# Phytoplankton of the Zámecký Pond

## Fytoplankton Zámeckého rybníka

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## Abstract

Current knowledge on the phytoplankton composition of the Zámecký Pond at Lednice (Moravia, Czech Republic) is presented. The pond has become a National Nature Reserve, and its use for fishery is highly limited by the purpose of nature conservation. The fish stock of the studied pond has the greatest influence on the structure and abundance of phytoplankton. Altogether 343 taxa of cyanophytes and algae were found during the whole hydrobiological monitoring.

## Introduction

The Zámecký Pond (area of 30 ha) is situated in southern Moravia by the Czech-Austrian border close to the town of Lednice. The construction of the pond started already in 1805. Together with the surrounding landscape it became a part of a vast Lednice-Valtice area and forms a unique landscape unit which was in 1996 inscribed on the UNESCO World Cultural and Natural Heritage List in the category ”cultural landscape”. The site is remarkable from the point of view of natural science as well, and, therefore, since 1953 the Zámecký Pond area has become a part of the National Natural Reserve ”Lednice Ponds” established to protect birds and other fauna, flora and the landscape character. At present the pond has the status of the National Nature Reserve. The Lednice Ponds represent wetlands of international importance and were included it the Ramsar Treaty List in 1990.

The first hydrobiological studies on the system of the Lednice Ponds started as early as 1902. Most of the papers published dealt with the largest ponds (Nesyt, Hlohovecký, Prostřední and Mlýnský), but only a few with the Zámecký Pond.

The first information on the flora of the Zámecký Pond was published by FISHER (1920), BÍLÝ (1929) and ZAPLETÁLEK (1932 a,b). More detailed research of the cyanophytes and algae of the Zámecký Pond has been carried out in the last ten years (HETEŠA et al. 1997, SUKOP & KOPP 2001, 2002, 2003, BYSTRIANSKÁ 2003, RAMENZAPOOR 2004).

Beside basic environmental variables, the phytoplankton composition of the Zámecký Pond is highly influenced by the intensity of fishery and by the inflow from the Dyje River. BAYER & BAJKOV (1929) already characterized the Zámecký Pond as eutrophic; nevertheless, fish breeding was carried out extensively at that time. Between the two World Wars the fish breeding became more intensive and was accompanied by liming, fertilizing by organic fertilizers and fish feeding. Since 1945 the intensification of fish breeding increased, the fish stock grew, and mineral fertilizers were used (superphosphate, and nitrogenous fertilizers). Fish stock increased later again due to introduction of herbivorous fish (*Ctenopharyngodon idella, Hypophthalmichthys molitrix*, and *Aristichthys nobilis*), and their feeding. The intensification of fishery gradually led to a lower transparency of water and an increased phytoplankton biomass, similarly to other fishponds in the Czech Republic (Poulíčková et al. 1998).

To restore the species diversity of aquatic organisms, a fishery study of the Lednice Ponds was formulated. It included the decrease in the fish stock, limited introduction of herbivorous fish and implementation of partial drying of ponds in summer. Steps for a gradual decrease in water trophy and the support of aquatic vegetation growth were included, too (LÁZNIČKOVÁ 1993). Since 1994 the fishery at the Zámecký Pond has undergone significant changes resulting in a total exclusion of fish stocking in 2004.

In 2005 a new maintenance plan for the Lednice Ponds was approved. Priorities of the nature conservation are 1) optimal development of communities dependent on an aquatic environment, including littoral and bank biocoenoses, 2) protection of the present species diversity, particularly endangered animal and plant species and 3) to provide conditions for the return of rare and endangered species which have disappeared recently (FORMÁNEK et al. 2005).

## Material and methods

The methods used by FISHER (1920), BÍLÝ (1929) a ZAPLETÁLEK (1932 a,b) for phytoplankton sampling and treating are not known. Phytoplankton samples of other authors were taken into 100-ml plastic bottles from the depth of approximately 20 cm below the surface. The samples were fixed with Lugol solution and condensed in ultra-filtering

equipment. Bürker counting chamber was used for phytoplankton abundance evaluation. Colonial cyanobacteria (*Microcystis*) were counted after disintegration of colonies.

Basic environmental variables were measured with mobile instruments: WTW (Germany) for oxygen, pH and temperature; Conmet 1 (Hanna Instruments, USA) for conductivity. Water transparency was measured with a Secchi disc. Analyses of chlorophyll *a* were made according to ČSN ISO 10260. Other chemical variables were analysed by standard methods (HORÁKOVÁ et al. 1986).

## Results and discussion

The selected environmental variables of the Zámecký Pond presented in Table 1 and 2 support the observation that its water is eutrophic. Transparency of water over most of the vegetation period is low (20-40 cm), it was particularly low during cyanobacterial dominance in 2002. The high photosynthetic activity of cyanophytes and algae results in the increase of pH values and fluctuation of oxygen regime with oversaturation in the afternoon hours and low concentration of dissolved oxygen in the morning before sunrise. Phosphorus and nitrogen concentrations are sufficient for an excessive development of cyanophytes and algae. In addition, the pond is highly supplied with allochtonous organic matter (inflow and leaves).

Table 1: Average, minimum and maximum values of selected environmental variables in the Zámecký Pond during the vegetation seasons (March-October) of the years 1996-2004 (number of measurements for 1996-1998: n = 8; for 2001: n = 12, for 2002: n = 16, for 2003: n = 32, for 2004: n = 16)

| Year | Transparency[cm] AVG/MIN-MAX | pH AVG/MIN-MAX | Oxygen [%] AVG/MIN-MAX | Conductivity [µS.cm$^{-1}$] AVG/MIN-MAX |
|---|---|---|---|---|
| 1996 | | 8.22/7.0 - 8.9 | 110/65 - 169 | 523/475 - 563 |
| 1997 | | 9.08/7.6 - 9.3 | 125/43 - 174 | 490/457 - 553 |
| 1998 | | 8.33/7.9 - 8.7 | 113/58 - 159 | 592/513 - 694 |
| 2001 | 41/25 - 90 | 8.59/7.9 - 9.2 | 107/58 - 201 | 537/473 - 585 |
| 2002 | 45/0 - 150 | 8.68/7.6 - 10.3 | 119/41 - 335 | 523/429 - 647 |
| 2003 | 49/20 - 80 | 8.71/8.1 - 9.6 | 81/37 - 180 | 535/469 - 590 |
| 2004 | 148/110 - 150 | 8.65/7.8 - 10.2 | 79/40 - 173 | 579/539 - 623 |

