The epipelic algae of fishponds of Central and Northern Moravia (The Czech Republic)

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Abstract: Epipelic assemblages have not been studied in the Czech Republic yet. The sampling method following Round (1953) was used for the fist time in the Czech Republic. The epipelic assemblages were dominated by diatoms, particularly in mesotrophic and meso-eutrophic fishponds, eutrophic fishponds were dominated by green algae and cyanobacteria. A total of 130 diatom species were found in 16 fishponds, their list with trophic preferences is presented. Seven morphospecies were distinquished within *Sellaphora pupula* species complex, their clonal cultures will be studied later by molecular methods.

Key words: epipelon, diatoms, ponds, diversity, *Sellaphora*

Introduction

Fishponds represent the most common type of stagnant water biotopes in the Czech Republic. Their investigation has had a long tradition, but has mainly focused on phytoplankton (KOŘÍNEK et al. 1987) and its primary production, especially in large fish-producing systems in the southern part of the Czech Republic (Třeboň, Lednice). Littoral periphytic algae have been studied only occasionally (KOMÁRKOVÁ & MARVAN 1987, KITNER & POULÍČKOVÁ 2003, POULÍČKOVÁ et al. 2003). Epipelic assemblages have not been studied yet. An easy method of their sampling (ROUND 1953) was used for the first time in this study.

The epipelon is an extremely widespread community occurring in all waters in regions where sediments accumulate and on to which light penetrates (lakes, ponds, pools, slowly flowing rivers). The species composition of the epipelon varies widely between habitats, though it tends to be fairly constant for any one type of water. Thanks to these features, it can be successfully used for stagnant water biomonitoring, which still has no standard method in the EU in contrast to rivers (POULÍČKOVÁ et al. 2004).

The use of diatoms for monitoring ecological conditions has had quite a long tradition also in the Czech Republic and is planned to continue, especially following the Water Framework Directive. The success of diatom monitoring depends critically on 1) **taxonomic precision** (are diatom species equivalent to species elsewhere, or are they equivalent to genera of angiosperms?, etc.), 2) **biogeography of diatoms** – are all diatoms cosmopolitan as claimed e.g. by FINLAY et al. (2002) or not (MANN 1999)? and 3) **consistent use of names**. All of these are compromised by lack of understanding of nature of species.

Traditionally, diatom taxonomy depends on cell wall characteristics, but there has been no consensus on where species boundaries should be drawn. So far most studies indicate that diatom species are often heterogenous complexes, containing several to many semicryptic or cryptic species. Although epipelic species complexes, particularly *Sellaphora pupula* agg., have been studied for a long time in British lakes and ponds, there is still no information about ecological preferences of diatom epipelic species, and only a little is known about the diversity and distribution of these species complexes in the rest of Europe.

The presented paper focuses on the species composition of the studied epipelic assemblages and their potential use in the assessment of trophic status of fishponds.

Methods

Altogether 16 localities (Central Moravia, The Czech Republic) were investigated at the end of the season – in September 2005. Phytoplankton, littoral attached algae and ecological variables had been studied

Table 1. The list of localities, the classification to types, environmental variables, trophic index according to Rott et al. (1999); Type:1 - forest-protected, 2 - meadow-recreational, 3 - field-recreational, 4 - field-fish-producting; TP - total phosphorus; Trophic index: oligo- to 1.0, meso- 1.1-1.9, meso-eu- 2-2.3, eu- 2.4-2.8, hypertrophic above 2.9).

