ACTA MYCOLOGICA
Vol. XXVI (2): 37-44
1990

Studies of aquatic fungi. XV. The hydromycoflora of the Biosphere Sanctuary, Lake Łuknajno

BAZYLI CZECZUGA, HALINA CHOMUTOWSKA, LUCYNA WORONOWICZ

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

Czeczuga B., Chomutowska H., Woronowicz L.: *Studies of aquatic fungi.. XV. The hydromycoflora of the Biosphere Sanctuary, Lake Łuknajno.* Acta Mycol. XXVI(2): 37-44, 1990.

The folowing fungi unknown from Poland were found in Łuknajno Like: *Allomyces arbuscula, Myzocytium microsporum* and *Rhipidium americanum.*

INTRODUCTION

Among the few biosphere sanctuaries in Poland, Łuknajno lake occupies a foremost place. It is a refuge for waterfowl including the largest number of dumb swans to be found not only in Poland but in the whole of Europe. For this reason, Lake Łuknajno has been included in the UNESCO list of biosphere sanctuaries.

During our hydromycological studies of various types of waters in the north-eastern region of Poland (Czeczuga et al., 1989 b), we decided to investigate the species composition of aquatic fungi in this specific water body, Łuknajno lake. The determination of species new to the hydromycoflora of Poland and observations of seasonal changes provide a contribution to our knowledge in this field of research. It is therefore felt that, if only for these reasons, the publication of the data presented in this paper.

STUDY AREA

Łuknajno lake is oval in shape, slightly elongated in north-east direction, and has a length of 3300 m, a width of 2900 m, and an area of 680 hectares. It has a poorly developed shoreline measuring 10 200 m. The mean depth is 0,6 m and maximum depth 3,0 m. In some parts, the layer of mud is several meters deep. The surface of the lake is on the average 115,8 m above sea level. The northern, western and southern shores are flat, of peat-bog type, and overgrown mainly with sedge. The eastern edge is higher with and adjacent strip of arable land beyond which stretches widely pine forest. The bottom of the lake is covered with extensive areas of algae – the stonewort. These algae grow over approximately 75 % of the lake bottom to a depth of 2,0 m. The stonewort is known to be the staple food of swans so that its presence is the main reason for the abundance of these birds at this lake. Together with the stoneworts, water nimfoils are found. Round the lake there is a belt of reeds from 30 to 150 m wide. The common reed is predominant, but reed-mace, the bulrush and lancet-like sorrel also occur. On the western, northern and southern borders of the lake, the reeds give way to long strips of sedge which grows on periodically flooded areas. Along the belt of reeds, on its inner side a community of pond-weeds grows which is most highly developed along the north-eastern border of the lake.

Łuknajno lake is famous above all for the huge flocks of the dumb swan (*Cygnus olor*) which gather there throughout the whole year. These are spring migrants, breeding pairs, non-breeding flocks of moulting birds, and autumn migrants, Their number ranges from several score to over a thousand pairs depending on the season. Numerous other species of waterfowl accompany the swans.

MATERIAL AND METHODS

On Łuknajno lake, four sites differing in their biotope were selected (Fig. 1):

Site I – a ditch 5 m in width, 23 m in length, and 2-3 m in depth which joins Łuknajno lake to Śniardwy lake.

Site II – situated near the edge, in the southern part of the lake 10 m from the ditch (site I). The depth of the lake at this site was 0,5 m.

Site III – situated in the western part of the lake in the rushes, depth of lake – 0,35 m.

Site IV – in the central part of the lake; depth of lake at this site – 1,5-2,0 m.

The studies on the Łuknajno lake were carried out over four consecutive years (1984-1987) except for the winter months.