Table 2: Selected chemical variables of the Zámecký Pond during the vegetation seasons (March-October) of the years 1999-2004. (average values are presented, n = 12; ANC = alkalinity, TP – total phosphorus)

| Year | ANC $mmol.l^{-1}$ | $N\text{-}NH_4$ $mg.l^{-1}$ | $N\text{-}NO_3$ $mg.l^{-1}$ | $N\text{-}NO_2$ $mg.l^{-1}$ | TP $mg.l^{-1}$ | $P\text{-}PO_4$ $mg.l^{-1}$ | $COD_{Mn}$ $mg.l^{-1}$ | $COD_{Cr}$ $mg.l^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| 1999 | 3.35 | 1.32 | 3.15 | 0.005 | | 0.180 | 14.24 | |
| 2000 | 2.80 | 2.22 | 3.00 | 0.003 | | 0.100 | 23.52 | |
| 2001 | 2.20 | 3.21 | 1.31 | 0.046 | | 0.048 | | 104 |
| 2002 | 3.36 | 0.31 | 0.69 | 0.068 | 0.274 | | 12.25 | 48 |
| 2003 | 1.39 | 0.62 | 0.63 | 0.016 | 0.062 | | 9.52 | 58 |
| 2004 | 2.65 | 0.61 | 0.63 | 0.032 | 0.233 | | 13.65 | 24 |

The fish stock of the studied pond has a significant influence on the qualitative composition and abundance of phytoplankton. An intense fish breeding (of carp and herbivorous fish in particular) carried out at the pond since the half of the last century, and their feeding with corn, both led to a high abundance of cyanophytes and algae. Great pressure of fish on the food of the bottom resulted in the release of biogenic compounds from the bottom, and the whirling of sediments highly decreased the water transparency as well. In the years 1994-1997, when the fishery was already regulated according to the maintenance plan for the Lednice Ponds, the abundance of phytoplankton was still high and the total number of species found in that period was 213 (KOPP unpublished).

Since 1998 up to the present the number of stocked fish have decreased and this was accompanied by increasing of ”coarse” fish from the Dyje River (Table 3). During the warmest months of 2000-2003, a significant growth of planktonic cyanophytes forming water bloom was observed. Density of water bloom often exceeded 1 million cells of blue-green algae per 1 ml of water. This situation was probably caused by several factors, including a higher input of blue-green algae from the Dyje River and the Novomlýnské Reservoirs, and changes in the zooplankton structure influenced by changes in the fish species composition. The phytoplankton species richness decreased. Eighty-six taxa were found in 2001 (SUKOP & KOPP 2001), 98 taxa (SUKOP & KOPP 2002) and 136 taxa (RAMENZAPOOR 2004) in 2002, 61 taxa (RAMENZAPOOR 2004) and 154 taxa (BYSTRIANSKÁ 2003) in 2003. Between 2001 and 2003 Heteša found 164 taxa at the Zámecký Pond (unpublished).

Table 3: The amount of fish (kg) harvested from the Zámecký Pond in the years 1996-2004 (coarse fish: *Carassius auratus, Rutilus rutilus, Abramis brama, Scardinius erythrophthalmus, Rhodeus sericeus, Blicca bjoerkna*; carnivorous fish: *Esox lucius, Silurus glanis, Sander lucioperca*).

| Year | Carp kg | Coarse fish kg | Carnivorous fish kg |
|---|---|---|---|
| 1996 | 134 200 | 29 500 | 3 800 |
| 1997 | 173 700 | 6 500 | 13 500 |
| 1998 | 207 500 | 7 000 | 3 300 |
| 1999 | 164 200 | 15 500 | 5 700 |
| 2000 | 142 800 | 18 800 | 6 300 |
| 2001 | 101 000 | 33 000 | 8 200 |
| 2002 | 98 000 | 28 000 | 6 800 |
| 2003 | 60 000 | 90 000 | 11 200 |
| 2004 | 0 | 0 | 0 |

In 2004 the complete cessation of fish stocking led to an even greater decrease in phytoplankton abundance and richness (56 species; unpublished). Poor stock of "coarse" fish was not able to reduce zooplankton sufficiently. The development of filamentous algae and aquatic macrophytes depleted biogenic compounds necessary for more intense development of cyanophytes and algae.

The most common genera of green algae observed recently correspond to previous records of ZAPLETÁLEK (1932 a,b), and FISHER (1920). The complete list of species is presented in Table 5. ZAPLETÁLEK (1932a) observed a dense bloom of *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*; the same species have been recorded at the pond recently as well.

A more detailed monitoring of phytoplankton development in the Zámecký Pond in the years 2001-2003 exhibited a similar seasonal dynamics. At the beginning of the vegetation season in spring months cyanophytes were represented by genera *Merismopedia*, *Aphanocapsa* and *Pseudanabaena*. In the above mentioned years the abundance of diatoms (*Bacillariophyceae*) was also high, in particular the genera *Nitzschia*, *Navicula* and *Stephanodiscus*. Genera *Monoraphidium* and *Scenedesmus* were the most frequent representatives of green algae (*Chlorophyta*) in March and April. Representatives of *Cryptophyta* were found as well, in particular genera *Chroomonas* and *Cryptomonas*.

Throughout May phytoplankton was dominated by green algae: *Actinastrum*, *Dictyosphaerium*, *Didymocystis*, *Monoraphidium*, *Scenedesmus*, *Pediastrum* and *Phacotus.* In summer, the composition of phytoplankton was strongly influenced by the inflow of water from the River Dyje. This water brought a rich inoculum of cyanophytes from the Novomlýnské Reservoirs: *Microcystis, Anabaena* and *Aphanizomenon*.

