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Studies of aquatic fungi. XII. Aquatic fungi of the lowland River Biebrza

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The work was undertaken to investigate the mycoflora ot the lowland river Biebrza. Samples of water collected once a month over spring and autumn (1984) for hydrochemical analysis and studies of the fungus content. Twenty five species of fungi were found most of them in the river Biebrza. The following fungi unknown from Poland were found in the river Biebrza: *Karlingia rosea, Blastocladiella britannica, Cladolegnia eccentrica, Centrospora filiformis* and *Flagellospora curvula.*

INTRODUCTION

Studies of the mycoflora of running waters in Poland (Stpiczyńska-Tober 1965; Czeczuga et. al. 1984, 1986, 1987) and in other geographical latitudes (Waterhouse 1942; Dayal, Tandon 1962; Iqbal, Webster 1975; Shearer, Webster 1985) have shown that though there is a whole number of cosmopolitan fungal species, there are species peculiar to different running waters. For this reason studies of running waters contribute among other things to our knowledge of the geographical spread of various fungal species. A clear example of this is the fungus, *Sommerstorffia spinosa*, which was found in Poland during mycoflora studies of the upper River Narew basin, this being the fourth site of this species in the world. Of the eight tributaries, all with a very similar bed and chemism of the water, this fungus was found in only one and that at only one site during the three-year period of observation. It was always found in the summer months (Czeczuga, Próba 1980).

Whilst carrying out mycological studies of water bodies of various types in north-eastern Poland, we became interested in the fungus species composition of the River Biebrza which flows through a lowland area covered in meadows. The river still has comparatively pure water in some sections.

Characteristics of the river; methods

The sources of the River Biebrza are situated in the Jatło marshes in the northern part of the Sokólskie eminence to the south of Nowy Dwór. The river is a right-side tributary of the River Narew. It is 156 km long with a slope of only 0.36%. It is a wild, lowland river winding through a wide marshy valley. The width of this marshy valley converted to peat-bog is several tens of metres in the upper course to 15 km in the lower. The width of the surface of the water in the upper course varies between 10-30 m and that in the lower course between 30-55 m. The banks of the River Biebrza are low, peaty and often overgrown with reeds and osier. The depth of the river near its source is 0.5 m, near Lipsk it reaches a few metres after which it becomes shallower and then reaches its maximum depth of several metres. For the purpose of our studies 6 different sites were chosen on the lowland river Biebrza in the north-eastern