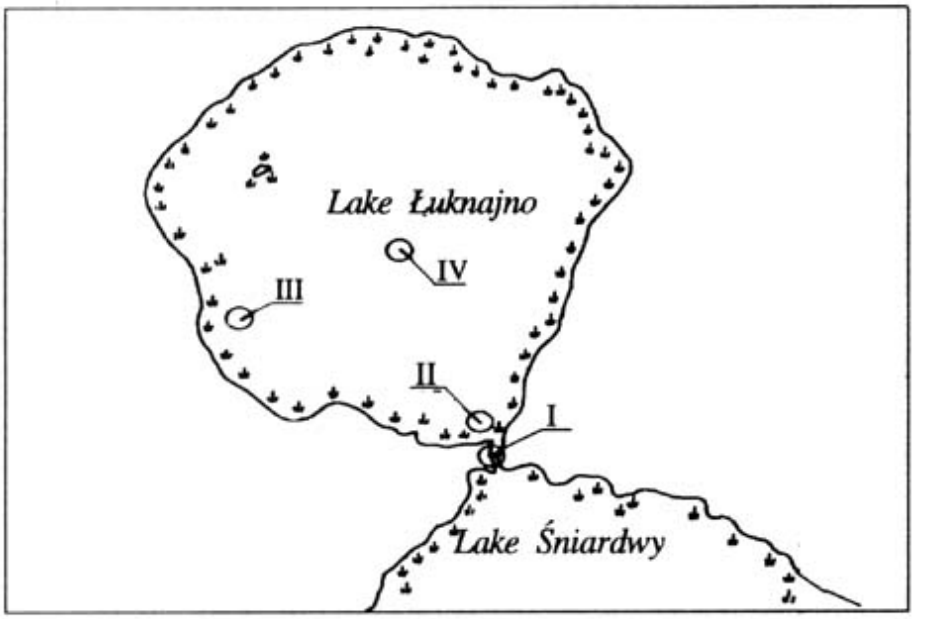

Fig. 1. Sampling sites (I-IV)

The water was collected in to a 0,5-litre Ruttner bucket from the depth at which the bucket was immersed. The temperature was measured and chemical analysis of the water was performed (Tab. 1); for determination of different chemical elements in the water methods recommended by Standard Methods (G o l t e r. am, C l y m o, 1969) were employed; details of these methods are described in the paper by C z e c z u g a, P r ó b a (1980).

The aquatic fungi were studied by a method based on direct microscopic examinations of the water and of the material collected from it as well as on the bait method (onion skin, hemp-seeds and clover-seeds) applied in the field and in the laboratory. The methods were described in detail in the paper C z e c z u g a, P r ó b a (1987). For determinations of the fungi the following three keys were used: B a t k o, 1975; D u d k a, 1973; S k i r g i e ł ł o, 1954; S p a r r o w, 1960.

RESULTS

The range of variations of the environmental factors in the water at the studied sites of Łuknajno lake is shown in Table 1. The water pH of the Łuknajno lake varied between 7,91-8,03, oxidability varied from 9,25 to 10,00 mg O_2/l, dissolved oxygen content varied between 13,07 and 15,12 mg O_2/l, BOD_5 from 5,14 to 7,59 mg O_2/l, carbon dioxide varied from 5,77 to 7,69 mg CO_2/l and alkalinity from

2,57 to 2,69 mval/l. Small amounts of nitrites and nitrates were noted. Amonia nitrogen content varied between 0,23 and 0,34 mg/l. The phosphate content ranged from 0,27 to 0,37 mg/l. The other components were: sulphates from 36,07 to 40,72 mg/l, chlorides from 21,19 to 23,42 mg/l, calcium from 36,84 to 40,32 mg/l, magnesium from 14,95 to 16,71 mg/l and iron from 0,03 to 0,18 mg/l.

The content of dry residue varied from 285,21 to 305,33 mg/l and dissolved substance varied from 250,92 to 272,33 mg/l.

At all four sites on Łuknajno lake, during the four years of studies, the presence of 43 aquatic fungi was determined: 8 species of *Chytridiomycetes*, 21 of *Oomycetes*, 2 of *Endomycetes*, 1 of the *Ascomycetes*, and 11 species of *Hyphomycetes* (Tab. 2). Most of the species found in Łuknajno lake have been quite frequently found in other water bodies but the finding of the following species is worth noting: *Allomyces arbuscula* (site III), *Myzocytium microsporum* (site II), *Rhipidium americanum* (site II), *Candida tropicalis* (at all four sites) and *Flagellospora stricta* (site III) (Fig. 2). The largest number of aquatic fungus species was noted at sites III and IV (21) and the smallest at site II (18). The largest number of aquatic fungus species over the four years of study was always noted in the spring and autumn months and the fewest in summer (Tab. 2).

