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# WATER QUALITY AND PHYTOPLANKTON COMMUNITIES IN NEWLY CREATED FISHPONDS

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## Abstract

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During the growing season of the year 2012 and 2013 (April–November) hydrobiological and hydrochemical monitoring of newly created fishponds inhered in Northern Moravia was carried out. Water temperature, dissolved oxygen content, pH, conductivity and water transparency were monitored directly at the sampling place. At the same time, water samples for taxonomical identification of phytoplankton were taken. Chemical parameters stabilization occurred in the second year after flooding.
Chemism of fishponds was influenced by higher ration of organic matter in fishponds sediment and by fertilizing and liming. Water saturation by dissolved oxygen, pH, transparency and chlorophyll–a values fluctuated in the wide range due the growth of planktonic communities and composition of the fish stock. Hydrochemical parameters stabilized in the second year after the first flooding. The phytoplanktonic community of fishponds during the much of the growing season was formed by the representatives of green algae. Golden–brown algae were dominant during the spring season, in some cases euglenas as well. Diatoms were present in fishponds from spring to autumn but only to limited degree. The cyanobacteria formed only minor part of phytoplanktonic community, except the fishpond P1 where they formed dominant group.

Keywords: hydrochemistry, green algae, diatoms, fish stock, cyanobacteria

## INTRODUCTION

Fishponds represent the most common type of standing water habitat in the Czech Republic and play important role in the hydrological system. Fishponds are generally man–made shallow water bodies where water level, fish stock and to some extent also nutrient and fish–food inputs are under the human control (Fott *et al.*, 1980). Owing to different hydrological characteristics as a low depth, these water bodies usually do not experience seasonal temperature-induced water column stratification and thus lack thermocline. These habitats are more under the influence of the weather and various anthropogenic factors in their immediate surroundings (Rettig *et al.*, 2006). It has been confirmed that small artificial ponds, made for a variety of reasons from ornamental and recreational to those of more economic value as aquaculture or irrigation fishponds, contribute a great deal to the regional freshwater biodiversity. The creations of new fishponds are proposed as potential sources for enhancement of local biodiversity particularly in impoverished environments (Williams *et al.*, 1997). Nevertheless, high biodiversity value of small fishponds is under constant threat from a variety of anthropogenic influences, namely eutrophication.

Phytoplankton plays many important ecological roles in aquatic ecosystems and affects human affairs in many ways. Planktonic algae are the primary producers of aquatic ecosystems and form the base of aquatic food webs that supports the zooplankton and fish (Graham *et al.*, 2009; Rahman, 2015). Phytoplankton live in fluctuating environment where many factors such as grazing pressure, sinking, light availability, nutrient uptake and nutrient turnover influence the distribution of phytoplankton in time and space (Crumpton and Wetzel, 1982; Costa *et al.*, 2014). An important regulatory role in the control of the biomass and species composition of the algal assemblage is affected by their consumers, i.e. zooplankton and fish stock density (Komárková, 1998; Masojídek *et al.*, 2001; Sipaúba–Tavares *et al.*, 2011).

Carbon, nitrogen, phosphorus, sulphur and silicon are considered major nutrient elements and may be limiting for phytoplankton growth. The sources of nutrients originate partly from fertilization of fishponds, through additional feeding of fish with corn and granulated food, and by run-off from agricultural land. Every fishpond has a rich nutrient pool in its bottom sediments (Graham *et al.*, 2009; Theisseir *et al.*, 2012). Fish farming practices had an important impact on both the structure and dynamics of the aquatic ecosystem. Management of higher fish stock densities accompanied by higher nutrient loads result in increasing trophic status, ultimately reaching a state of hypertrophy in fishponds. The main symptoms of this state across the world are the massive development of phytoplankton and cyanobacterial blooms, high fluctuations in oxygen concentrations and pH, and high values of ammonia nitrogen destabilizing the fishpond ecosystem (Komárková, 1998; Pechar, 2000; Potužák *et al.*, 2007; Costa *et al.*, 2014; Sipaúba–Tavares *et al.*, 2014).

The aim of this study was to investigate the development of major groups of phytoplankton and water quality in six small artificial fishponds newly built for fish rearing.

## MATERIAL AND METHODS

### Study Area and Sampling Sites

Monitored fishponds are typical small, shallow ponds for breeding the fish situated in North Moravia (mean depth around 1.4 m, bottom containing soft sediment). Data about ponds area, volume and depth are presented in the Tab. I.

### Fishery Management in Study Fishponds

The fish stock in P1 fishpond was formed by 300 kg of stone moroko (*Pseudorasbora parva*) and 200 pcs of common eel fingerlings (*Anguilla anguilla*) in 2012. During the year 2012, limestone was applied (75 kg) and the fishpond was fished at the end of the year. In 2013 the fish stock was formed by 40 kg of stone moroko and 200 pcs of largemouth bass (*Micropterus salmoides*). The fishpond was fished in September, than limed by burn lime (50 kg) and kept 10 days dry. Subsequently, it was flooded and stocked by 120 kg of stone moroko and 3000 pcs of pike perch yearling (*Sander lucioperca*).

The fishpond P2 was fertilized by manure (200 kg) after the flooding in 2011. The fish stock was formed by 20 pcs of broodstock tench (*Tinca tinca*), 22 pcs of broodstock pike perch and fodder fish (70 kg) in 2012. During this year the fishpond was fertilized by manure (300 kg), limed by limestone (75 kg) and fished at the end of the year. The fish stock was formed by 80 pcs of broodstock tench, 41 pcs of broodstock pike perch and fodder fish (40 kg) in 2013. During this year, the fishpond was fertilized by manure (300 kg).