Locality	Coordinates	Type	Diatom species richness	TP ($mg.l^{-1}$)	NO_3^- ($mg.l^{-1}$)	NH_4^+ ($mg.l^{-1}$)	pH	Conductivity ($\mu S.cm^{-1}$)	Trophic index	Trophic state
U třech krátkých	49°29′32′′N, 16°47′29′′E	1	36	0.160	0.000	0.857	6.92	105	1.286	meso-
Bouzov 1	49°41′20′′N, 16°53′46′′E	1	21	0.178	0.899	0.077	8.30	160	No data	No data
Bouzov 2	49°41′17′′N, 16°53′53′′E	1	11	0.165	0.639	0.947	8.20	210	No data	No data
Černé jezero	50°14′00′′N, 17°24′49′′E	1	21	0.030	2.000	0.100	6.80	63	1.572	meso-
Obora	49°27′45′′N, 16°47′57′′E	1	34	0.164	0.477	0.735	7.64	150	2.650	eu-
Suchý 2	49°28′47′′N, 16°45′43′′E	2	8	0.615	0.452	1.200	7.29	132	2.151	meso-eu-
Buková	49°30′32′′N, 16°49′47′′E	2	19	0.586	1.118	0.878	7.52	207	2.745	eu-
Suchý 1	49°28′53′′N, 16°45′22′′E	3	18	1.298	0.713	1.087	8.49	223	2.516	eu-
Pavlov	49°31′00′′N, 16°48′20′′E	3	34	0.427	0.467	0.663	8.29	206	2.249	meso-eu-
Protivanov	49°28′25′′N, 16°49′01′′E	3	30	0.778	0.753	1.291	7.78	167	2.701	eu-
Drahany	49°25′51′′N, 16°53′33′′E	3	14	0.437	0.560	0.776	8.89	207	2.855	eu-
Tovačov	49°25′56′′N, 17°16′59′′E	4	13	0.664	0.778	1.204	7.77	342	2.818	eu-
Chropyně	49°21′27′′N, 19°21′39′′E	4	18	0.729	0.679	1.214	7.41	485	2.886	eu-
Záhlinice	49°17′28′′N, 17°28′54′′E	4	21	0.612	0.417	1.087	7.56	485	3.256	eu-
Hrdibořice1	49°28′43′′N, 16°13′07′′E	4	12	0.674	0.541	0.852	7.16	677	2.584	eu-
Hrdibořice 2	49°28′43′′N, 16°13′10′′E	4	11	1.333	0.609	0.878	7.43	739	2.528	eu-

at the same sites previously (KITNER & POULÍČKOVÁ 2003). The altitude of investigated sites ranges from 490 to 660 m a.s.l., their area ranges from 0,068 ha to 5.52 ha, their maximal depth is 75–280 cm and shading 5-85%. Tab. 1 summarizes the trophic characteristics of the sites.

Surface sediments and overlying water were collected using a glass tube, as described by ROUND (1953), transported to the laboratory in polyethylene bottles, poured out into plastic boxes, and allowed to stand in the dark for at least 5 h. Then the supernatant was removed by suction and the mud covered with lens tissue. Under continuous low-level illumination (circa 5 µmol photons.m^{-2}.s^{-1}), epipelic algae moved up through the lens tissue and became attached to cover slips placed on top. The cover slips were collected from the mud after 12 and 24 h of exposition. The algae were counted on the identical area of the cover slip (22 mm^2).

Cleaned valves were prepared with boiling 30% hydrogen peroxide, followed by washing with distilled water. After washing, the valves were mounted in Naphrax.

Results and discussion

The epipelic assemblages were represented by Bacillariophyceae, Chlorophyta, Cyanophyta, Euglenophyta, Dinophyta and Cryptophyta (Tab. 2), most of them being dominated by diatoms (Tab. 3). The representation of epipelic diatom species on cover slips were similar when collected after 12 or 24 h, with the exception of large diatoms (*Amphora ovalis, Pinnularia gibba*) which colonize a trap after 24 h. Although the species representation seems to be similar to that studied in England (POULÍČKOVÁ et al. 2007), we cannot be sure that morphospecies distinquised within the species complexes (*Sellaphora pupula* agg. and others) are genetically identical. Our research will continue in two directions: (1) Diversity and distribution of epipelic diatom species and their ecological preferences, particularly *Navicula cryptocephala* agg., *Sellaphora pupula* agg., *Amphora copulata*, *Pinnularia gibba* agg., *Cymatopleura solea* agg. (2) Determination of the relationship between morphological and cytological variation, mating compatibility and genetic population diversity in selected epipelic pennate diatoms.

Table 2. Representation of cyanobacteria and algae in the fishponds under investigation.

