisospora (de Bary) Coker	.	.	c	.	c	c	.	.	.	a	.	.
Saprolegnia dicilina Humph.	.	.	.	.	.	.	.	.	.	.	ac	.
S. ferax (Gruith) Turnet	c	.	c	b	abc	c	c	.	abc	abc	.	c
S. monoica Prinngs.	.	c	.	.	.	.	.	.	.	.	.	.
S. parasitica Coker	.	.	.	.	.	c	.	.	ac	.	.	.
Dictyuchus monosporus Leitgeb	.	.	.	.	.	c	.	.	c	.	.	.
Traustotheca clavata (de Bary) Humph.	.	.	.	.	.	.	c	.	.	.	.	.
Leptomitus lacteus (Roth) Agardh	abc	.	.	.	.	abc	.	c	.	.	abc	.
Pythiogeton nigricans Batko	.	.	.	.	.	ac	.	.	.	.	ac	.
Pythium artotrogus de Bary	.	.	.	.	.	.	.	c	c	.	.	.
P. debaryanum Hesse	.	.	.	.	.	c	.	.	.	.	.	c
P. middletonii Sparrow	.	.	c	.	.	.	.	.	.	.	.	.
P. rostratum Butler	a	.	.	.	.	.	.	.	.	.	.	.
P. ultimum Trow	c	.	.	.	.	ac	.	.	.	.	.	.
Zoophagus insidians Sommerst.	.	.	.	b	.	c	.	.	ac	.	.	.
Z. pectosporus (Drechs.) M. W. Dick	.	.	.	.	.	.	c	.	.	.	.	.
Endomycetes												
Canidia albicans Berkh.	bc	.	.	.	.	.	.	.	.	.	.	.
C. tropicalis (Cast.) Berk.	bc	.	.	.	c	.	.	.	.	.	.	.
Rhodosporidium toruloides Banno	a	.	.	.	.	.	.	.	.	.	.	.
Trichosporon cutaneum (de Beur. Goug. et Vauch) Ota	.	.	.	.	.	ac	.	c	.	c	.	.
Ascomycetes												
Apostemidium guernisaci (Crouan) Boud	c	.	.	.	.	c	.	.	.	.	.	c
Aspergillus fumigatus Fres.	abc	.	.	.	.	abc	.	.	.	.	.	.
Hyphomycetes												
Alatospora acuminata Ing.	c	.	.	.	.	.	.	.	.	.	.	.
Anguillospora longissima (Saccar. et Sydov) Ing.	.	c	.	c	.	c	a	c	c	.	.	c
Arthrobotrys oligospora Fres.	.	.	.	.	c	.	.	.	.	a	.	.
Bacillispora aquatica Nillson	ac	.	.	.	.	c	.	.	.	.	.	.
Fusarium aquaeductum (Radlk. et Rabenh.) Lagerh.	.	.	.	.	.	.	ac	.	a	.	.	.
Lemonniera aquatica de Wild.	.	.	.	.	.	b	.	.	a	.	.	ac
Robillarda phragmitis Cunnel	.	.	a	.	.	b	.	.	.	.	.	.
Tetracladium setigerum (Grove) Ing.	c	.	.	.	.	.	.	.	.	.	.	.
Trichophyton menthagrophytes Blanch.	abc	.	.	.	.	abc	.	.	.	.	.	.
Vargamyces aquaticus (Dudka) Toth	.	.	.	.	c	.	.	.	.	.	.	.

pine pollen. It is somewhat surprising that in the woods, this fungus was not found while there are no pine woods in the nearest vicinity of Lake Kolno. The presence of *Rhizophydium pollinis-pini* in the water of Lake Kolno would seem to indicate that fungus had grown on the pollen of flowering plants other than gymnosperms. In spring, the water of Lake Kolno, had the highest alkalinity, oxygen consumption index, ammonia nitrogen, nitrate nitrogen, iron and manganese concentrations as compared to the remaining Augustów Lakes. There were no detectable amounts of carbon dioxide.

The *Chytriomyces cosmarii* is a parasite of algae of the genus *Cosmarium*. We observed the development of this fungus in cells of *Cosmarium* sp. in a littoral part of Lake Necko in autumn 1986. This is the first time that this fungus has been reported from Polish waters. *Chytriomyces poculatus*, found in the water of Lake Białe in spring and autumn is also new to Polish waters. S p a r r o w (1968) observed it in waters bodies in California and classified it to keratinophilic fungi. The keratinophilic character of this fungus was demostrated by I r i n e o and D o g m a (1969) and its environmental morphological mutability by B o o t h and B a r r e t (1970).

Considerable number of fungi considered to be new or rare to the Polich hydromycology were isolated from the waters of Lakes Białe and Necko. The water of Lake Białe as compared with that of the other lakes of the Augustów group, was found to contain the lowest amounts of chlorides and iron in spring and, in autumn, and the highest amount of suspended matter.

The water of Lake Necko, contained more carbon dioxide, calcium and substances dissolved in the water than any of the other lakes studied.

Lagenidium humanum is known to be a saprophyte of human skin. Its occurrence in the water of Lake Białe would seem to indicate the pollution of the lake by municipal sewage. *Aphanomyces astaci* was another new species reported from Polish waters the growth of which we observed in individuals of the crayfish *Cambarus affinis* in the littoral part of Lake Białe. It is known to cause losses in the population of crayfish. R a h e and S o y l u (1989) reported, that approximately 90 % of the population of the crayfish *Astacus leptodactylus* died as a result of infection by the fungus *Aphanomyces astaci* in the waters of Turkey.