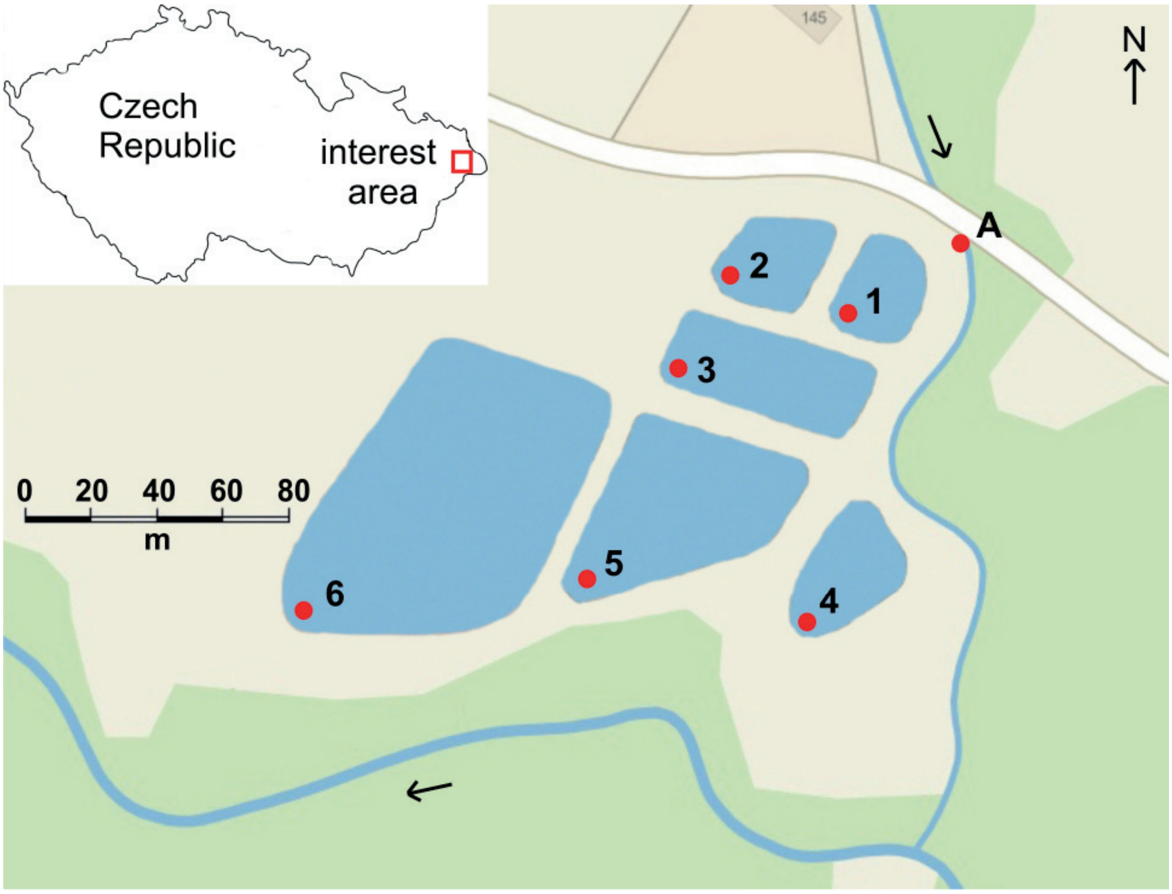
The fishpond P3 was flooded in the autumn 2011, fertilized by manure (300 kg) and stocked by 21 pcs of broodstock tench, 12 pcs of broodstock pike perch and fodder fish (20 kg). It was fished in April 2012, flooded again after 12 days and stocked by 1600 pcs of stocking tench, 190 pcs of largemouth bass and 20 kg of stone moroko. The fishpond was fertilized by manure (500 kg) during the year. It was fished at the beginning of October, then limed by burn lime (75 kg) and wintered till April 2013. 40 pcs of broodstock tench and 2 nests with pike perch eggs were stocked in April 2013. Stone moroko (20–30 kg) was stocked into the fishpond during the summer. The fishpond was fished in October.

The fishpond P4 was fertilized by manure (200 kg) after flooding in 2011. The fish stock was formed by 10 pcs of broodstock and 10 pcs of stocking largemouth bass, 47 pcs of broodstock tench and 200 pcs of pike perch yearling in 2012. The fishpond was fertilized by manure (300 kg), limed by limestone (50 kg) during the year. It was fished at the end of the year. The fish stock in 2013 was formed by 22 pcs of broodstock tench and 1 nest with pike perch eggs. Stone moroko (20kg) was stocked during the summer. The fishpond was fished in October.

The fishpond P5 was stocked by 24 pcs of broodstock tench after flooding in October 2011. 2000 pcs of pike perch fry was stocked in 2012. The fishpond was fertilized by manure (500 kg) and limed by limestone (75 kg) during the year. Stone moroko (20 kg) was stocked during the summer. The fishpond was fished at the end of the year and

I: *Habitat description of the monitored fishponds*

| Fishpond | Fishpond area (ha) | Volume ($m^3$) | Mean depth (m) | Max depth (m) | First flooding |
|---|---|---|---|---|---|
| P1 | 0.09 | 1302 | 1.4 | 1.8 | September 2011 |
| P2 | 0.10 | 1330 | 1.4 | 1.8 | September 2011 |
| P3 | 0.16 | 2400 | 1.5 | 1.9 | October 2011 |
| P4 | 0.10 | 1372 | 1.4 | 1.7 | September 2011 |
| P5 | 0.28 | 3920 | 1.4 | 1.9 | October 2011 |
| P6 | 0.50 | 7000 | 1.4 | 2.2 | October 2012 |




1: *Map of sampling localities (1–6) – fishponds, (A) – water inflow*

left drained during the winter. Burn lime (50 kg) was applied on fishing ground in February 2013. The fishpond was flooded at the beginning of March. The fish stock was formed by 50 kg stocking tench and 2 nests with pike perch eggs. The fishpond was fertilized by manure (500 kg) during the year and stocked by stone moroko (20 kg). It was fished in October.

