

## PHYSICAL AND CHEMICAL CHARACTERISTICS OF WATER IN SELECTED SMALL GARDENS PONDS

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**Summary.** Research were conducted in three small garden ponds of decorative and breeding nature located on Lublin suburbs. Samples for examination were taken three times a year from April to October in 2013 and 2014. The aim of the study were to discover physical and chemical water characteristic in examined water reservoirs and to determine seasonal dynamics. It was shown that unreasonable way of water reservoirs use concerned with improper stock of fish causes growth of eutrophisation processes which are even more intensive with the increase of temperature.

**Key words:** small garden pond, physical and chemical factors of water, eutrophisation

### INTRODUCTION

Small water reservoirs lately became quite popular. They are least examined surface water reservoirs. They were thought as smaller as less valuable lakes equivalents. They are mostly located on forest or agricultural lands. They are also often artificial decorative elements in backyards. They are especially important landscape elements [Mioduszewski 1997, 2006, Pieńkowski 2003]. They were usually omitted in hydrobiology investigations and in nature preservation [Biggs *et al.* 2005]. However their role in biological diversity preservation and the function of habitat replacement especially for water-dependent migrating animals is significant in nature preservation [Kalbarczyk 2002, Ożgo 2010].

These water reservoirs because of way of usage and thermal conditions are in danger of intensified eutrophisation processes, which cause significant decrease of their naturalistic and decorative value [Solarski and Solarski 1994]. The scope of work was to analyze change of water physical and chemical characteristics and to determine the way of examined water bodies usage.

#### STUDY AREA, MATERIAL AND METHODS

Researches of selected physical and chemical water characteristics of water reservoirs were conducted in the spring, summer and autumn (June, August, October) in 2013 and 2014.

**Water reservoir I** was created by peat-digging from low moor peat meadow, supplied by ground water and rainwater. Reservoir dimensions are  $32 \times 6$  m with the depth of about 1m. Water reservoir is strongly silted up with parts of emergent and floating plants. Water is colored by humus compounds coming from peat and peat earth from near meadow. That meadow is under strong water level fluctuations connected with rainfalls. During low water level eutrophisation processes intensify in water reservoir.

**Water reservoir II** is decorative reservoir artificially build by the use of foil for water pound. Reservoir dimensions:  $8 \times 7$  m, depth about 1.5 m. Reservoir is supplied by water from water pipe. Plants of few, limited to single emergent macrophytes. Reservoir is strongly stocked with prussian carp. On the beginning of research this water reservoir was in quite good ecological condition – there were no intensive phytoplankton blooms.

**Water reservoir III** is decorative reservoir artificially build by the use of foil for water pound. Reservoir dimensions:  $9 \times 6$  m, depth about 1.2 m. Reservoir is supplied by water from water pipe. Plants of few, limited to single emergent and floating plants. Reservoir is strongly stocked with prussian carp. On the beginning of research this water reservoir was in quite good ecological condition.

The temperature, electrolytic conductivity, redox potential, water oxygenation (in % and mg/L) and reaction were measured by the use of multiparameters probe YSI. There was also visibility measured using Secchi disk. In the laboratory by the use of spectrophotometer Pastel UV were determined as follows: organic carbon content, total suspension, chemical and biochemical oxygen demand and surfactans presence. Total phosphorus was determined in non-filtrated water samples. In order to determine the rest of biogenic compounds water were dripped through glass fiber filters GF/C. Suspension collected in filters was gravimetrically determined. Phosphates were also determined. Biogenic compounds content was determined using colorimetric methods: total phosphorus and phosphates using method of molybdenum blue [PN-EN 1189]. Ammonium nitrogen were determined by the method of direct nesslerization

and nitrate nitrogen by the brucyne method. Content of chlorophyll *a* was also determined [Dojlido 1995, Hermanowicz *et al.* 1999].

## RESULTS AND DISCUSSION

Temperature in water reservoirs was changing typically for shallow reservoirs in annual cycle (Tab. 1). Those cycles characterize high temperatures, what increase primary production, made by phytoplankton in examined reservoirs. Slightly lower temperatures were noticed in reservoir I, because it was connected with ground water present in peat subsoil.