Table 1

Chemical characterisation of the water at particular sampling sites Łuknajno lake (in mg / l)

Specification	Sites			
	I	II	III	IV
Temperature	10,74 ± 1,84	11,09 ± 7,21	12,11 ± 6,69	12,02 ± 6,69
pH	07,91 ± 0,05	08,02 ± 0,28	08,02 ± 0,18	08,03 ± 0,21
Oxidability	09,84 ± 0,69	09,25 ± 1,83	09,98 ± 0,86	10,00 ± 3,69
Dissolved O_2	13,67 ± 0,91	14,16 ± 3,54	14,68 ± 3,69	15,12 ± 3,77
BOD_5	05,14 ± 0,76	05,89 ± 3,39	07,59 ± 4,02	05,62 ± 3,29
CO_2	07,69 ± 0,91	06,68 ± 3,19	06,23 ± 2,94	05,77 ± 3,55
Alkalinity	02,69 ± 0,13	02,69 ± 0,50	02,62 ± 0,51	02,57 ± 0,50
$N(NO)_3$	00,04 ± 0,02	00,04 ± 0,05	00,05 ± 0,09	00,03 ± 0,05
$N(NO)_2$	0,005 ± 0,00	0,005 ± 0,005	0,005 ± 0,005	0,005 ± 0,005
$N(NH)_4$	00,29 ± 0,09	00,29 ± 0,23	00,23 ± 0,18	00,34 ± 0,40
$P(PO)_4$	00,35 ± 0,08	00,32 ± 0,27	00,37 ± 0,33	00,27 ± 0,16
SO_4	38,52 ± 3,03	38,13 ± 16,76	40,72 ± 8,00	36,07 ± 15,11
Cl	22,49 ± 1,40	21,19 ± 9,59	22,57 ± 8,21	23,42 ± 5,65
Ca	40,32 ± 2,60	40,09 ± 11,03	38,04 ± 11,97	36,84 ± 11,37
Mg	16,71 ± 1,35	14,95 ± 3,69	15,98 ± 4,67	15,73 ± 4,00
Fe	00,18 ± 0,11	00,05 ± 0,14 2	00,04 ± 0,08	00,03 ± 0,08
Dry residue	85,21 ± 12,63	98,77 ± 41,29	88,17 ± 35,61	05,33 ± 56,65
Dissolved solids	50,92 ± 16,14	69,38 ± 50,85	60,00 ± 37,57	72,33 ± 42,59
Suspended solids	34,28 ± 8,82	27,09 ± 31,04	28,17 ± 26,42	33,00 ± 30,07

DISCUSSION

Hydrochemical analysis of the water of the Łuknajno lake revealed a chemical content indicative of the eutrophic character of the water.

The species most worthy of note are those which are new to the Polish hydromycoflora, that is *Allomyces arbuscula, Myzocytium microsporum* and *Rhipidium americanum*. The species *Flagellospora stricta* is also of interest: it has been found previously in the ponds of Poryta Jabłoń (C z e c z u g a et al., 1989 b), but since Łuknajno lake is only the fourth site of this species in the world, it should, we feel, be further described.