The fishpond P6 was stocked by 300 kg of stone moroko, 69 pcs of broodstock tench, 250 pcs of largemouth bass, 2 pcs of marketable common carp (*Cyprinus carpio*) and 180 pcs of pike perch yearling after flooding at the end of 2012. 410 kg of marketable tench, 370 pcs of pike perch yearling and 20 kg of white fish were additionally stocked during the year 2013. Manure (200 kg), limestone (125 kg) and burn lime (50 kg) were applied during the year.

### Phytoplankton Sampling and Analyses

Water samples were taken from the outlet area of fishponds. Phytoplankton samples were taken into 100ml plastic bottles by the plankton net (20 µm) sampler. Water sampling of fishponds was realized from April to October 2012 and from April to November 2013 (Fig. 1).

The samples in plastic test tubes (capacity 50–100 ml) were stored in the cooling box until identification. Identification and quantification were performed in native samples and remainder was fixed in formaldehyde (4%) for later check–up. If necessary, samples were concentrated by filtration equipment by Marvan (Marvan, 1957). Cyanobacteria and algae cells were quantified with Bürker counting chamber under the microscope Olympus BX51 and subsequently identified to the species level and expressed by scale (Sládečková and Marvan, 1978).

### Water Quality Sampling and Analyses

Water samples for chemical analyses were taken into plastic bottles from the depth of 0–35 cm. 1000 ml of the water sample was kept at 4 °C until the transportation to the laboratory where the chemical analyses of water were carried out. Water oxygen saturation, temperature, pH, conductivity and water transparency were measured immediately in the locality. Basic physico–chemical parameters (oxygen saturation of water, pH and temperature) were measured by HACH HQ40d (Hach Lange, USA). Conductivity was measured by conductivity meter Hanna Combo HI98130. The transparency of water was assessed using a Secchi disc. Ammonium ions ($N\text{–}NH_4$) were determined by the indophenols method, nitrite nitrogen ($N\text{–}NO_2$) by the method using N– (1–naphthyl) –ethylenediamine, nitrate nitrogen ($N\text{–}NO_3$) by the method using sodium salicylate, total nitrogen ($N_T$) was assessed with dimethylphenol after transformation of all nitrogen compounds into nitrate by Koroleff's method, total phosphorus ($P_T$) and orthophosphate ($P–PO_4$) by a method using ascorbic acid and ammonium molybdenate, chemical oxygen demand ($COD_{Cr}$) by the method using potassium dichromate and acid neutralization capacity (ANC) was assessed by a method using hydrochloric acid (APHA, 1998). Cyanobacterial and algal biomass were evaluated by chlorophyll–*a* concentrations using a heated ethanol extraction (Lorenzen, 1967).

## RESULTS

Values of physical and chemical parameters are presented in Tabs. II and III. In the first year after flooding, chemism of fishponds was influenced by the high level of organic matter in fishpond sediments supported by application of manure. The water saturation by dissolved oxygen was fluctuating in the wide range due the growth of plankton communities. Water transparency was strongly influenced by the fish stock where the transparency increased with the increasing proportion of carnivorous fish and decreasing proportion of stone moroko. High values of chlorophyll–*a* were established in the fishponds stocked by zooplanktonophagous fish (P1–P4). These values strongly fluctuated during the growing season due the growth of plankton communities (Fig. 2). In the second growing season after first flooding, chemism of fishponds has stabilized and the fluctuation of monitored parameters was lower than a year before. There was recorded a decrease of proportion of basic nutrients (N, P) in water, content of organic matters, as well as value of chlorophyll–*a* in the most of fishponds.

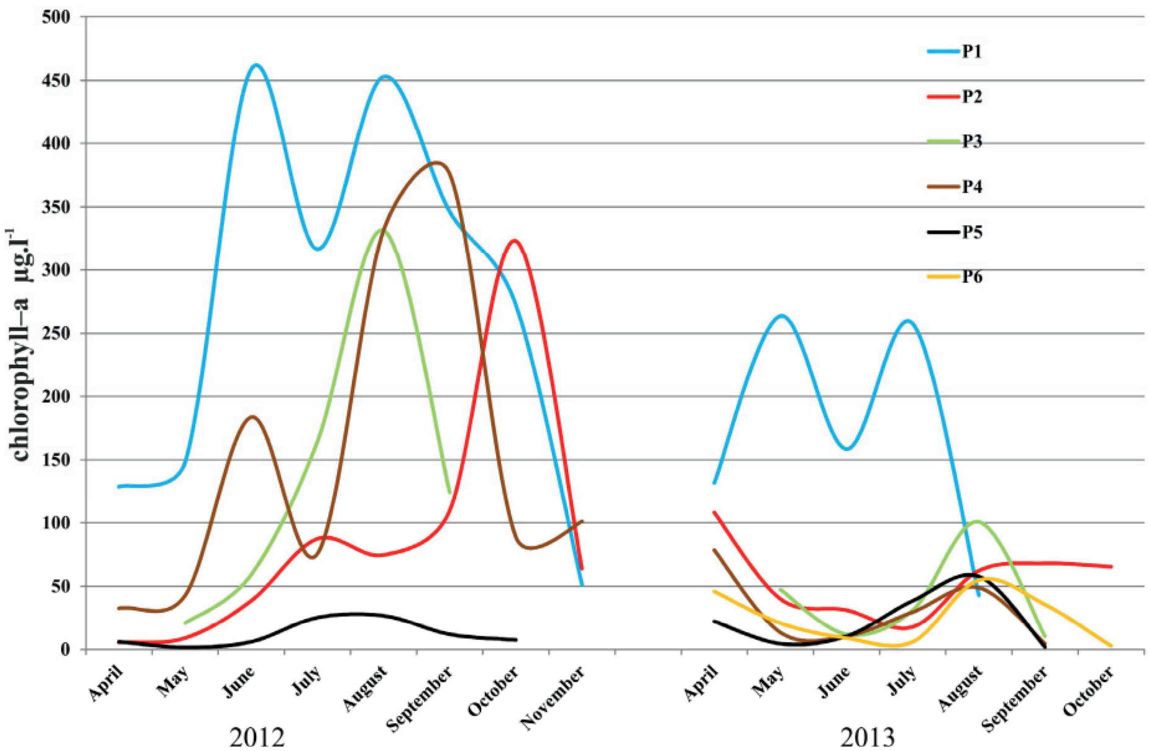
II: *The physical and chemical characteristics of the sites in the fishponds (P1–P6) and the water inflow (A) during the growing season (April–November, 2012) (Mean ± standard deviation)*