Leptolegniella piligena hich is new to Polish hydromycoflora, belongs to the group of keratinolytic fungi. It was first isolated from fresh water on a bird's feater which was used as a bait by O o k u b o and K o b a y a s i (1955). *Achlya klebsiana* is a saprophyte found on twigs and dead insects in water. It has also been isolated from soil (S p a r r o w, 1960).

With respect to the species new to the Polish hydromycoflora, *Cladolegenia unispora*, belongs to the aquatic saprophytes. As B a t k o reported (1975) it groups on twigs and dead insects, usually in spring. It has also been isolated from damp loam at the bottom of a drying ditch. In Lake Sajno, this fungus was noted in waters which had collected over the last ten days of April 1986 in the littoral part of the lake. The water of this lake contained the highest concentration of sulphates.

A noteworthy finding was that of the predatory fungus, *Zoophagus pectosporus*, in the water of Lake Rospuda in autumn 1986. In comparison with the other lakes from this group, the water of Lake Rospuda contained at that time the highest concentration of nitrate nitrogen, chloride, magnesium and dry residue. The total alkalnity of the water was also the highest.

While *Zoophagus insidians* is a very commonly occurring fungi (D o d g e, 1983; C z e c z u g a, 1991; M o r i k a w a et al., 1993). *Zoophagus pectosporus* has so far rarely been found. It was first described by D r e c h s l e r (1962) as *Acaulopage pectospora* but was later classified by D i c k (1990) as belonging to the genus *Zoophagus*. It was also isolated from soil in the State of Indiana (D a s - G u p t a, D h o m e, 1965) and from the waters of Japan (M i u r a, 1967). On the other hand, S a i k a w a and M o r i k a w a (1985) and S a i k a w a et al. (1988) revealed characteristics of this species by means of an electron microscope which were common to and differing from the other species of the genus *Zoophagus*.

As regards the new species of the representatives of the *Endomycetes*, *Rhodosporidium toruloides*, has been found to be a saprophyte in various environments (B a t k o, 1975).

With respect to the representatives of the *Hyphomycetes* – *Vargamyces aquaticus* was the most noteworthy species found for the first time in Poland in the waters of the Augustów lakes. The fungus was first described by D u d k a (1966) who named it *Camposporium aquaticum*. Subsequently T o t h (1979) classified it as belonging to the genus *Vargamyces*. In addition to the USSR and Hungary, this fungus has also been found in Japan (D u d k a, 1985). It develops on leaves of various species of trees which have fallen into the water and even on needles of gymnosperms in water (D u d k a, B e r e g o v a, 1972). The authors drew attention to the fact that *Vargamyces aquaticus* has been found in waters containing more than 70 mg l^{-1} of carbon dioxide (D u d k a, 1985). In our case, such an amount of carbon dioxide dissolved in the water was not noted in Lake Kolno in which we found the *Vargamyces aquaticus* as well as in the other lakes of the Augustów group. On the contrary, the content of CO_2 in Lake Kolno did not exceed several mg l^{-1}.

Chytriomyces annulatus is one of the rarest species. In Poland this fungus was observes in Lake Niegocin in spring 1986 whithin the Masurian Lake District (C z e c z u g a, W o r o n o w i c z, 1992). Lake Niegocin known to be one of the most polluted lakes in that region. *Chytriomyces annulatus* is, a saprophyte of *Pinus* sp. and *Liquidambar* sp. pollen and a parasite of fungi of the genera *Rhizophydium* and *Rhizophlyctis*. It was first described by D o g m a (1969) who found it in the Douglas lake region. It grows best on the slough of grass-snakes, which indicates its keratinophilic properties (I r i n e o, D o g m a, 1969; B o o t h, B a r r e t t, 1971).

Mitochytridum regale, was reported for the second time in Poland from Lake Necko. It was previously been noted in Poland by H a s s a n (1986) in the ponds in the Łazienki Park in Warsaw.

Karlingia rosea, was also found for the second time in water bodies in Poland. Its growth was observed in the water of the River Rudawka, a tributary of the River Orlanka (Czeczuga, Muszyńska, 1993). The fungus occurred in the littoral part of Lake Necko in mid August 1987. It leads a saprophytic life on plant remains, paper and is a parasite of horsetail spores. It is found not only in water but also in soil.

The findings concerning the occurrence of sewage fungus, *Leptomitus lacteus*, and such pathogenic fungi as *Candida albicans, C. tropicalis, Aspergillus fumigatus* and *Trichophyton mentagrophytes* in the waters of some of the Augustów lakes indicate the progressive pollution of these lakes, above all, by municipal wastes.

Whereas the sewage fungus and the two yeast species of the genus *Candida* have frequently been found in water bodies in Poland *Aspergillus fumigatus* and *Trichophyton menthagrophytes* have been reported for the first time. Both species were isolated from the encountered in drinking-water distribution systems (Rozenzweig et al., 1986). *Trichophyton menthagrophytes* has so for been noted in soil (Yousef Al-Doory, 1966) in swimming pools (Gentles, Evans, 1973) and even in dust on classroom floors, boats and motor coaches (Mercantini et al., 1989).

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