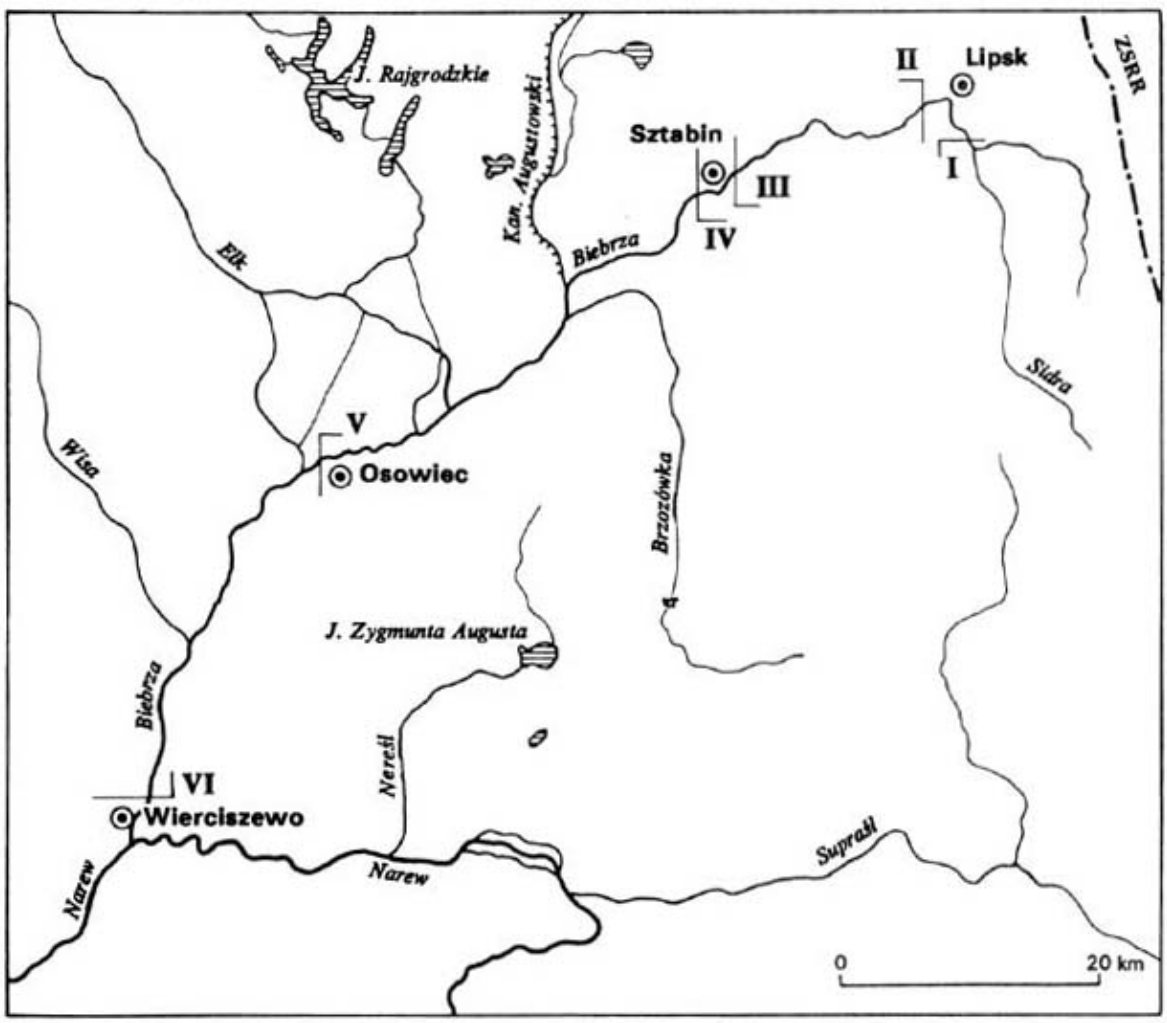

Fig. 1. Site near the river Biebrza

I – before Lipsk, II – below Lipsk, III – before Sztabin, IV – below Sztabin, V – in Osowiec, VI – in Wierciszewo

part of Poland; contained in the section of the river from Lipsk, to Wierciszewo (sites: I – before Lipsk, II – below Lipsk, III – before Sztabin, IV – below Sztabin, V – in Osowiec and VI – in Wierciszewo) (Fig. 1). Samples of water were collected once a month (spring, summer and autumn) for hydrochemical analysis and studies of the fungus content (spring and autumn). In addition to water from the bed, 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 the following determinations were made: pH, CO_2, oxidability, alkalinity, in $CaCO_3$, hardness of the water calculated in Ca and Mg, ammonium, organic nitrogen, nitrates, phosphates, chlorides, iron, sulphates, dry residue, substances dissolved in the water and suspensions in the water. For determinations of the different chemical elements in the water the methods recommend by Standard Methods (Golterman, Clymo 1969) were employed; the details of the methods are described in a previous paper (Czeczuga, Próba 1980).

The fungi in the water were studied by methods based on direct microscopic examination of materials collected from the waters as well as the bait method applied in environmental studies and in the laboratory. These methods are described in detail in our previous paper (Czeczuga et al. 1984).

RESULTS

The range of variations of the environmental factors in the water at the sites studied over the year is shown in Table 1. The presence of 25 aquatic fungus species was noted at the sites on the River Biebrza studied (Table 2). The largest number of species were those of the *Oomycetes* community (13), then followed the *Chytriomycetes* and *Deuteromycetes* (5 species of each) and finally the *Endomycetes* consisting of 2 species. Most of the species found in the River Biebrza have been found in other water bodies of Poland, whereas such species as *Karlingia rosea*, *Blastocladiella britanica*, *Cladolegnia eccentrica*, *Centrospora filiformis* and *Flagellospora curvula* are new in the aquatic mycoflora of Poland. The site at Osowiec was found to be richest in aquatic fungus species (11) and nest came the first two sites near Lipsk (9-8 species). The fewest number of species was noted at a site below Sztabin, only 4 species. The commonest fungi in the River Biebrza were the species *Saprolegnia ferax* (found at each site), *Achlya papilosa* and *Pythiogeton nigricans* found at 5 sites and *Dictyuchus monosporus* found at 4 sites. The following species were encountered at only one site; *Nowakowskiella elegans* (Sztabin IV), *Blastocladiella britanica*, *Blastocladia globosa*, *B. ramosa*, *Achlya flagellata*, *A. polyandra*, *A. radiosa*, *Pythium debaryanum*, *P. middletonii*, *P. rostratum*, *Candida tropicalis*, *Trichosporon cutaneum*, *Centrospora filiformis*, *Tetracladium marchalianum* and *T. anomalum*.