| Variables | Unit | P1 | P2 | P3 | P4 | P5 | P6* | A |
|---|---|---|---|---|---|---|---|---|
| Temperature | °C | 16.4 ± 5.7 | 16.8 ± 5.9 | 20.5 ± 3.5 | 16.7 ± 5.8 | 19.2 ± 5.0 | 6.9 | 14.7 ± 4.5 |
| $O_2$ saturation | % | 65 ± 26 | 94 ± 27 | 67 ± 18 | 103 ± 42 | 82 ± 24 | 90 | 85 ± 5 |
| pH | | 8.0 ± 0.3 | 8.3 ± 0.4 | 7.9 ± 0.3 | 8.5 ± 0.6 | 8.3 ± 0.3 | 9.2 | 8.4 ± 0.2 |
| Conductivity | mS m$^{-1}$ | 39.5 ± 5.1 | 42.4 ± 6.2 | 42.0 ± 5.1 | 40.2 ± 8.9 | 34.6 ± 1.8 | 37.1 | 50.3 ± 16.4 |
| Transparency | cm | 42 ± 16 | 73 ± 28 | 37 ± 9 | 60 ± 30 | 114 ± 45 | 90 | |
| $N-NH_4$ | mg l$^{-1}$ | 0.12 ± 0.18 | 0.05 ± 0.07 | 0.05 ± 0.08 | 0.14 ± 0.14 | 0.04 ± 0.04 | 0.03 | 0.05 ± 0.05 |
| $N-NO_2$ | mg l$^{-1}$ | 0.02 ± 0.02 | 0.01 ± 0.02 | > 0.01 | 0.01 ± 0.01 | > 0.01 | 0.01 | 0.03 ± 0.04 |
| $N-NO_3$ | mg l$^{-1}$ | 0.36 ± 0.26 | 0.57 ± 0.29 | 0.39 ± 0.20 | 0.47 ± 0.24 | 0.41 ± 0.25 | 0.26 | 0.69 ± 0.36 |
| $N_T$ | mg l$^{-1}$ | 3.0 ± 0.8 | 1.8 ± 0.7 | 2.3 ± 0.9 | 2.0 ± 0.6 | 1.4 ± 0.6 | 0.9 | 1.2 ± 0.4 |
| $P-PO_4$ | mg l$^{-1}$ | 0.05 ± 0.04 | 0.03 ± 0.03 | 0.03 ± 0.02 | 0.02 ± 0.02 | 0.02 ± 0.02 | > 0.01 | 0.04 ± 0.03 |
| $P_T$ | mg l$^{-1}$ | 0.31 ± 0.09 | 0.17 ± 0.09 | 0.24 ± 0.11 | 0.20 ± 0.11 | 0.10 ± 0.03 | 0.07 | 0.10 ± 0.02 |
| ANC | mmol l$^{-1}$ | 3.40 ± 0.56 | 3.79 ± 0.60 | 3.70 ± 0.35 | 3.87 ± 0.78 | 2.84 ± 0.42 | 3.15 | 5.44 ± 0.55 |
| $COD_{Cr}$ | mg l$^{-1}$ | 64 ± 23 | 31 ± 15 | 47 ± 22 | 37 ± 13 | 30 ± 9 | 22 | 20 ± 13 |

*Pond P6 was sampled only in November

III: *The physical and chemical characteristics of the sites in the fishponds (P1–P6) and the water inflow (A) during the growing season (April–October, 2013) (Mean ± standard deviation)*