Second peak of diatoms was observed in October: *Aulacoseira*, *Cyclotella*, *Nitzschia,* and *Stephanodiscus;* and the representatives of Euglenophyta (*Euglena* a *Trachelomonas*) became more frequent. Phytoplankton abundance is given in Table 4.

Table 4: The abundance of cyanophytes (with aerotopes only) and the rest of algae, and chlorophyll ***a*** values in the Zámecký Pond during vegetation period (April-October) of the years 2001-2004 (average, minimum and maximum values; number of measurements for 2001: n = 12, for 2002: n = 16, for 2003: n = 32, for 2004: n = 16)

| Year | Abundance [$10^3$ cells . $ml^{-1}$] Cyanophytes AVG/MIN-MAX | Abundance [$10^3$ cells . $ml^{-1}$] Other phytoplankton AVG/MIN-MAX | Chlorophyll a [µg.l-1] AVG/MIN-MAX |
|---|---|---|---|
| 2001 | 20.4/0 - 114.6 | 391.2/23.5 - 1033.1 | |
| 2002 | 257.1/0 - 970.0 | 376.6/4.3 - 1575.0 | 129.91/45.4 - 324.7 |
| 2003 | 68.9/0 - 270.0 | 78.9/4.4 - 290.4 | 240.05/18.0 - 2388.7 |
| 2004 | 1.2/0 - 6.3 | 3.4/0.6 - 7.7 | 5.52/2.1 - 15.1 |

In 2004 an important change in phytoplankton composition was observed when the pond was not stocked with fish and, therefore, the fish stock composed only of a ”coarse” fish from the inflowing River Dyje. Significant declines in phytoplankton abundance and chlorophyll *a* values were observed (Table 4). The transparency of water was high all year round; a more significant development of zooplankton was observed in comparison to previous years as well (unpublished). Low fish stock allowed the growth of submerged aquatic macrophytes (*Ceratophyllum demersum* and *Potamogeton crispus),* filamentous algae (*Oedogonium*, *Spirogyra*, *Cladophora* and *Entheromorpha*) which were later replaced by the floating aquatic plants (*Lemna minor* and *Spirodela polyrhiza*). During August and September the *Lemnion* community covered a great part of the pond (ca 1/3-1/2 of the area) and negatively influenced the chemical and light regime in the water column and subsequently also phytoplankton structure. Diatoms, green algae and cyanobacterium *Microcystis aeruginosa* occurred in low abundances (Table 4).

Table 5: The list of species of the Zámecký Pond (species occurrence is listed chronologically according to individual authors, asterisk represents the presence of the taxon). Nomenclature according to Süßwasserflora von Mitteleuropa Gustav Fischer Verlag.
**1-** FISHER 1920, **2-** BÍLÝ 1929, **3-** ZAPLETÁLEK 1932a, **4-** ZAPLETÁLEK 1932b, **5-** KOPP (nepublikovaná data 1994-1997), **6-** HETEŠA et al. 1997, **7-** SUKOP & KOPP 2001, **8-** SUKOP & KOPP 2002, **9-** HETEŠA (unpublished data 2001-2003), **10-** BYSTRIANSKÁ 2003, **11-** MARVAN et al. 2003, **12-** RAMENZAPOOR et al. 2004, **13-** KOPP (unpublished data 2004)

| ***TAXON*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***7*** | ***8*** | ***9*** | ***10*** | ***11*** | ***12*** | ***13*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***CYANOBACTERIA*** | | | | | | | | | | | | | |
| *Anabaena compacta* (NYGAARD) HICKEL | | | | | * | | | | * | * | | * | |
| *Anabaena flos-aquae* BRÉB. ex BORN. et FLAH. | | | | | * | | * | * | * | * | | * | |
| *Anabaena planctonica* BRUNNTH. | | | | | | * | | | | | | | |
| *Anabaena spiroides* KLEB. | | | * | | | | * | | | | | | |
| *Anabaena* sp. | | | | | * | | | * | * | * | | * | |
| *Anabaena viguieri* cf. DENIS ET FRÉMY | | | | | * | | | | * | * | | | |
| *Anabaenopsis elenkinii* MILL. | | | | | * | * | | | * | * | | | |
| *Aphanizomenon flos-aquae* (L.) RALFS et BORN. et FLAH. | | | * | * | * | | * | | | * | | | |
| *Aphanizomenon gracile* (LEMM.) LEMM. | | | | | * | | | * | * | * | | | |
| *Aphanizomenon issatschenkoi* (USAČ.) PROŠK.-LAVR. | | | | | | | | * | | | | * | |
| *Aphanizomenon klebahnii* ELENK. | | | | | | | | | | | | * | |
| *Aphanizomenon* sp. | | | | | * | | | | | | | | |
| *Aphanocapsa incerta* (LEMM.) CRONG. et KOM. | | | | | * | | * | * | * | * | | * | |
| *Chroococcus dispersus* (KEISSL.) LEMM. | | | | | | * | | | | | | | |
| *Chroococcus limneticus* LEMM. | | | | | | | | | | | | * | |
| *Chroococcus minutus* (KÜTZ.) NÄG. | | | | | | | | | | | | * | |
| *Coelosphaerium kuetzingianum* NÄG. | | | | * | | | | | | | | | |
| *Cylindrospermopsis raciborskii* cf. (WOLOSZ.) SEENAYYA et S. RAJU | | | | | * | | | | | | | | |
| *Geitlerinema splendidum* (GREU. ex GOM.) ANAGN. | | | | | | * | | | | | | | |
| *Gomphosphaeria pusilla* VAN GOOR | | | | | * | | | | | | | | |
| *Jaaginema* sp. | | | | | * | | | | * | * | | | * |
| *Limnothrix redekei* (VAN GOOR) MEFERT. | | | | | * | | | | | * | | | |
| *Merismopedia punctata* MEYEN | | | | | | | | * | | | | | |
| *Merismopedia* sp. | | | | | * | | | | | * | | | |
| *Merismopedia tenuissima* LEMM. | | | | | * | | * | * | * | * | | * | |
| *Microcystis aeruginosa* (KÜTZ.) KÜTZ. | | | * | * | * | | * | * | * | * | | * | * |
| *Microcystis flos-aquae* (WITTR.) KIRCHN. | | | | | | | | | | | | * | |
| *Microcystis ichthyoblabe* KÜTZ. | | | | | | | | | | | | * | |
| *Microcystis pulverea* (WOOD) FORTI | | | | | | * | | | | | | | |
| *Microcystis* sp. | | | | | * | | | | * | * | | | |
| *Microcystis viridis* (A. BRAUN in RABENH.) LEMM. | | | | | * | | | | | | | * | |
| *Microcystis wesenbergii* (KOM.) KOM. in KONDR. | | | | | * | | | | * | * | | * | |
| *Nostoc commune* VAUCH. ex BORN. et FLAH. | | | | | * | | | | | | | | |
| *Oscillatoria limosa* AG. ex GOM. | | | | | * | | * | | * | | | * | |
| *Oscillatoria* sp. | | | | | * | | | * | * | * | | | * |
| *Phormidium* sp. | | | | | * | | | | | * | | | |
| *Phormidium tenue* (MENEG) GOM. | | | | | | | | | | | | * | |
| *Phormidium viscosum* LEMM. | | | | | | | | | | | | * | |