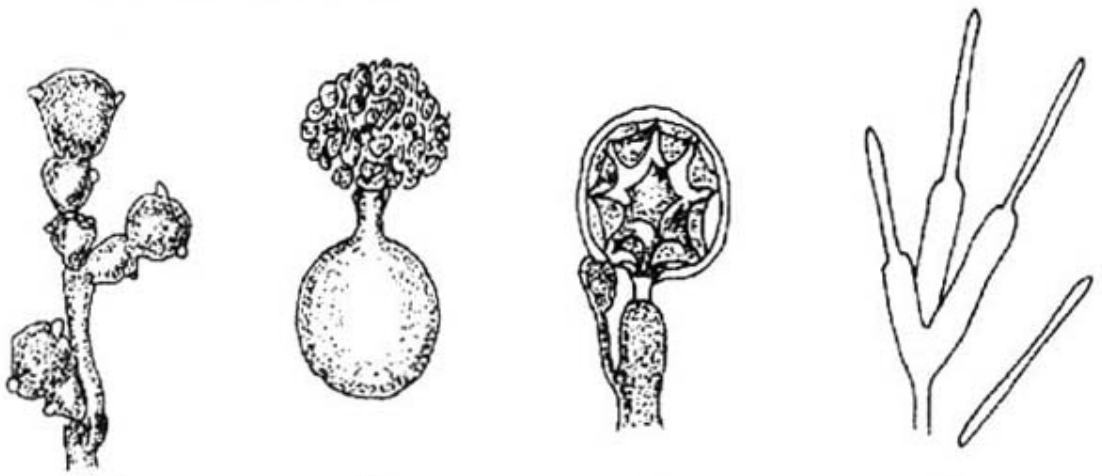

Fig. 2. Aquatic fungi

A – *Allomyces arbuscula* – gametophyte forming gametangium (gametangium ♀ 22 x 50 μ, gametangium ♂ 18 x 36 μ); B – *Myzocytium microsporum* – turn aut sporangium (10-20 μ); C – *Rhipidium americanum* – oogonium (45-50 μ); D – *Flagellospora stricta* – conidia (25-38 x 1-1,5μ)

As regards *Allomyces arbuscula*, in the development of this fungus both the gametophyte and the sporophyte occur (E m e r s o n, 1941). It is an aquatic and soil saprophyte which is also found on dead insects (B a t k o, 1975) within a comparatively wide geographical range (J e f f r e y, W i l l o u g h b y, 1964). It was found in Łuknajno lake only in the spring of 1984 at site III which is overgrown with rushes. *Myzocytium microsporum* is a parasite of grain, pollen, but above all of rotifers of the *Distyla* genus. In Łuknajno lake it was also found at only one single site, that is, site II an the same border, in the autumn of 1984. As mentioned above, this lake is the fourth site of this imperfect fungus, the *Flagellospora stricta*, in the world. It was first described by N i l s s o n (1962) who found it on fallen leaves in a small stream in Sweden.

Table 2

Aquatic fungi were founded in the Łuknajno lake and seasonal changes in the occurrence over the years 1984-1987

Species	Sites				1984			1985			1986			1987		
	I	II	III	IV	sp	su	au	sp	su	au	sp	su	au	sp	su	au
Chytridiomycetes																
Rhizophydium carpophilum (Zopf.) Fisch.				x										x		
Rhizophydium keratinophilum Karling			x	x	x											x
Chytridium xylophilum Cornu	x			x				x		x	x		x			
Nowakowskiella elegans (Nowak.) Schr.	x		x	x	x		x				x		x	x		x
Nowakowskiella macrospora Karling					x		x	x		x						x
Blastocladia globosa Kanouse	x			x										x		
Blastocladia ramosa Thaxter			x		x		x									
Allomyces arbuscula Boutler					x											
Oomycetes																
Olpidiopsis saprolegniae (Braun) Cornu	x									x		x				
Myzocytium microsporum (Karling) Sparrow		x					x									
Aphanomyces irregularis Scott			x		x		x									
Aphanomyces parasiticus Coker				x											x	x
Achlya debaryana Humphrey	x				x	x	x		x							
Achlya papillosa Humphrey		x		x	x	x	x									
Achlya polyandra Hildebrandt	x		x		x	x	x									
Achlya racemosa Hildebrandt			x							x						
Isoachlya anisospora (de Bary) Coker	x		x		x	x	x			x						
Isoachlya toruloides Kauffman et Coker			x								x		x			
Saprolegnia ferax (Gr.) Thurnet	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Saprolegnia parasitica Coker			x											x		
Dictyuchus monosporus Leitgeb.	x	x	x	x	x		x	x		x			x	x		x
Aplanes androgynus (Arch.) Humphrey		x														x
Rhipidium americanum Thaxter		x													x	
Pythiogeton nigricans Batko	x	x	x	x	x	x	x				x	x	x	x		x