| Variables | Unit | P1 | P2 | P3 | P4 | P5 | P6 | A |
|---|---|---|---|---|---|---|---|---|
| Temperature | °C | 18.0 ± 4.4 | 17.1 ± 3.6 | 20.3 ± 3.4 | 19.0 ± 4.5 | 20.1 ± 3.6 | 19.4 ± 5.0 | 19.0 ± 3.1 |
| $O_2$ saturation | % | 142 ± 35 | 101 ± 41 | 80 ± 21 | 90 ± 36 | 104 ± 43 | 125 ± 38 | 107 ± 10 |
| pH | | 8.4 ± 0.4 | 8.4 ± 0.4 | 8.3 ± 0.4 | 8.4 ± 0.5 | 8.6 ± 0.4 | 8.9 ± 0.3 | 8.5 ± 0.4 |
| Conductivity | mS m$^{-1}$ | 34.4 ± 6.8 | 46.1 ± 4.7 | 37.8 ± 3.1 | 35.2 ± 6.3 | 28.0 ± 5.7 | 28.1 ± 2.2 | 34.9 ± 3.2 |
| Transparency | cm | 52 ± 12 | 75 ± 19 | 94 ± 39 | 111 ± 38 | 117 ± 43 | 96 ± 38 | |
| $N-NH_4$ | mg l$^{-1}$ | 0.04 ± 0.04 | 0.09 ± 0.10 | 0.11 ± 0.06 | 0.14 ± 0.15 | 0.05 ± 0.07 | 0.01 ± 0.01 | 0.07 ± 0.13 |
| $N-NO_2$ | mg l$^{-1}$ | > 0.01 | 0.02 ± 0.01 | 0.01 ± 0.01 | 0.01 ± 0.01 | > 0.01 | > 0.01 | 0.01 ± 0.01 |
| $N-NO_3$ | mg l$^{-1}$ | 0.37 ± 0.2 | 0.69 ± 0.4 | 0.43 ± 0.1 | 0.33 ± 0.3 | 0.50 ± 0.2 | 0.27 ± 0.2 | 0.43 ± 0.5 |
| $N_T$ | mg l$^{-1}$ | 2.6 ± 0.6 | 1.9 ± 0.9 | 1.3 ± 0.3 | 1.2 ± 0.4 | 1.1 ± 0.3 | 1.3 ± 0.9 | 1.6 ± 0.6 |
| $P-PO_4$ | mg l$^{-1}$ | 0.01 ± 0.02 | 0.02 ± 0.01 | 0.04 ± 0.03 | 0.02 ± 0.02 | 0.02 ± 0.02 | 0.01 ± 0.01 | 0.02 ± 0.01 |
| $P_T$ | mg l$^{-1}$ | 0.27 ± 0.16 | 0.10 ± 0.03 | 0.13 ± 0.03 | 0.09 ± 0.02 | 0.06 ± 0.03 | 0.07 ± 0.02 | 0.12 ± 0.04 |
| ANC | mmol l$^{-1}$ | 2.84 ± 0.74 | 3.88 ± 0.66 | 3.30 ± 0.32 | 2.69 ± 0.50 | 1.97 ± 0.15 | 2.51 ± 0.68 | 2.87 ± 0.50 |
| $COD_{Cr}$ | mg l$^{-1}$ | 45 ± 13 | 21 ± 6 | 26 ± 7 | 26 ± 5 | 32 ± 11 | 24 ± 5 | 29 ± 5 |



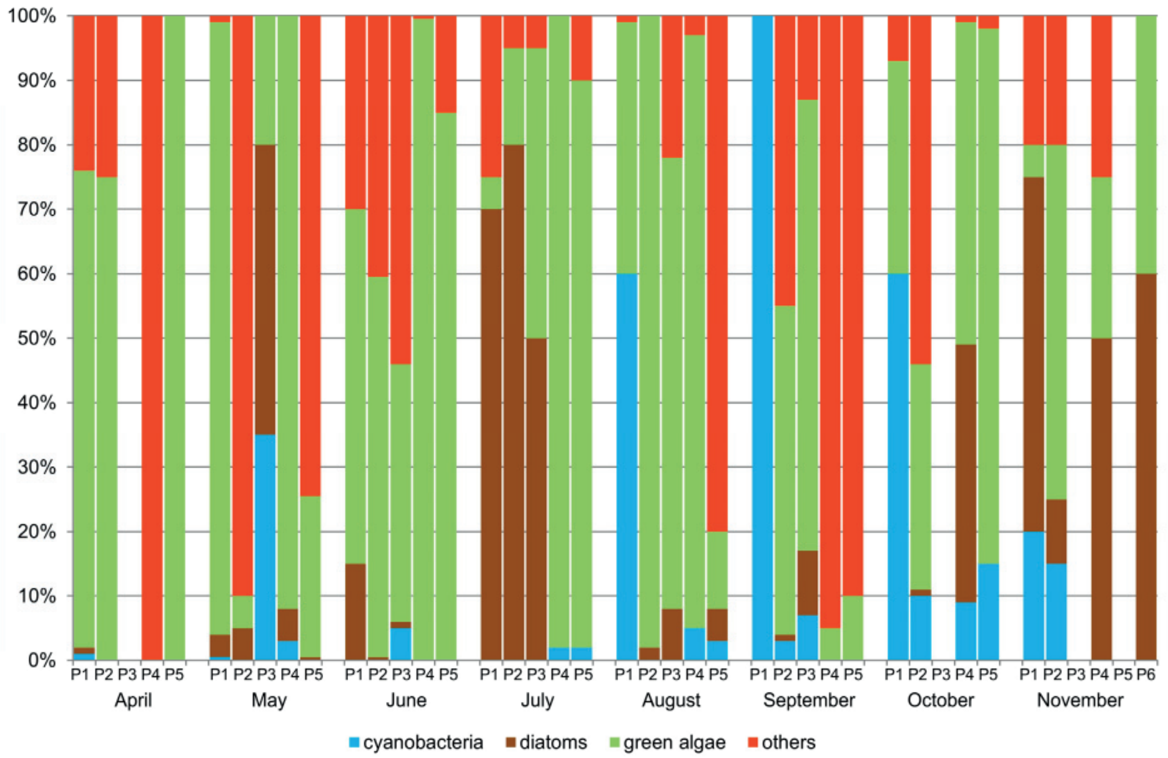

2: *Variation values of chlorophyll–a in growing season from April to November 2012 and April to October 2013*

The composition of phytoplankton in monitored fishponds was changing very quickly (Figs. 2 and 3). Representatives of green algae and golden-brown algae were dominant in April 2012. Namely *Koliella variabilis* and *Dinobryon* species representatives in fishpond P1, *Chlamydomonas* and *Euglena* species representatives in fishpond P2, *Dinobryon sociale* and *D. divergens* in fishpond P4 and *Planktosphaeria gelatinosa* in fishpond P5. Fishpond P3 was drained in this month.