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|---|---|---|---|---|---|---|---|---|---|
| *Planktolyngbya sp.* | | | | | | | * | | |
| *Planktothrix agardhii* (GOM.) ANAGN. et KOM. | * | | | * | * | * | | * | |
| *Pseudanabaena catenata* LAUTERB. | * | | | | * | * | | | |
| *Pseudanabaena limnetica* (LEMM.) KOM. | * | | * | * | * | * | | * | * |
| *Pseudanabaena mucicola* (NAUM.et HUB.-PEST.) SCHWABE | * | | | * | * | * | | * | |
| *Raphidiopsis mediterranea* SKUJA | * | | | | * | * | | | |
| *Romeria elegans* WOLOSZ. | | * | | | | | | | |
| *Spirulina maior* KÜTZ. ex GOM. | * | | | | | * | | | |
| *Synechococcus elongatus* (WOLOSZ.) KOM. | | * | | | | | | | |
| *Synechocystis aquatilis* cf. SAUVAGEAU | * | | | | | | | | |
| *Woronichinia naegeliana* (UNG.) ELENK. | | | | | | | | * | |
| ***DINOPHYTA*** | | | | | | | | | |
| *Amphidinium* sp. | * | | | | | | | | |
| *Gymnodinium* sp. | * | | | * | * | * | | * | |
| *Perinidium aciculiferum* LEMM. | | | | | * | | | * | |
| *Peridinium* sp. | * | | | * | * | * | | | * |
| ***CRYPTOPHYTA*** | | | | | | | | | |
| *Chroomonas caudata* GEITL. | * | | * | * | * | * | | | * |
| *Chroomonas nordstedtii* HANSG. | | | * | | * | | | * | |
| *Chroomonas* sp. | * | | | | * | * | | | |
| *Cryptomonas curvata* EHRENB. | * | | * | | * | * | | * | * |
| *Cryptomonas erosa* EHRENB. | | | | | | | | * | |
| *Cryptomonas marssonii* SKUJA | * | | * | * | * | * | | * | |
| *Cryptomonas ovata* EHRENB. | * | | | | * | | | | |
| *Cryptomonas reflexa* SKUJA | | * | | | | | | | |
| *Cryptomonas* sp. | * | | | * | * | * | | | |
| *Rhodomonas lacustris* PASCH. et RUTTN. | * | | | | | * | | * | |
| *Rhodomonas pusilla* (BACHM.) JAVORN. | | | * | | | | | | |
| *Rhodomonas minuta* SKUJA | | | | | | | | * | |
| ***CHROMOPHYTA - Chrysophyceae*** | | | | | | | | | |
| *Chromulina* sp. | * | | | | * | * | | | |
| *Chrysococcus biporus* SKUJA | | | | | | | | * | |
| *Chrysococcus punctiformis* PASCH. | | | | | * | | | * | |
| *Chrysococcus rufescens* KLEBS | * | | * | | * | * | | * | |
| *Chrysococcus* sp. | * | | | | | * | | | |
| *Chrysococcus triporus* MACK | | | * | | | | | | |
| *Codomonas pascheri* VAN GOOR | | | * | | | | | | |
| *Dinobryon* sp. | * | | | | | | | | |
| *Kephyrion moniliferum* (SCHID.) BOURR. | * | | * | | | | | | |
| *Kephyrion tubiforme* FOTT | | | | | * | | | * | |
| *Pseudokephyrion entzii* CONRAD | * | * | | | | | | | |
| *Pseudokephyrion obtusum* SCHMID. | | * | | | | | | | |
| *Pseudokephyrion sp.* | | | | | | | | | * |
| ***CHROMOPHYTA - Bacillariophyceae*** | | | | | | | | | |
| *Achnanthes hungarica* (GRUN.) ROUND ET BASSON | | | | | * | | | * | |
| *Achnanthes lanceolata* (BRÉB.) GRUN | | | | | | | | * | |
| *Actinocyclus normanii v. subs.* (GREG.) HUST | | | | | | | | * | |
| *Amphora ovalis* (KÜTZ.) KÜTZ. | * | | | | * | * | | | * |
| *Amphora sp.* | | | | | * | | | | |
| *Amphora veneta* KÜTZ. | | | | | * | | | * | |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Anomoeoneis sphaerophora* (EHRENB.) PFITZ. | | | | | | | | | * | |