Algal groups	Locality							
	Buková	Pavlov	Suchá 1	Suchá 2	Protivanov	Obora	Hrdibořice 1	Hrdibořice 2
Chlorophyta	19%	9%	24%	30%	22%	15%	33%	34%
Cyanophyta	10%	4%	24%	30%	19%	19%	22%	21%
Euglenophyta	14%	13%	10%	10%	7%	4%	8%	11%
Cryptophyta	5%	4%	0%	0%	4%	0%	0%	0%
Dinophyta	10%	0%	0%	0%	0%	0%	4%	0%
Bacillariophyceae	42%	70%	42%	30%	48%	62%	33%	34%
	Záhlinice	Tovačov	Chropyně	Bouzov 1	Bouzov 2	Drahany	Černé jezero	U třech krátkých
Chlorophyta	29%	25%	25%	37%	50%	35%	21%	12%
Cyanophyta	8%	21%	30%	22%	11%	17%	21%	15%
Euglenophyta	13%	12%	10%	11%	17%	13%	13%	12%
Cryptophyta	4%	4%	5%	0%	0%	4%	4%	0%
Dinophyta	0%	0%	0%	0%	0%	0%	0%	4%
Bacillariophyceae	46%	38%	30%	30%	22%	31%	42%	57%

Table 3. List of taxa (Bacillariophyceae) in 16 fishponds of Northern and Central Moravia. *Locality*: 1 U třech krátkých, 2 Bouzov 1, 3 Bouzov 2, 4 Černé jezero, 5 Obora, 6 Suchý 2, 7 Buková, 8 Suchý 1, 9 Pavlov, 10 Protivanov, 11 Drahany, 12 Tovačov, 13 Chropyně, 14 Záhlinice, 15 Hrdibořice 1, 16 Hrdibořice 2; Occurrence: 1 rare, 2 frequent, 3 common; trophic preferences: our data based on 16 fishponds. Nomenclature according to Krammer & Lange-Bertalot 1986, 1988, 1991 except of *Sellaphora* sp. comp.

Taxa	Locality	Occurrence	Trophic preferences
Achnanthes altaica (V.S. PORETZKY) CLEVE - EULER	15, 16	1	eutrof
Achnanthes helvetica (HUST.) LANGE – BERT.	8	1	eutrof
Achnanthes lanceolata (BRÉBI.) GRUNOW	1, 5, 7	1	meso-eutrof
Achnanthes minutisima KÜTZ.	1	1	meso
Anomoeoneis sphaerophora (EHRENB.) PFITZER	13, 16	1	eutrof
Anomoeoneis vitrea (GRUNOW) ROSS	1, 12	1	meso-eutrof
Amphora ovalis KÜTZ.	1, 9, 10, 11, 12	2	meso-eutrof
Asterionella formosa HASSAL	5	1	eutrof
Aulacoseira alpigena GRUNOW (KRAMMER)	10, 12, 15	1	eutrof
Aulacoseira granulata (EHRENB.) SIMONSEN	5, 9, 10, 12, 14, 16	2	meso-eutrof
Aulacoseira lirata (EHRENB.) ROSS	7	1	eutrof
Caloneis silicula (EHRENB.) CLEVE	4, 9	1	meso-eutrof
Cocconeis placentula EHRENB.	1, 6, 9, 10	2	meso-eutrof
Cyclotella atomus HUST.	1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	3	meso-eutrof
Cyclotella distinguenda HUST.	2, 5	1	eutrof
Cyclotella dubia (Fricke) ROUND	10	1	eutrof
Cyclotella meneghiniana KÜTZ.	1, 3, 6, 7, 9, 12, 13, 14	2	meso-eutrof
Cyclotella pseudostelligera HUST.	3, 7, 10, 13	1	eutrof
Cyclotella stelligera CLEVE et GRUNOW	5	1	eutrof
Cymbella affinis KÜTZ.	14	1	eutrof
Cymbella amphicephala NÄGELI	1, 5	1	meso-eutrof
Cymbella cistula (EHRENB.) KIRCHN.	6	1	meso-eutrof
Cymbella descripta (HUST.) KRAMMER	4	1	meso
*Cymbella gracilis (*EHRENB.) KÜTZ.	1, 4, 8	1	meso-eutrof
Cymbella minuta HILSE	9	1	meso-eutrof
Cymbella naviculiformis AVERSWALD	4	1	meso
Cymbella silesiaca BLEISCH	2, 5, 9, 10, 15	2	meso-eutrof
Cymbella tumida (BRÉB.) HEURCK	2, 10	1	eutrof
Epithemia sorex KÜTZ.	16	1	eutrof
Eunotia bilunaris (EHRENB.) MILLS	8	1	eutrof
Eunotia incisa W.GREG.	1	1	meso
Eunotia exigua (BRÉB.) RABENH.	1, 4, 8	1	meso-eutrof
Eunotia minor (KÜTZ.) GRUNOW	5	1	eutrof
Eunotia paludosa GRUNOW	8	1	eutrof