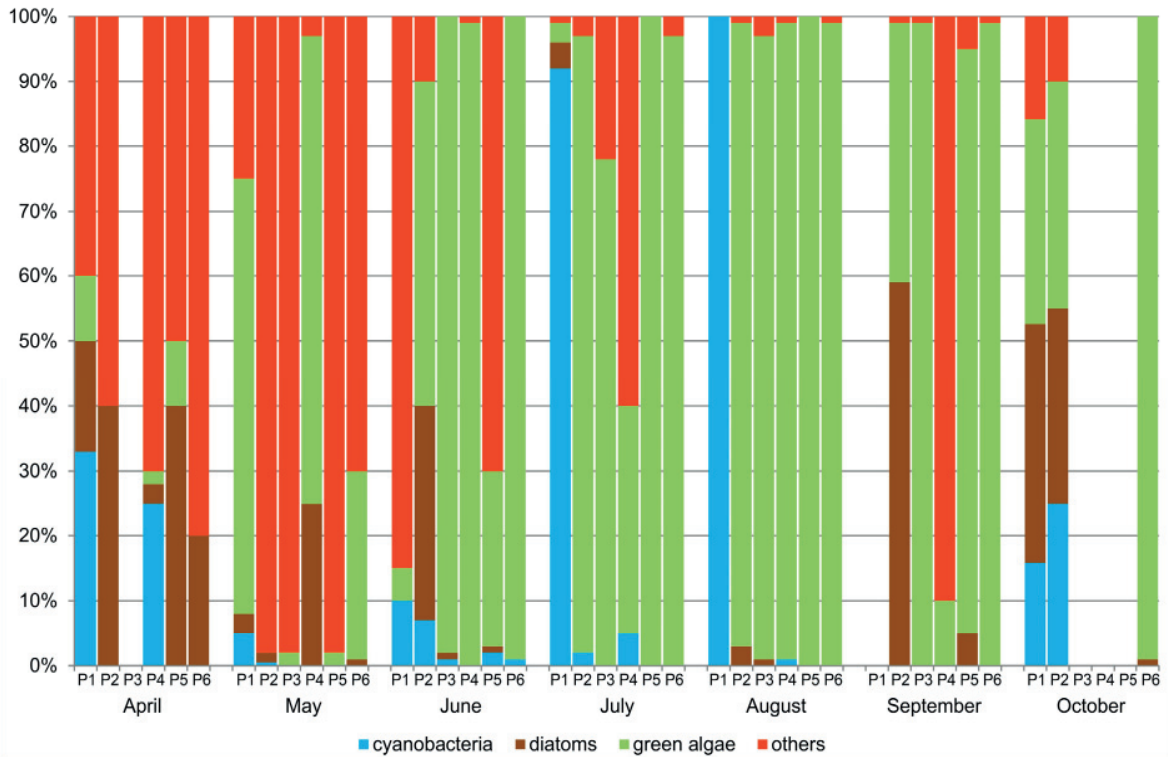
During May 2012 there was green coccal alga *Planktosphaeria gelatinosa* dominant in fishpond P1, green algae species *Pediastrum* and macroskopic filamentous algae species *Spirogyra* and *Mougeotia* in fishpond P4. The phytoplankton of newly flooded fishpond P3 was mostly formed by representatives of diatoms, cyanobacteria and green algae. Due the higher predation pressure of zooplankton, there was higher water transparency in fishponds P2 and P5 in May. Also dominant phytoplankton representatives were released epizoon individuals of *Colacium* species. Dominant phytoplankton organisms in all monitored fishponds in June were representatives of green algae (genera *Pediastrum*, *Planktosphaeria* and *Chlamydomonas*) together with euglenas species (genera *Colacium* and *Euglena*). In July, there were dominant diatoms in fishponds P1, P2 and P3 (genera *Synedra* and *Nitzschia*), abundantly present were euglenas and green algae species *Pediastrum*. In fishponds P4 and P5 were obviously dominant representatives of common species of green algae (*Coelastrum*, *Closterium*, *Pediastrum*). In August, there were filamentous planktonic cyanobacterium *Planktothrix aghardii* and coccal green algae species *Chlamydomonas* predominant in fishpond P1, green algae (mainly *Chlamydomonas* and *Eudorina* species) were dominant in fishponds P2, P3 and P4 and euglenas species *Colacium* was dominant in fishpond P5. In September, there was entirely dominant cyanobacterium *Planktothrix aghardii* in fishpond P1, mostly green algae (genus *Chlorella* and species *Pandorina morum*) with euglenas were present in phytoplankton of fishponds P2 and P3. Also coenobial golden-brown alga *Synura* was present in fishpond P2. There were dominant euglenas in fishponds P4 and P5, namely tiny *Euglenaria anabaena* in P4 and genus *Colacium* in P5.