| *Asterionella formosa* MASS. | | | * | | | * | * | | * | |
| *Aulacoseira ambigua* (GRUN.) SIMONS | | | * | | * | * | * | | * | * |
| *Aulacoseira granulata* (EHRENB.) SIMONS | | | * | | * | * | * | | * | * |
| *Aulacoseira granulata v. angustissima* (O. MŰLL.) SIMONS | | | | * | | | | | | |
| *Aulacoseira italica* cf. (EHRENB.) SIMONS. | | | | | | * | | | | |
| *Aulacoseira* sp. | | | * | | | * | | | | * |
| *Caloneis amphisbaena* (BORY) CLEVE | | | * | | | * | * | | | * |
| *Caloneis silicula* (EHRENB.) CLEVE | | | | | | * | | | * | |
| *Caloneis* sp. | | | * | | | | | | | |
| *Campylodiscus clypeus* EHRENB. | | * | | | | | | | | |
| *Cocconeis placentula* EHRENB. | | * | | | | | | | * | * |
| *Cocconeis* sp. | | | * | | | * | * | | | |
| *Cyclostephanos dubius* (FRICKE) ROUND | | | * | | | * | | | * | |
| *Cyclotella meneghiniana* KÜTZ. | | | * | * | | * | * | | * | * |
| *Cyclotella* sp. | | | * | | * | * | * | | | * |
| *Cymatopleura librilis* (EHRENB.) PANT. | | | * | * | | | * | | * | |
| *Cymbella lanceolata* (EHRENB.) KIRCHN. | * | | | | | | | | | |
| *Cymbella* sp. | | | * | | | | | | * | |
| *Diatoma elongatum* (LYNGBYE) AG. | | | * | | | | * | | | |
| *Diatoma tenuis* AG. s.l. | | | | | | | | | * | |
| *Diatoma vulgaris* BORY | | | | | | | | | * | |
| *Epithemia sorex* KŰTZ. | * | | | | | | | | | |
| *Epithemia zebra* (EHRENB.) KŰTZ. | * | | | | | | | | | |
| *Fragilaria capucina* DESM. | | | | * | | | | | | |
| *Fragilaria crotonensis* KITT. | | | | * | | | | | * | |
| *Fragilaria* sp. | | | * | | | | * | | * | |
| *Gomphonema* sp. | | | * | | * | | * | | | * |
| *Gomhonema truncatum* EHRENB. | | | | | | | | | * | |
| *Gyrosigma acuminatum*(KŰTZ.) RABENH. | | | | * | | * | | | * | |
| *Gyrosigma scalproides* (RABENH.) CLEVE | * | | | | | | | | | |
| *Gyrosigma* sp. | | | * | | * | | * | | | * |
| *Hantzschia sp.* | | | | | | | | | | * |
| *Melosira varians* AG. | | | * | | | * | | | | * |
| *Navicula accomoda* HUST. | | | | | | | | | * | |
| *Navicula capitata* (EHRENB.) LANGE-BERT.et al | | | | | | * | | | * | |
| *Navicula citrus* KRASSKE | | | | | | | | * | | |
| *Navicula cryptocephalsa* LANGE-BERT. | | | | | | | | | * | |
| *Navicula cuspidata* (KŰTZ.) KŰTZ. | | | * | | | | | | * | |
| *Navicula gregaria* DONKIN | | | | | | * | | * | * | |
| *Navicula menisculus* SCHUM. | | | | | | * | | | * | |
| *Navicula reinhardtii* GRUN. | | | | | | | | | * | |
| *Navicula rhynchocephala* KÜTZ | | | * | | | | * | | * | * |
| *Navicula* sp. | | | * | | * | * | * | | * | * |
| *Navicula tripunctata* (O.F.MÜLL.) BORY | | | | | | * | | | * | |
| *Navicula viridula* (KÜTZ.) EHRENB. | | | | | | * | | | * | |
| *Nitzschia acicularis* (KŰTZ.) W. SMITH | | | * | | * | * | * | | * | * |
| *Nitzschia closterium* cf. (EHRENB.) W. SMITH | | | * | | | | * | | | |
| *Nitzschia fonticola* GRUN. | | | | | | | | | * | |
| *Nitzschia gracilis* cf. HANTZSCH | | | * | | | * | * | | * | |
| *Nitzschia heufleriana* GRUN. | | | | | | | | | * | |
| *Nitzschia hungarica* GRUN. | | | | | | * | | | * | |
| *Nitzschia linearis* (AG.) W.SMITH | | | | | | * | | | * | |