Table 1

Characteristic of the water at particular stations in the river Biebrza (in mg/dm^3)

Specification	Spring (11 – 25.04.1984)					Summer (27.06. – 9.07.1984)					Autumn (20.09. – 24.10.1984)				
	I	II	IV	V	VI	I	II	IV	V	VI	I	II	IV	V	VI
Temperature	11.0	11.5	11.5	11.0	13.0	12.0	14.0	16.0	15.5	20.5	12.5	12.5	13.0	13.0	9.0
pH	7.5	7.6	7.7	7.7	8.1	7.7	7.8	7.8	7.8	8.2	8.2	8.2	8.4	8.6	7.9
Oxydability	4.4	5.2	5.8	6.3	9.6	2.4	4.0	4.4	3.6	8.0	7.2	6.2	7.6	7.6	12.8
O_2	8.4	11.4	9.6	10.6	15.0	7.4	9.8	10.4	10.4	8.2	6.4	8.6	8.2	10.4	20.0
BOD_5	3.0	2.8	5.3	3.6	6.4	3.6	1.2	1.8	3.0	8.2	4.0	8.6	8.2	2.2	10.4
CO_2	15.4	22.0	12.6	9.9	4.4	17.6	17.6	18.7	22.0	35.2	6.6	6.6	4.4	6.6	22.0
Alkalinity*	5.1	4.6	4.8	4.3	4.0	6.4	6.6	6.0	5.5	5.6	6.2	5.7	5.7	4.8	5.3
$N(NO_3)$	0.08	0.10	0.15	0.13	0.20	0.06	0.06	0.08	0.06	0.06	0.08	0.22	0.12	0.08	0.34
$N(NO_2)$	0.022	0.014	0.019	0.013	0.016	0.004	0.000	0.000	0.002	0.006	0.010	0.034	0.034	0.013	0.025
$N(NH_3)$	0.45	0.27	0.14	0.20	0.15	0.18	0.38	0.19	0.02	0.17	0.00	0.00	0.00	0.00	0.32
$P(PO_4)$	0.05	0.06	0.035	0.02	0.27	0.78	1.42	5.50	4.80	0.78	0.85	0.76	0.85	0.60	0.73
$S(SO_4)$	30.44	46.07	40.31	32.91	69.93	18.92	21.80	14.39	17.69	53.07	18.51	19.33	36.20	37.84	35.79
Cl	26.0	21.0	14.0	32.0	27.0	24.0	30.0	19.0	69.0	69.0	10.0	9.0	6.0	11.0	16.0
Total hardness in Ca	73.44	54.00	72.72	61.92	64.80	83.52	79.92	72.00	72.72	72.00	46.80	45.36	39.60	37.44	43.92
Total hardness in Mg	33.54	13.76	35.69	19.35	16.34	31.82	36.98	34.83	35.26	25.80	28.38	25.37	34.83	29.67	18.49
Fe	1.10	0.85	1.18	0.68	0.76	0.00	0.10	0.10	0.00	0.00	0.33	0.33	0.26	0.03	0.70
Dry residue	422.0	381.0	458.0	334.0	436.0	385.0	355.0	350.0	353.0	378.0	360.0	323.0	398.0	287.0	374.0
Dissolved solids	365.0	362.0	388.0	323.0	313.0	370.0	338.0	320.0	350.0	323.0	338.0	177.0	228.0	252.0	359.0
Suspended solids	57.0	19.0	70.0	11.0	123.0	15.0	17.0	30.0	3.0	55.0	22.0	146.0	170.0	35.0	15.0

* – in mval/dm^3.