Cont. Table 3			
Fragilaria bicapitata A. MAYER	1, 5	1	meso-eutrof
Fragilaria capucina DESM.	1, 9, 10	1	meso-eutrof
Fragilaria construens (EHRENB.) GRUNOW	1, 9	1	meso-eutrof
Fragilarie elliptica SCHUM.	8	1	eutrof
Fragilaria parasitica (W.SMITH) GRUNOW	1, 5	1	meso-eutrof
Fragilaria pinnata EHRENB.	9, 15, 16	1	meso-eutrof
Fragilaria virescens RALFS	1	1	meso
Gomphonema acuminatum EHRENB.	1, 7, 10, 11	2	meso-eutrof
Gomphonema affine KÜTZ.	10	1	eutrof
Gomphonema angustatum (KÜTZ.) GRUNOW	1, 2	1	meso-eutrof
Gomphonema gracile EHRENB.	1, 4, 5, 8, 9, 11	2	meso-eutrof
Gomphonema olivaceum (HORNEM.) BRÉB.	6	1	meso-eutrof
Gomphonema parvulum (KÜTZ.) GRUNOW	5, 7, 8, 10, 11, 12, 14, 15, 16	3	eutrof
Gomphonema truncatum EHRENB.	1	1	meso
Gyrosigma acuminatum (KÜTZ.) RABENH.	14	1	eutrof
Melosira varians AGARDH	9	1	meso-eutrof
Navicula accomoda HUST.	14	1	eutrof
Navicula angusta GRUNOW	2	1	eutrof
Navicula atomus (KÜTZ.) GRUNOW	2	1	eutrof
Navicula capitata EHRENB.	2, 4, 5, 9, 10, 13	2	meso-eutrof
Navicula cincta (EHRENB.) RALFS	13	1	eutrof
Navicula constans HUST.	1, 5	1	meso-eutrof
Navicula cryptocephala KÜTZ.	1, 2, 4, 5, 7, 8, 9, 10, 11, 13, 15, 16	3	meso-eutrof
Navicula cuspidata (KÜTZ.) KÜTZ.	13, 14	1	eutrof
Navicula elginensis (GREG.) RALFS	4	1	meso
Navicula gallica (W.SMITH) LAGERST.	2, 3, 9, 10, 15	2	meso-eutrof
Navicula gregaria DONKIN	3, 10	1	eutrof
Navicula halophila (GRUNOW) CLEVE	4, 7	1	meso-eutrof
Navicula lenzii HUST.	10	1	eutrof
Navicula menisculus SCHUM.	2, 14	1	eutrof
Navicula minima GRUNOW	5, 11, 13	1	eutrof
Navicula phyllepta KÜTZ.	9, 10	1	eutrof
Navicula radiosa KÜTZ.	4	1	meso
Navicula rhynchocephala KÜTZ.	5, 9	1	meso-eutrof
Navicula seminulum GRUNOW	7	1	eutrof
Navicula schoenfeldii HUST.	14	1	eutrof
Navicula similis KRASSKE	11	1	eutrof
Navicula species LANGE-BERT.	12	1	eutrof
Navicula subtilissima CLEVE	7	1	eutrof
Navicula trivialis LANGE-BERT.	2, 9, 13	1	meso-eutrof
Navicula viridula (KÜTZ.) KÜTZ.	3	1	eutrof