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|---|---|---|---|---|---|---|---|---|---|
| *Nitzschia palea* (KŰTZ.) W. SMITH | | | | * | | * | | * | |
| *Nitzschia recta* HANTZSCH | | | | | | * | | | |
| *Nitzschia reversa* cf. W. SMITH | | | * | | | | * | | |
| *Nitzschia sigmoidea* (EHRENB.) W. SMITH | | | * | | * | * | * | * | |
| *Nitzschia* sp. | | | * | | * | * | * | * | * |
| *Nitzschia tryblionella* HANTZSCH | | | | | | * | | * | |
| *Pinnularia gibba* EHRENB. | | | | | | | | * | |
| *Pinnularia* sp. | | | * | | * | * | * | | * |
| *Rhoicosphenia curvata* (KÜTZ.) RABENH. | | | * | | | * | * | | |
| *Rhopalodia gibba* (EHRENB.) O. MŰLL. | * | | * | | | | | | |
| *Skeletonema potamos* (WEBER) HASLE | | | * | | | * | | * | |
| *Stauroneis sp.* | | | | | | | | | * |
| *Stephanodiscus hantzschii* GRUN. | | | * | | * | * | | * | |
| *Stephanodiscus invisitatus* HOHN et HELLERM. | | | * | | | * | | * | |
| *Stephanodiscus* sp. | | | * | | | * | * | | * |
| *Surirella bifrons* (EHRENB.) EHRENB. | | | | | | | | * | |
| *Surirella minuta* BRÉB. ex KÜTZ. | | | | | | * | | * | |
| *Surirella ovata* KÜTZ. | | | * | | | * | * | * | * |
| *Surirella* sp. | | | * | | | | * | | |
| *Synedra acus* KÜTZ. | | | * | | * | * | * | * | * |
| *Synedra* sp. | | | * | | | | | | |
| *Synedra ulna* (NITZSCH) EHRENB. | | | * | | * | * | * | * | * |
| *Tabellaria* sp. | | | * | | | | * | | |
| ***CHROMOPHYTA - Tribophyceae*** | | | | | | | | | |
| *Goniochloris fallax* FOTT | | | * | | | * | | | |
| *Goniochloris mutica* (A. BR.) FOTT | | | * | | * | * | * | * | |
| *Goniochloris sculpta* GEITL. | | | | | | | | * | |
| *Goniochloris smithii* (BOURR.) FOTT | | | * | | * | | | | |
| *Goniochloris spinosa* PASCH. | | | * | | | * | * | | |
| *Istmochloron lobulatum* (NÄG.) SKUJA | | | * | | | * | | | |
| *Ophiocytium capitatum* WOLLE | * | | | | | | | | |
| *Tribonema aequale* PASCH. | | | | | * | | | | |
| *Tribonema* sp. | | | * | | | | * | | |
| *Tribonema viride* PASCH. | | | | | * | | | | |
| *Tribonema vulgare* PASCH. | | | | | * | | | | |
| ***EUGLENOPHYTA*** | | | | | | | | | |
| *Euglena acus* EHRENB. | | | * | | | * | * | | |
| *Euglena pisciformis* KLEBS | | | | | | * | | * | |
| *Euglena spirogyra* DANG. | | | | | * | | | | |
| *Euglena* sp. | | | * | | | * | * | * | * |
| *Euglena tripteris* (DUJARD.) KLEBS | | | | | | | | * | |
| *Euglena viridis* cf. PERTY | | | | | | * | | * | |
| *Lepocinclis* sp. | | | * | | | * | | | |
| *Lepocinclis texta* (DUJARD.) LEMM | | | * | | * | * | * | * | |
| *Monomorphina pyrum* (EHRENB.) MEREŠK | | | * | | * | * | * | | |
| *Phacus curvicauda* SWIR. | | | * | | | * | | * | |
| *Phacus longicauda* (EHRENB.) DUJARDIN | | | * | | | * | * | * | |
| *Phacus pleuronectes* (O. F. MÜLLER) DUJARDIN | | | * | | | | | | |
| *Phacus* sp. | | | * | | | * | * | * | |
| *Phacus tortus* (LEMM.) SKVORC. | | | * | | | | | | |
| *Strombomonas fluviatilis* (LEMM.) DEFL. | | | | * | | | | | |
| *Strombomonas* sp. | | | * | | | | * | | |
| *Strombomonas verrucosa* (DADAY) DEFL. | | | * | | | | * | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Trachelomonas lefevrei* DEFL. | | | | | * | | | | | | | |
| *Trachelomonas ornata* cf. (SWIR.) SKVORTZ. | | | | * | | | * | | | | | |
| *Trachelomonas* sp. | | | | * | | * | * | * | | * | | |
| *Trachelomonas volvocina* EHRENB. | | | | * | * | * | * | * | | | | * |
| *Trachelomonas volvocinopsis* SWIR. | | | | * | | | * | * | | | | |
| ***CHLOROPHYTA - Chlamydophyceae*** | | | | | | | | | | | | |
| *Chlamydomonas pertusa* CHOD. | | | | | * | | | | | | | |
| *Chlamydomonas* sp. | | | | * | | * | * | * | | * | | * |
| *Chlorogonium fusiforme* MATV. | | | | | | | * | | | * | | |
| *Coccomonas eliptica* cf. CONRAD | | | | * | | | | * | | | | * |
| *Coccomonas* sp. | | | | | | | * | | | | | |
| *Eudorina elegans* EHRENB. | | * | * | * | | * | * | * | | * | | |
| *Gloeococcus schroeteri* (CHOD.) LEMM. | | | * | | | | | | | | | |
| *Gonium sociale* (DUJARD.) WARM. | | | | * | | | * | * | | * | | |
| *Pandorina morum* (O. F. MÜLLER) BORY | | | * | * | | * | * | * | | * | | |
| *Phacotus lenticularis* EHRENB. | | | | * | * | * | * | * | | * | | * |
| *Pteromonas aculeata* LEMM. | | | * | * | * | | * | * | | | | |
| *Pteromonas angulosa* LEMM. | | | | | * | | | | | | | |
| *Pteromonas cordiformis* LEMM. | | | | | | | * | | | | | |
| *Pteromonas golenkiniana* PASCH. | | | | | | | * | | | | | |
| *Pteromonas sp.* | | | | | | | | | | * | | |
| *Volvox aureus* EHRENB. | | | | | | | | | | | | * |
| ***CHLOROPHYTA - Chlorophyceae*** | | | | | | | | | | | | |
| *Actinastrum aciculare* (HUB.-PEST.) COMP. | | | | | | | * | | | * | | |
| *Actinastrum hantzschii* LAGERH. | | | | * | | * | * | * | | * | | |
| *Ankistrodesmus fusiformis* cf. CORDA | | | | * | | | * | | | | | |
| *Ankistrodesmus gracilis* (REINSCH) KORŠ. | | | | * | | | * | * | | | | |
