

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

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Abstract: Epipellic assemblages have not been studied in the Czech Republic yet. The sampling method following Round (1953) was used for the first time in the Czech Republic. The epipellic 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 distinguished 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 (KORÍNEK 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). Epipellic 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 heterogeneous complexes, containing several to many semicryptic or cryptic species. Although epipellic 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 epipellic 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 epipellic 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-producing; 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 (µS.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-
Hrdibořice I	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 $\mu\text{mol photons.m}^{-2}.\text{s}^{-1}$), epipellic 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 mm²).

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 epipellic 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 epipellic 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 distinguished within the species complexes (*Sellaphora pupula* agg. and others) are genetically identical. Our research will continue in two directions: (1) Diversity and distribution of epipellic 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 epipellic 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
<i>Achnanthes altaica</i> (V.S. PORETZKY) CLEVE - EULER	15, 16	1	eutrof
<i>Achnanthes helvetica</i> (HUST.) LANGE – BERT.	8	1	eutrof
<i>Achnanthes lanceolata</i> (BRÉBL.) GRUNOW	1, 5, 7	1	meso- eutrof
<i>Achnanthes minutissima</i> KÜTZ.	1	1	meso
<i>Anomoeoneis sphaerophora</i> (EHRENB.) PFITZER	13, 16	1	eutrof
<i>Anomoeoneis vitrea</i> (GRUNOW) ROSS	1, 12	1	meso- eutrof
<i>Amphora ovalis</i> KÜTZ.	1, 9, 10, 11, 12	2	meso- eutrof
<i>Asterionella formosa</i> HASSAL	5	1	eutrof
<i>Aulacoseira alpigena</i> GRUNOW (KRAMMER)	10, 12, 15	1	eutrof
<i>Aulacoseira granulata</i> (EHRENB.) SIMONSEN	5, 9, 10, 12, 14, 16	2	meso- eutrof
<i>Aulacoseira lirata</i> (EHRENB.) ROSS	7	1	eutrof
<i>Caloneis silicula</i> (EHRENB.) CLEVE	4, 9	1	meso- eutrof
<i>Cocconeis placentula</i> EHRENB.	1, 6, 9, 10	2	meso- eutrof
<i>Cyclotella atomus</i> HUST.	1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	3	meso- eutrof
<i>Cyclotella distinguenda</i> HUST.	2, 5	1	eutrof
<i>Cyclotella dubia</i> (Fricke) ROUND	10	1	eutrof
<i>Cyclotella meneghiniana</i> KÜTZ.	1, 3, 6, 7, 9, 12, 13, 14	2	meso- eutrof
<i>Cyclotella pseudostelligera</i> HUST.	3, 7, 10, 13	1	eutrof
<i>Cyclotella stelligera</i> CLEVE et GRUNOW	5	1	eutrof
<i>Cymbella affinis</i> KÜTZ.	14	1	eutrof
<i>Cymbella amphicephala</i> NÄGELI	1, 5	1	meso- eutrof
<i>Cymbella cistula</i> (EHRENB.) KIRCHN.	6	1	meso- eutrof
<i>Cymbella descripta</i> (HUST.) KRAMMER	4	1	meso
<i>Cymbella gracilis</i> (EHRENB.) KÜTZ.	1, 4, 8	1	meso- eutrof
<i>Cymbella minuta</i> HILSE	9	1	meso- eutrof
<i>Cymbella naviculiformis</i> AVERSWALD	4	1	meso
<i>Cymbella silesiaca</i> BLEISCH	2, 5, 9, 10, 15	2	meso- eutrof
<i>Cymbella tumida</i> (BRÉB.) HEURCK	2, 10	1	eutrof
<i>Epithemia sorex</i> KÜTZ.	16	1	eutrof
<i>Eunotia bilunaris</i> (EHRENB.) MILLS	8	1	eutrof
<i>Eunotia incisa</i> W.GREG.	1	1	meso
<i>Eunotia exigua</i> (BRÉB.) RABENH.	1, 4, 8	1	meso- eutrof
<i>Eunotia minor</i> (KÜTZ.) GRUNOW	5	1	eutrof
<i>Eunotia paludosa</i> GRUNOW	8	1	eutrof

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

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

Cont. Table 3

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

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