In October, there were dominant filamentous planktonic cyanobacterium *Planktothrix aghardii* and coenobial green alga *Pandorina morum* in fishpond P1. Gold algae (genera *Synura* and *Mallomonas*) and green alga *Eudorina elegans* were dominant in fishpond P2, diatoms (genera *Stephanodiscus* and *Nitzschia*) in high abundance and common species of green algae (genera *Desmodesmus* and *Scenedesmus*) were present in fishpond P4, green alga *Eudorina elegans* dominated in fishpond P5. Fishpond P3 was already drained in this month. In November, the abundance of cyanobacteria and green algae decreased and presence of diatoms increased. Mainly genera *Nitzschia* and *Synedra* were present in all the fishponds. Flagellates of genus *Chlamydomonas* were the most abundant green algae species.

During April 2013 significant part of phytoplankton biomass was formed by golden-brown alga species *Dinobryon*. Genus *Euglena* and




3: *Abundance of main cyanobacteria and algae groups present in fishponds (percentage values) in growing season from April to November 2012*




4: *Abundance of main cyanobacteria and algae groups monitored in fishponds (percentage values) in growing season from April to October 2013*

cyanobacteria *Planktothrix aghardii* were dominant representatives in fishpond P1. The significant part of phytoplankton was created by diatoms *Synedra acus* and *Asterionella formosa* in fishpond P2.

Cyanobacteria genus *Aphanizomenon* was dominant in fishpond P4. Diatoms genus *Nitzsichia* and species *Synedra acus* were subdominant in fishponds P5 and P6. In May, there were dominant green algae in fishpond P1 (*Actinastrum hantzschii*, *Dictyosphaerium pulchellum*, *Eudorina elegans*) and in fishpond P4 (*Pandorina morum*). Gold algae genus *Dinobryon* was total dominant in fishponds P2 and P3. Euglena genus *Colacium* was dominant in fishponds P5 and P6. In June, green algae became dominant group in the most of fishponds. Except the green algae (*Planktosphaeria gelatinosa*, genus *Pediastrum*), also diatom genera *Navicula* and *Nitzschia* were large group in fishpond P2. The green alga *Planktosphaeria gelatinosa* was the main dominant in fishponds P3, P4 and P6. Gold alga genus *Dinobryon* was dominant in fishponds P1 and P5.

In July, there was filamentous cyanobacterium *Planktothrix agardhii* dominant in fishpond P1. Euglena genus *Colacium* was dominant in phytoplankton in fishpond P3. This genus was also dominant in fishpond P4. In other fishponds, there were predominant green algae genera *Pediastrum* (P3, P4), *Coenocystis* (P5, P6) and *Planktosphaeria gelatinosa* (P2, P3, P6). In August, filamentous cyanobacterium *Planktothrix agardhii* was still dominant in fishpond P1. In the other fishponds there were decidedly dominant green algae genera *Coelastrum* (P2, P3), *Chlamydomonas* (P5), *Closterium* (P6) and *Planktosphaeria gelatinosa* (P2, P3, P4). In September, the fishpond P1 was drained. There were predominant diatoms (genus *Aulacoseira*) and green alga *Closterium limneticum* in fishpond P2. Euglena genus *Colacium* was dominant in fishpond P4. In the other fishponds (P3, P5, P6) there was green alga *Planktosphaeria gelatinosa* dominant. In October, green alga *Planktosphaeria gelatinosa* was still dominant in fishpond P6. The abundance of green algae deceased in fishponds P1 and P2, also diatoms (mainly *Nitzschia acicularis*), cryptophyta (genus *Cryptomonas)*, cyanobacterium *Planktothrix agardhii* (P1) and genus *Oscillatoria* (P2) released from the benthos. The other fishponds were already drained.

## DISCUSSION

The physicochemical parameters of monitored fishponds were fluctuating in the wide range largely during the first year after the flooding. High values of organic matter content ($COD_{Cr}$) exceeded norms of environmental quality in accordance with the Order of the government No. 61/2003 of legal code in all of the fishponds. Comparing to fishpond P5 with higher stocking density of planktonivorous fish, values of chlorophyll–*a* were very high in fishponds P1–P4. The value of water transparency was fluctuating due the growth of planktonic communities during the year. In the second year after flooding, decreasing of nutrient content, content of organic matter and chlorophyll–*a* values occurred in all fishponds. Mean values of water transparency and dissolved oxygen content increased. Exhausting of freely available nutrients from newly flooded areas and progressive mineralisation of sediment resulted in overall stabilization of physicochemical conditions in fishponds. Also the fishing management had an influence on the fluctuation of physicochemical parameters.

Phytoplanktonic community in fishponds was considerably variable, which corresponds with frequent changes in living conditions due the human activity and weather fluctuations (Rosenzweig and Buikema, 1994; Poulíčková, 2011). In accordance with Fott *et al*. (1974) development of phytoplankton during the growing season occurred in several stages (spring maximum, depression, development of water bloom, chlorococcal maximum). This trend is described in fishponds with low stocking density of fish. In fishponds with higher stocking density of fish is higher percentage of single celled algae (Komárková *et al*., 1986). Cyanobacteria became usually dominant part of phytoplankton for all summer. Because of their size, content of biological substances and changes of basic hydrochemical parameters, cyanobacteria are limiting for zooplankton and natural fish production (Sevrin–Reyssac and Pletikosic, 1990; Potužák *et al*., 2007). Except in fishpond P1, cyanobacteria were minor group of phytoplankton in fishponds monitored by us. In comparison with the other fishponds, there were higher values of nutrients and high proportion of stone moroko in fish stock. This could be the reason for cyanobacteria growth. Higher phosphorus values and the fish stock of zooplanktonivorous fish increase the dominance of cyanobacteria in phytoplankton biomass (Watson *et al*., 1997; Pechar, 1995, 2000).