Table 2

Aquatic fungi found in the river Biebrza

Species	Sites					
	I	II	III	IV	V	VI
Chytridiomycetes						
Nowakowskiella elegans (Nowakow.) Schr.				s		
Blastocladia globosa Kanouse	a					
Blastocladia ramosa Thaxter					a	
Blastocladiella britannica Horen., Cant.					s	
Karlingia rosea (de Bary et Wor.) Joh.		a	sa		a	
Oomycetes						
Achlya flagellata Coker		a				
Achlya papillosa Humphrey	s	a	s		sa	a
Achlya polyandra Hildebrandt					a	
Achlya radiosa Maurizio						a
Cladolegnia eccentrica (Coker) Johannes	s					
Dictyuchus monosporus Leitgeb	sa	sa			sa	sa
Isoachlya anisospora (de Bary) Coker	a		a			
Pythiogeton nigricans Batko	s	s	s		s	sa
Pythium middletonii Sparrow		sa				
Pythium debaryanum Hesse				s		
Pythium rostratum Butler	a					
Pythium ultimum Trow			sa		a	
Saprolegnia ferax (Gruith) Thurnet	sa	a	sa	sa	sa	a
Endomycetes						
Candida tropicalis (Cast.) Berk.	a					
Trichosporon cutaneum (de Beur., Goug. et Vauch.)					s	
Deuteromycetes						
Bacillospora aquatica Nilsson				s		
Centrospora filiformis (Greath.) Peter.		s				
Flagellospora curvula Ingold					s	s
Tetracladium marchalianum de Wildeman						a
Tricladium anomalum Ingold			s			

a – autumn, s – spring

DISCUSSION

As was mentioned above, the smallest number of aquatic fungus species was noted at site IV, below Sztabin. On comparing the chemical composition of the water of the River Biebrza at this site with that of other sites, no differences were noted except for a slightly higher magnesium and dry residue content in spring and autumn and a slightly higher content of iron in spring. The section of the River Biebrza at site IV was drained some years ago and this may have

resulted in the reduction in the species composition of aquatic fungi in this section. A similar observation was made during our studies of the mycoflora of the River Narew and its tributaries (C z e c z u g a, P r ó b a 1987). The sections which had been drained for land reclamation purposes had a considerably fewer number of species than had the sections left in their natural state. The section of the River Narew at Radule which is an overflow arm on an old river bed was found to be characteristic for its large number of species of aquatic fungi. The River Biebrza at site V in Osowiec (where also the current is rapid) is of a similar character. It is possible that this character of the river at Osowiec is the reason why the greatest number of fungus species was found there.

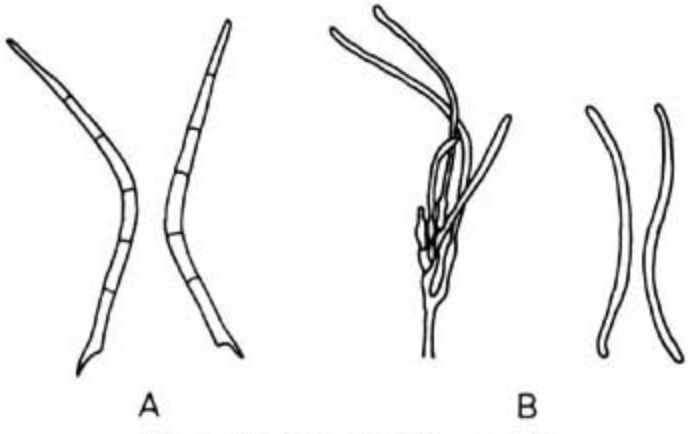

Fig. 2. *Centrospora filiformis* (A)
konidia (200-250 × 3,7 μ/m)
Flagellospora curvula (B)
phialides and konidia (100-150 × 2 μ/m)

As mentioned above, 5 species of aquatic fungi not hitherto noted in Polish waters were found in the River Biebrza. One of these, the *Karlingia rosea* known to be a saprophyte of plant remains, was encountered as sites II and V in spring and, in spring and autumn, in the overflow arm at Osowiec (site V). The *Blastocladiella britannica*, another aquatic saprophyte, occurred at site V (Osowiec) on the River Biebrza in spring. *Cladolegnia eccentrica*, on the other hand, is a phyto-and zoosaprophyte which occurred only in spring at site I (above Lipsk). Also in the upper section of the River Biebrza (site II) the imperfect fungus, *Centrospora filiformis* (Fig. 2A), was noted in spring. This is a comparatively rare species found to date in the waters of the Ukrainian forest-steppe (D u d k a, B e r e g o v a 1974). Another species of imperfect fungi, the *Flagellospora curvula* (Fig. 2B), a new species as regards Polish aquatic mycoflora, was also noted in spring at two sites in the lower course of the River Biebrza, that is at site V (Osowiec) and VI (Wierciszewo). In contrast to the previous species, *Flagellospora curvula* has been noted in running waters at various latitudes. It has been found at Kola-Karelian, the Northern

Province of the USSR (Dudka 1972), in the waters of Lapland and the Arctic region (Muller-Haeckel, Marvanova 1977, 1979), in Germany (Marvanova 1984), in the River Teign in England (Shearer, Webster 1985) and in some streams (Suberkropp 1984) and rivers (Shearer, Lane 1983) in North America.

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