Cont. Table 3			
Navicula veneta KÜTZ.	6, 14	1	meso-eutrof
Neidium ampliatum (EHRENB.) KRAMMER	1, 4, 5, 8, 9	2	meso-eutrof
Neidium productum (W. SMITH) CLEVE	8, 14	1	eutrof
Nitzschia acicularis W. SMITH	3, 5, 6, 12, 14, 15, 16	2	meso-eutrof
Nitzschia actinastroides (LEMMERM.) V. GOOR	3, 7, 10	1	eutrof
Nitzschia agnita HUST.	1	1	meso
Nitzschia calida GRUNOW	13	1	eutrof
Nitzschia capitellata HUST.	13, 14	1	eutrof
Nitzschia fonticola GRUNOW	14	1	eutrof
Nitzschia fruticosa HUST.	11	1	eutrof
Nitzschia gracilis HANTZSCH	4, 6, 10, 14	2	meso-eutrof
Nitzschia inconspicua GRUNOW	3	1	eutrof
Nitzschia intermedia HANTZSCH	1, 2, 7, 9	2	meso-eutrof
Nitzschia linearis (AGARDH) W. SMITH	4	1	meso
Nitzschia palea (KÜTZ.) W. SMITH	1, 2, 4, 5, 7, 9, 11, 12, 13, 16	3	meso-eutrof
Nitzschia paleacea GRUNOW	2, 5, 9, 13	2	meso-eutrof
Nitzschia perminuta GRUNOW	5, 9, 10, 11	2	meso-eutrof
Nitzschia pusila GRUNOW	14	1	eutrof
Nitzschia recta HANTZSCH	5	1	eutrof
Nitzschia subacicularis HUST.	1, 2, 6, 7, 10, 12, 13, 15	3	meso-eutrof
Nitzschia tubicola GRUNOW	2, 3, 4, 5, 9, 11, 15	3	meso-eutrof
Pinnularia braunii (GRUNOW) CLEVE	1	1	meso
Pinnularia divergens W. SMITH	6	1	meso-eutrof
Pinnularia gibba EHRENB.	7, 9	1	meso-eutrof
Pinnularia intermedia (LAGERST.) CLEVE	1, 8, 13	1	meso-eutrof
Pinnularia interrupta W. SMITH	7, 8	1	eutrof
Pinnularia legumen EHRENB.	8	1	eutrof
*Pinnularia maior (*KÜTZ.) RABENH.	4, 8, 9, 10	2	meso-eutrof
Pinnularia microstauron (EHRENB.) CLEVE	5, 10, 14	1	eutrof
Pinnularia subcapitata GREG.	1	1	meso
Pinnularia viridis (NITZSCH) EHRENB.	1, 8, 15	1	meso-eutrof
Pleurosigma salinnarum GRUNOW	12	1	eutrof
Sellaphora *AULDREEKIE* MANN & MCDONALD	2, 5, 10, 13, 14	2	eutrof
Sellaphora „big´´	9	1	meso-eutrof
Sellaphora blackfordensis MANN & DROOP	9, 10	1	meso-eutrof
Sellaphora „blunt capitata´´	1	1	meso
Sellaphora capitata MANN & MCDONALD	5, 9	1	meso-eutrof
Sellaphora „elliptic´´	5, 7, 13	1	eutrof
Sellaphora pupula (KÜTZ.) MERESCHK.	2, 5, 9, 14	2	meso-eutrof

Cont. Table 3

Stauroneis acuta W. SMITH	4	1	meso
Stauroneis anceps EHRENB.	4, 11	1	meso-eutrof
Stauroneis phoeniceteron (NITZSCH) EHRENB.	11	1	eutrof
Stauroneis smithii GRUNOW	5	1	eutrof
Stephanodiscus dubius (FRICKE) HUST.	10	1	eutrof
Stephanodiscus hantzschii GRUNOW	2	1	eutrof
Stephanodiscus parvus STOERMER & HÅK.	3	1	eutrof
Surirella angustata KÜTZ.	1, 2, 5, 7, 9, 14	2	meso-eutrof
Surirella bohemica MALY	1	1	meso
Surirella BREBISSONI KRAMMER & LANGE-BERT.	5, 7, 10	1	eutrof
Surirella lapponica A. CLEVE	4	1	meso
Surirella minuta BRÉB.	9	1	meso-eutrof
Surirella subsalsa W. SMITH	5	1	eutrof
Tabellaria fenestrata (LYNGB.) KÜTZ.	1, 11	1	meso-eutrof
Tabellaria flocculosa (ROTH) KÜTZ.	1, 5, 8, 9, 10, 12	2	meso-eutrof
Tetracyclus rupestris (A. BRAUN) GRUNOW	4	1	meso

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