| *Ankyra ancora* (G.M.SMITH) FOTT | | | | | | | | * | | * | | * |
| *Ankyra juday* (G. M. SMITH) FOTT | | | | * | | * | * | * | | | | * |
| *Ankyra lanceolata* (KORŠ.) FOTT | | | | | * | | | | | | | |
| *Botryococcus braunii* KÜTZ. | | | | | | | | | | * | | |
| *Catenococcus minutus* KOM. | | | | | * | | | | | | | |
| *Chlorella* sp. | | | | * | | * | * | * | | * | | * |
| *Closteriopsis longissima* var. *longissima* (LEMM.) LEMM. | | | | | * | | | | | | | |
| *Coelastrum astroideum* DE-NOTARIS | | | | * | | * | * | * | | | | |
| *Coelastrum microporum* NÄG. | * | | * | * | | * | * | * | | * | | |
| *Coelastrum pseudomicroporum* KORŠ. | | | | * | | | | | | | | |
| *Coenococcus planctonicus* KORŠ. | | | | | * | | | | | | | |
| *Crucigenia fenestrata* SCHMIDLE | | | * | | | | | | | | | |
| *Crucigenia quadrata* MORREN | | | | | * | | | | | * | | |
| *Crucigenia tetrapedia* (KIRCHN.) W. et G. S. WEST | | | | * | | * | * | * | | * | | |
| *Crucigeniella apiculata* (LEMM.) KOM. | | | | * | | * | * | | | | | |
| *Crucigeniella neglecta* (FOTT et ETTL) KOM. | | | | * | | * | * | * | * | | | |
| *Crucigeniella pulchra* (W. et G. S. WEST) KOM. | | | | * | | | * | | * | | | |
| *Crucigeniella rectangularis* (NÄG.) KOM. | | | | * | | | | | | | | |
| *Dictyosphaerium ehrenbergianum* NÄG. | | | | * | | * | | * | | | | |
| *Dictyosphaerium pulchellum* WOOD | | | | * | | | * | | * | | | |
| *Dictyosphaerium* sp. | | | | * | | | | | | | | |
| *Dictyosphaerium simplex* KORŠ. | | | | | * | | | | | | | |
| *Dictyosphaerium subsolitarium* VAN GOOR | | | | * | | | * | * | * | | | |
| *Didymocystis inconspicua* KORŠ. | | | | | | | | * | | * | | |
| *Didymocystis planctonica* KORŠ. | | | | * | | * | * | * | * | * | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| *Didymogenes anomala* (G. M. SMITH) HIND. | | | * | | | | | | | |
| *Elakatothrix genevensis* (REVERD.) HIND. | | * | | | * | * | | | | |
| *Elakatothrix* sp. | | * | | | | * | | | | |
| *Golenkinia radiata* CHOD. | * | * | | | * | | | * | | |
| *Golenkinia* sp. | | * | | | | | | | | |
| *Granulocystis helenae* cf. HIND. | | * | | | | | | * | | |
| *Granulocystopsis coronota* var. *coronata* (LEMM.) HIND. | | | | * | | | | | | |
| *Hyaloraphidium contortum* PASCH.et KORSH. | | | | | * | | | * | | |
| *Kirchneriella contorta* (SCHMIDLE) BOHL. | | * | | * | * | * | | | | |
| *Kirchneriella dianae* (BOHL.) COMAS | | * | | * | | * | | | | |
| *Kirchneriella irregularis* (G. M. SMITH) KORŠ. | | * | | * | | * | * | | | |
| *Kirchnerilla lunaris* (KIRCHN.) MOEB | | | * | | | | * | | | |
| *Kirchneriella obesa* (WEST) SCHMIDLE | | | | | | | * | | | |
| *Kirchneriella* sp. | | * | | * | * | * | | | | |
| *Koliella longiseta* (WISLOUCH) HIND. | | * | | * | * | * | * | * | | |
| *Koliella* sp. | | * | | | | * | | | | |
| *Koliella spiculiformis* (WISLOUCH) HIND. | | * | | | | * | | | | |
| *Korschikoviella limnetica* (LEMM.) SILVA | | * | | | * | | | | | * |
| *Lagerheimia balatonica* (SCHERFF. in KOL.) HIND. | | * | | | | | * | | | |
| *Lagerheimia ciliata* (LAGERH.) CHOD. | | * | | | | | * | | | |
| *Lagerheimia genevensis* CHOD. | * | * | | * | * | * | * | * | | |
| *Lagerheimia longiseta* (LEMM.) PRINTZ | | * | | | | | * | | | |
| *Lagerheimia wratislaviensis* SCHROD. | | * | | | * | | | | | |
| *Micractinium pusillum* FRES. | * | | | | | | | * | | |
| *Monoraphidium arcuatum* (KORŠ.) HIND. | | * | | * | * | * | * | * | | |
| *Monoraphidium circinale* (NYG.) NYG. | | * | * | * | | * | | | | |
| *Monoraphidium contortum* (THUR.) KOM.-LEGN. | | * | | * | * | * | * | * | * | |
| *Monoraphidium griffithii* (BERKELEY) KOM.-LEGN. | | * | | * | * | * | * | * | * | |
| *Monoraphidium komarkovae* NYG. | | * | | | | | * | * | | |
| *Monoraphidium minutum* (NÄG.) KOM.-LEGN. | | * | | * | * | * | * | * | | |
| *Monoraphidium nanum* (ETTL) HIND. | | * | | | | * | | * | | |
| *Monoraphidium pusillum* (PRINTZ) KOM.-LEGN. | | * | | | * | | * | | | |
| *Monoraphidium tortile* (W. et G. S. WEST) KOM.-LEGN. | | * | | | * | * | * | | | |
| *Neodesmus danubialis* HIND. | | | * | | | | | | | |
| *Nephrochlamys rotunda* KORŠ. | | | | * | | | | * | | |
| *Nephrochlamys willeana* (PRINTZ) KORSCH | | | | | | | | * | | |
| *Oocystis lacustris* CHOD. | | * | | * | * | * | * | * | * | |
| *Oocystis marssonii* LEMM. | | * | | * | | * | * | * | | |
| *Oocystis parva* W. et G. S. WEST | | | | * | | | | * | | |
| *Oocystis solitaria* WITTR. | | * | | | | | | | | |
| *Oocystis* sp. | | * | | | | | | | | |
| *Pediastrum boryanum* (TURP.) MENEGH. | | * | | * | * | * | * | * | * | |
| *Pediastrum duplex* MEYEN | | * | | * | * | * | * | * | * | |
| *Pediastrum simplex* MEYEN | | * | | | | | * | * | | |
| *Pediastrum simplex* var. *sturmii* (REINSCH) WOLLE | | * | | | * | * | * | | | |
| *Pediastrum tetras* (EHRENB.) RALFS | * | * | | | * | * | * | * | | |
| *Planctonema lauterbornii* SCHMIDLE | | * | | | | | | | | * |