The highest conductivity values were determined in reservoirs supplied by pipe water rich in mineral salts (Tab. 1). In those reservoirs electrolytic conductivity was on high level ( $135\text{--}324\ \mu\text{S cm}^{-1}$ ) during the whole period of researches. In reservoir in Melgiew rapid increase of conductivity appeared in August what could also influence on subsequent phytoplankton bloom in that reservoir. It could be caused by influence of fertilization or drying meadows surrounding examined reservoir. During next months decrease of conductivity appeared and it returned to initial value. Small water reservoirs of Wielkopolska described by Joniak [2009] reached higher values of conductivity. In most of described reservoirs located in forest values of conductivity was between  $400\text{--}1000\ \mu\text{S cm}^{-1}$  – were so much higher than in the present study. Values so high point on high water pollution or influence of agriculture catchment [Niemirycz *et al.* 1993, Joniak 2009].

Factors like: surfactants concentration, total P, phosphates, ammonium N, showed significant decreasing trend in water reservoirs but in reservoir III their increase was noticed. Visibility values SD significantly increased during researches in reservoir II in comparison with reservoir III. In all examined reservoirs there were too high animals stock in it. Their excretion has cumulated in water reservoirs as nitrates for a few years and products of ammonium nitrogen transformations also could increase nitrates concentration in water. It caused increase of nitrates concentration in water of all reservoirs contributing to intense growth of phytoplankton (Tab. 1). Similar biogenic transformation mechanisms were observed also in other researches [Kosturkiewicz and Fiedler 1996, Koc and Nowicki 1997].

„A” chlorophyll concentration results in water visualize phytoplankton bloom intensity run. Maximum always was observed in August. The most significant decrease of chlorophyll concentration during vegetation period obtained in reservoirs I and II. In reservoir III concentration decrease was slightly lower and has never reached initial state (Tab. 1).

Low water visibility in all reservoirs was caused by intensive phytoplankton growth. The most beneficial values of water transparency was observed in reservoir II. It oscillated between 20 cm and 45 cm. The lowest values from 10 cm to 15 cm

Table 1. Physical and chemical characteristics of water in investigated water bodies (values for the period 2013–2014)

Parameters/sites	Reservoir I			Reservoir II			Reservoir III		
	spring	summer	autumn	spring	summer	autumn	spring	summer	autumn
Temp., °C	17	19	16	18	21	18,9	18.8	21	18
pH	8.1	7.81	7.2	8	7.75	7.4	8,3	7.79	8,3
Conductiv., $\mu\text{S cm}^{-1}$	44	40	63	252	249	324	153	135	180
N-NO <sub>3</sub> , mg NO <sub>3</sub> l <sup>-1</sup>	0.242	0.12	0.11	0.022	0.051	0.03	0.016	0.16	0.016
N-NH <sub>4</sub> , mg NH <sub>4</sub> l <sup>-1</sup>	0.945	0.38	0.51	0.182	0.09	0.14	0.281	0.39	0.281
PO <sub>4</sub> , mg PO <sub>4</sub> l <sup>-1</sup>	0.036	0.054	0.04	0.012	0.018	0.05	0.035	0.053	0.031
TP, mg P L <sup>-1</sup>	0.482	0.44	0.08	0.062	0.9	0.01	0.47	0.53	0.622
Chlorophyl <i>a</i> , mg l <sup>-1</sup>	131.3	33.5	28.7	38.4	128	65.04	270	393	1330
TOC, mg C l <sup>-1</sup>	12.2	12.9	13.1	6.4	6.7	7	13.4	11.9	21.4
COD, mg O <sub>2</sub> l <sup>-1</sup>	30.0	30.7	24	18.8	18.9	17	18	31.3	63
BOD, mg O <sub>2</sub> l <sup>-1</sup>	15.7	17.9	17	9.5	8.9	8.5	37	16.3	30.7
Saturation O <sub>2</sub> , %	78	68	85	97	118	90	110	89	110
Visibility SD, cm	20	10	10	20	35	35	10	15	10

were found in reservoir I and were caused by phytoplankton growth and inflow of humus compounds from near meadows, which changed color of water (Tab. 1).

Higher visibility occurs in small Wielkopolska reservoirs described by Joniak [2009], medium visibility in field reservoir was 90 cm and in forest water bodies average was 1 m. It should be noted that those are natural reservoirs probably with poor stock of fish and better biological balance.