In general, the phytoplankton of eutrophic fishponds is characterized by high proportion of littoral species of green algae (genera *Scenedesmus*, *Pediastrum*). Dominance of golden-brown algae is typical for oligotrophic fishponds (Poulíčková, 2011). In spite of the fishery management (fertilization, liming) in fihsponds, dominance of gold algae in spring time was obvious in both years of monitoring. Representatives of green algae (genera *Scenedesmus* and *Pediastrum*) dominated only in summer season. Also cenobial flagellates (genera *Pandorina*, *Eudorina*) were dominant, as well as species with high proportion of slime (*Planktosphaeria gelatinosa*). Dominant presence of this algae species is typical for waters with zooplankton growth, its predation pressure is primarily focused on the unicellular and small species of algae (Graham *et al*., 2009; Pechar, 1995). Higher biomass of zooplankton in fishponds is supported by presence of epizootic species of genus *Colacium* and filamentous green algae genera *Spirogyra, Zygnema* and *Mougeotia*. Similar increase of phytoplankton containing species of clean water (golden–brown algae) and macroscopic filamentous algae is known in replenished revitalised fishponds after the removing sediments (Poulíčková, 2011).

The phytoplankton communities are highly diverse and the occurrence of most species is difficult to predict (Beninca *et al.*, 2008). There are many variously sophisticated systems for ecological classification of phytoplankton. More complex systems provide more relevant information but the phytoplankton identification expert is needed and it is not always easy to classify all of the found species (Reynolds *et al.*, 2002; Salmaso and Padisak, 2007; Mieleitner *et al.*, 2008). For classification of monitored fishponds was used simple system based on the thallus morphology „morphologically based functional groups" (MBFG) which classifies phytoplankton into 7 functional groups. All of the found species can be classified without any expert knowledge of taxonomical identification. Final sorting is admittedly coarse (Kruk *et al.*, 2010). Based on the MBFG classifying system, fishpond P1 was out of the other fishponds. Functional group III was predominant in both years of monitoring. This group includes planktonic filamentous cyanobacteria with aerotops. It is an euryphotic group which prefers higher trophy of the environment (Padisak and Reynolds, 1998). This was in the accordance with chemical parameters of the fishpond, when the highest values of chlorophyll-*a*, nutrients, organic matters were in fishpond P1. On the contrary, the lowest values of water transparency were measured in this fishpond as well.

The fishponds P2–P5 were similar from the functional groups dominance point of view. But there were differences between particular years of monitoring. In the first year (2012) of monitoring, functional groups IV (organisms of medium size lacking specialized traits) and V (unicellular flagellates from medium to large size) were predominant. These groups contain a spectrum from typically r–selected to K–selected types (Pianka, 1970). The group IV characterizes the environment with a lower nutrient content, higher zooplankton abundance and consequently higher water transparency. The representatives of functional group V tolerate lower nutrient content, worse light conditions and may give substantial tolerance to grazing by zooplankton (Reynolds, 1997; Reynolds *et al.*, 2002).

During the growing season 2013 functional group VII (large mucilaginous colonies) was predominant in fishponds P2–P6. Most organisms in this group are typically K-selected. Large size and volume and low surface-to-volume ratio, should tend to make species sensitive to low resource supply. Moreover, mucilage may help maintaining an adequate microenvironment for cells and avoidance of grazing (Reynolds, 1997). We would expect an increase of this group in high–trophic status waters with higher temperature (Kruk *et al.*, 2010).

There was quick succession of particular phytoplankton communities proceeding in all of the monitored fishponds. The significant impact on planktonic community had a water chemism due the first flooding and fishing management, mainly liming and fertilizing. Generic composition of phytoplankton in monitored fishponds can be characterised as typical for meso– to slightly eutrophic conditions. Standard development from initial presence of r–strategists consequently replaced by K–strategists can be recorded when evaluating the changes in phytoplanktonic community based on the living strategy.

## CONCLUSION

Chemism of fishponds was influenced by higher ration of organic matter in fishponds sediment and by fertilizing and liming. The water saturation by dissolved oxygen was fluctuating in the wide range due the growth of plankton communities. Water transparency was strongly influenced by the fish stock where the transparency increased with the increasing proportion of carnivorous fish and decreasing proportion of stone moroko. High values of chlorophyll–*a* were established in the fishponds stocked by zooplanktonophagous fish. In the second growing season after first flooding, chemism of fishponds has stabilized and the fluctuation of monitored parameters was lower than a year before. There was recorded a decrease of proportion of basic nutrients (N, P) in water, content of organic matters, as well as value of chlorophyll–*a* in the most of fishponds.

The phytoplanktonic community of fishponds during the much of the growing season was formed by the representatives of green algae. From community of green algae (genera *Scenedesmus* and *Pediastrum*) dominated only in summer season. Also cenobial flagellates (genera *Pandorina*, *Eudorina*) were dominant, as well as species with high proportion of slime (*Planktosphaeria gelatinosa*). Golden–brown algae (genus *Dinobryon*) were dominant during the spring season, in some cases euglenas (genus *Colacium*) as well. Diatoms were present in fishponds from spring to autumn but only to limited degree. The cyanobacteria formed only minor part of phytoplanktonic community, except the fishpond P1 where they formed dominant group (species *Planktothrix agardhii*).

Generic composition of phytoplankton in monitored fishponds can be characterised as typical for meso– to slightly eutrophic conditions. There was quick succession of particular phytoplankton communities proceeding in all of the monitored fishponds. The significant impact on planktonic community had a water chemism due the first flooding and fishing management, mainly liming and fertilizing.

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