| *Planktosphaeria gelatinosa* cf. G. M. SMITH | | * | | | | * | | | | |
| *Scenedesmus aculeolatus* REINSCH | | * | | | | | | | | |
| *Scenedesmus acuminatus* (LAGERH.) CHOD. | * | * | | * | * | * | * | * | * | |
| *Scenedesmus acutus* (MEYEN) | | * | | | | * | * | | | |
| *Scenedesmus bicaudatus* (HANSG.) CHOD. | | * | | * | * | * | * | * | * | |
| *Scenedesmus denticulatus* LAGERH. | | * | | * | | | | | | |
| *Scenedesmus dimorphus* (TURP.) KÜTZ. | | | | | * | | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| *Scenedesmus disciformis* (CHOD.) FOTT et KOM. | | | * | | * | * | | * | | |
| *Scenedesmus linearis* KOM. | | | * | | | * | * | * | * | * |
| *Scenedesmus nanus* CHOD. | | | * | | | | | * | | |
| *Scenedesmus obliquus* (TURP.) KÜTZ. | | | * | | * | | | * | * | |
| *Scenedesmus opoliensis* RICHTER | | | * | | * | * | * | | * | * |
| *Scenedesmus ovalternus* CHOD. | | | | * | | | | | | |
| *Scenedesmus pannonicus* HORTOB. | | | * | | | * | * | * | | |
| *Scenedesmus quadricauda* (TURP.) BRÉB. | | | * | | * | * | * | * | * | * |
| *Scenedesmus sempervirens* CHOD. | | | * | | * | * | * | * | * | * |
| *Scenedesmus smithii* TEIL. | | | * | | | | | | | |
| *Scenedesmus* sp. | | | | | | | | | * | |
| *Scenedesmus subspicatus* CHOD. | | | * | | | * | * | * | | |
| *Schroederia robusta* KORŠ. | | | * | | * | | * | * | * | |
| *Schroederia setigera* (SCHRÖD.) LEMM. | | | * | | * | * | * | * | * | * |
| *Schroederia spiralis* (PRINTZ) KORŠ. | | | * | | | * | * | | | |
| *Selenastrum capricornutum* PRINTZ | | | * | | | * | | * | | |
| *Stichococcus contortus* (CHOD.) HIND. | | | * | | | | * | | | |
| *Stichococcus* sp. | | | * | | | | * | | | |
| *Tetrachlorella alternans* (G. M. SMITH) KORŠ. | | | | * | | | | | | |
| *Tetraedron arthrodesmiforme* (W. WEST) WOLOSZ. | | | * | | | * | | | | |
| *Tetraedron caudatum* (CORDA) HANSG. | | | * | | * | * | * | * | * | |
| *Tetraedron incus* (TEIL.) G. M. SMITH | | | * | | | | | * | | |
| *Tetraedron limneticum* BORGE | | * | | | * | | | | | |
| *Tetraedron minimum* (A. BR.) HANSG | | | * | | * | * | * | * | * | |
| *Tetraedron platyisthmum* (ARCH.) G. S. WEST | | | * | | * | | | | * | |
| *Tetraedron quadratum* (REINSCH) HANSG. | | | * | | * | | * | * | | |
| *Tetraedron trigonum* (NÄG.) HANSG. | | | * | | | | | * | | |
| *Tetranephris europaea* (HIND.) KOM. | | | | | * | | | | | |
| *Tetrastrum elegans* PLAYF. | | | * | | * | | * | * | * | |
| *Tetrastrum glabrum* (ROLL) AHLSTR. | | | * | | * | * | * | * | * | * |
| *Tetrastrum punctatum* (SCHMIDLE.) AHLSTR. | | | * | | | * | * | | * | |
| *Tetrastrum staurogeniaforme* (SCHROD.) LEMM. | | | * | | * | * | * | | * | |
| *Tetrastrum triangulare* (CHOD.) KOM. | | | * | | | * | * | * | | |
| *Treubaria schmidlei* SCHRÖD. | | | * | | | | | * | | |
| *Treubaria setigera* (RACH.) G. M. SMITH | | | * | | | | | * | | |
| *Westella botryoides* (W. WEST) DE WILD | | | * | | * | | | | | |
| | | | | | | | | | | |
| ***CHLOROPHYTA - Zygnematophyceae*** | | | | | | | | | | |
| *Closterium acutum* BRÉB. | | | * | | | | | | | |
| *Closterium limneticum* LEMM. | | | * | | | * | * | * | * | |
| *Closterium* sp. | | | * | | | | | * | | * |
| *Cosmarium granatum* BRÉB. | * | | | | | | | | | |
| *Cosmarium portianum* ARCH. | * | | | | | | | | | |
| *Cosmarium protractum* (NÄG.) DE BY | * | | | | | | | | | |
| *Cosmarium punctulatum* BRÉB. | * | | | | | | | | | |
| *Cosmarium reniforme* (RALFS) ARCH. | * | | | | | | | | | |
| *Cosmarium turpinii* var. *podolicum* GUTW. | * | | | | | | | | | |
| *Cosmarium* sp. | | | * | | | * | * | * | | |
| *Euastrum* sp. | | | * | | | | | * | | |
| *Mougeotia genuflexa* (DILLW.) AG. | * | | | | | | | | | |
| *Spirogyra sp.* | | | | | | | | | | * |
| *Staurastrum pingue* TEILING | | | | | | | | | * | |
| *Staurastrum* sp. | | | * | | | * | * | * | | |

## Conclusion

During approximately the last 10 years, the composition of the phytoplankton communities of the Zámecký Pond at Lednice has been observed in greater detail due to the increased interest from the point of the nature conservation. It will be interesting to observe the development of cyanophyte and algae communities in the following years as well, in particular in relation to the amount of stocked fish. So far, the development of the community in the year 2005 resembles that of the previous year, but the transparency of water decreased, and the abundance of phytoplankton is already higher than in 2004. In spring 2005 endangered halophil green alga *Enteromorpha,* recorded from this region, occurred in the pond in higher abundance.

The new maintenance plan for the years 2006-2013 includes limited fishery and possible stocking with herbivorous grass carp (*Ctenopharyngodon idella*) to eliminate the excessively multiplied aquatic macrophytes, particularly *Lemna* species.

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