Selected reservoirs was backyard water reservoirs, with decorative-farming function. All of them were stocked with prussian carp dominated. The stock of fish was repeatedly exceeded recommended values for such objects in all examined reservoirs. Moreover fish were usually fatten and their concentration causes resuspension of bottom deposits and strong feed pressure on zooplankton, invertebrate macrofauna and macrophytes [Ozimek and Renman 1996]. In all reservoirs water birds were observed. According to unreasonable usage of chosen reservoirs submerged plants became eliminated which can be alternative for phytoplankton [Ozimek and Renman 1996, Koc and Nowicki 1997]. Fish concentration and also water birds presence causes significant amounts of biogenic compounds inflow to examined reservoirs what causes phytoplankton growth. In the investigated water bodies phytoplankton totally dominated primary production in examined reservoirs. The effect of such conditions were phytoplankton bloom [Niemirycz *et al.* 1993].

Usage of direct catchment is most important especially in case of small water reservoirs (small dimensions and small depth), which are particularly exposed on rapid changes in environment and water quality change from organic and mineral matter supply [Joniak 2009]. Antropopression in catchment causes that ground water and rainwater getting into water reservoirs from catchment entail their eutrophisation. It is followed in a wake of biotic and abiotic transformations [Ozimek and Renman 1996]. That type of effect reflects in reservoir I in which improper catchment administration causes infiltration of large amount of biogenic compounds. Water reservoirs II and III were in much better condition. It was probably caused by tight isolation from ground and catchment by foil for water pounds. In those reservoirs there was no risk to be polluted by either rainwater or ground water and ground with any compounds.

Inadequate structure of fish fauna causes increased fish pressure on zooplankton and macrophytes what in consequence leads to lack of control on phytoplankton and to atrophy of plants. Fish also causes bottom deposits resuspension leading probably to water enrichment in biogenic. Eutrophisation effect is also increased by birds and fish excretion, treated feed or fish ground bait. Even if all of mentioned factors are removed sometimes no increase of water quality is observed [Niemirycz *et al.* 1993].

Small water reservoirs show great differentiation of chemical and physical characteristics of water. The most apparent are those caused by different kind of water supply (water from pipe or from catchment). It can be observed that quite

different are trends of water reservoirs existing in natural environment than backyard water ponds isolated from ground water and catchment.

### CONCLUSIONS

1. In all examined water reservoirs too high fish density occurred. Their excretions has cumulated for a few years and transformation products also could increase biogenic compounds concentration in water. It caused increase of nitrates concentration in water in all reservoirs contributing intensive phytoplankton growth.

2. First procedure to improve water quality in all water reservoirs is to decrease of fish stock and to change fish structure in order to restore balance and inhibit inordinate phytoplankton growth as well as reduce fish pressure on zooplankton.

3. Phytoplankton bloom can be significantly reduced in reservoirs by planting them with rushes and by introducing submerged plants. It should be also popularized to apply emergent and floating plants which cause water decrease phytoplankton growth. In those water reservoirs which has contact with catchment it is recommended to create buffer zones using rushes plants what will reduce catchment influence on water reservoirs.

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#### WŁAŚCIWOŚCI FIZYCZNE I CHEMICZNE WÓD W WYBRANYCH PRZYDOMOWYCH ZBIORNIKACH WODNYCH

**Streszczenie.** Badania prowadzone były w trzech przydomowych zbiornikach wodnych o charakterze ozdobno-hodowlanym, położonych na przedmieściach Lublina. Materiał do pracy pobierano od kwietnia do października 2013 i 2014 r., trzy razy w roku. Celem niniejszej pracy było określenie właściwości fizycznych i chemicznych wody w badanych zbiornikach wodnych oraz określenie dynamiki sezonowej. W badanych zbiornikach stwierdzono, iż nieracjonalny sposób użytkowania związany z niewłaściwą obsadą ryb powoduje intensyfikację procesów eutrofizacji, nasilających się wraz ze wzrostem temperatury.

**Słowa kluczowe:** przydomowe zbiorniki wodne, właściwości fizyczne i chemiczne wody, eutrofizacja