Pythium debaryanum Hesse			x	x	x		x									
Pythium hydnosporum (Mont. ap. Berk.) Schr.	x						x									
Pythium rostratum Butler				x	x											
Pythium ultimum Trow.	x		x		x		x				x		x			
Zoophagus insidians Sommer.	x	x	x	x				x		x	x		x			x
Endomycetes																
Candida tropicalis (Cast.) Berkh.	x	x	x	x	x		x									
Trichosporon cutaneum (de Beurm.) Ota		x		x	x					x						
Ascomycetes																
Apostemidium guernisaci (Crouan) Boud.		x			x			x								x
Hyphomycetes																
Anguillospora gigantea Ranzoni	x				x		x									
Anguillospora longissima (Scot. et Syd.) Ing.	x		x					x		x	x		x	x	x	
Arthrobotrys oligospora Fresenius	x		x	x									x	x		x
Bacillispora aquatica Nilsson			x	x										x	x	x
Dimorphospora foliicola Tubaki				x							x		x			
Flagellospora stricta Nilssen			x										x			
Lemmoniera aquatica de Wildeman	x	x	x	x				x		x	x	x	x		x	x
Robillarda phragmitis Cunnel	x	x		x				x	x	x			x			
Tetracladium marchalianum de Wildeman		x						x								
Tricladium angulatum Ingold		x					x									
Tricladium gracile Ingold		x					x									
Total	19	18	21	21	20	6	19	10	3	12	10	4	14	10	6	13

sp – spring, su – summer, au – autumn

Osipjan, Ajrapetijan (1979) also noted this fungus in running water in Armenia. Poland is the third country in the waters of which *Flagellospora stricta* has been found. In Poland, it was first noted in the littoral zone of a fish pond in Kowale (Czeczuga et al., 1989) so that Łuknajno lake is the second Polish site. During the four years of investigations, this species occurred only in autumn in 1986 at site III in the rushes. At all the sites in 1984, *Candida tropicalis* was observed.

In all the years of study of the hydromycoflora of Łuknajno lake, there was a far greater abundance of species in spring and autumn than in summer. A similar observation was made in our studies of springs and forest streams in ponds (Czeczuga et al., 1989, 1986/87) and in the larger lowland rivers such as the river Narew and some of its tributaries (Czeczuga, Próba, 1987).

REFERENCES

Batko A., 1975. Zarys hydromykologii. Warszawa.

Czeczuga B., Próba D., 1980. The characteristics of the environment of *Sommerstoffia spinosa* (*Oomycetes*: *Saprolegniales*), a parasite of certain rotifers. Mycologia (USA) 72: 702-707.

Czeczuga B., Brzozowska K., Woronowicz L., 1986/87. Studies of aquatic fungi. IV. A mycoflora of the moat at the Branicki Palace. Rocz. AM Białystok 31-32: 39-48.

Czeczuga B., Próba D., 1987. Ditto VII. Mycoflora of the upper part of the River Narew and its tributaries in a differentiated environment. Nova Hedwigia 44: 151-161.

Czeczuga B., Orłowska M., Woronowicz L., 1989 (1990). Ditto. X. Some rare species *Hyphomycetes* in North-Eastern Poland. Acta Mycol. 25: 5-20.

Czeczuga B., Woronowicz L., Brzozowska K., 1986. Ditto. VI. Aquatic fungi of two forest brooks. Nova Hedwigia 43: 459-465.

Czeczuga B., Woronowicz L., Brzozowska K., Chomutowska H., 1989. Ditto. IX. Mycoflora of different types of springs. Acta Hydrobiol. 31: 273-283.

Dudka I. O., 1973. Vodni hufomiceti Ukraini. Kiiv. Emerson R., 1941. An experimental study of the life cycles and taxonomy of *Allomyces*. Lloydia 4: 77-144.

Golterman H. L., Clymo R. S., 1969. Methods for chemical analysis of fresh waters. IBP Handbook No.8, Oxford Edinburgh.

Jeffrey J. M., Willoughby L. G., 1964. A note on the distribution of *Allomycetes* in Australia. Nova Hedwigia 7: 507-515.

Nilsson S., 1962. Second note Swedish fresh-water *Hyphomycetes*. Bot. Not. 115: 7386.

Osipjan L. L., Ajrapetijan O. G., 1979. K flore vodnych hifal'nych gribov Armianskoy SSR. Novosti Sist. Nizs. Rast. 16: 86-90.

Skirgiełło A., 1954. Grzyby niższe. Grzyby i glonowce. Warszawa

Sparrow F. K., 1960. Aquatic *Phycomycetes*. Ann. Arbor. Michigan.