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Total alkaline phosphatase activity in bottom sediments of Rusalka lake in the city of Szczecin

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ABSTRACT

Have studied lake close to neutral pH 7.75 to 7.62. Aquatic waters are order - phosphorus and nitrogen compounds. Level of activity alkaline phosphatase (APA) has an important impact on the chemical and biological processes taking place in the aquatic environment. APA belongs to a group of indicators, who tells us about the extent limitations to development of biomass in the tank water. Water of Rusalka lake were the subjects of 2008-2012 (July – September). Total alkaline phosphatase activity was determined seven times a year in these environments. A study of seasonal fluctuations showed that a maximum total alkaline phosphatase activity, both in the bottom sediment, occurred in spring (May) and summer (July, August).

***Keywords*:** total alkaline phosphatase activity, bottom sediment, Rusalka lake.

1. INTRODUCTION

Phosphorous plays a key role in biological production and thereby in the eutrophication of the water environment [4-7, 11, 21-23]. One of the important processes impacting on the level of available mineral phosphorous is enzymatic hydrolysis of organic bonds of this element [11, 19, 22, 23].

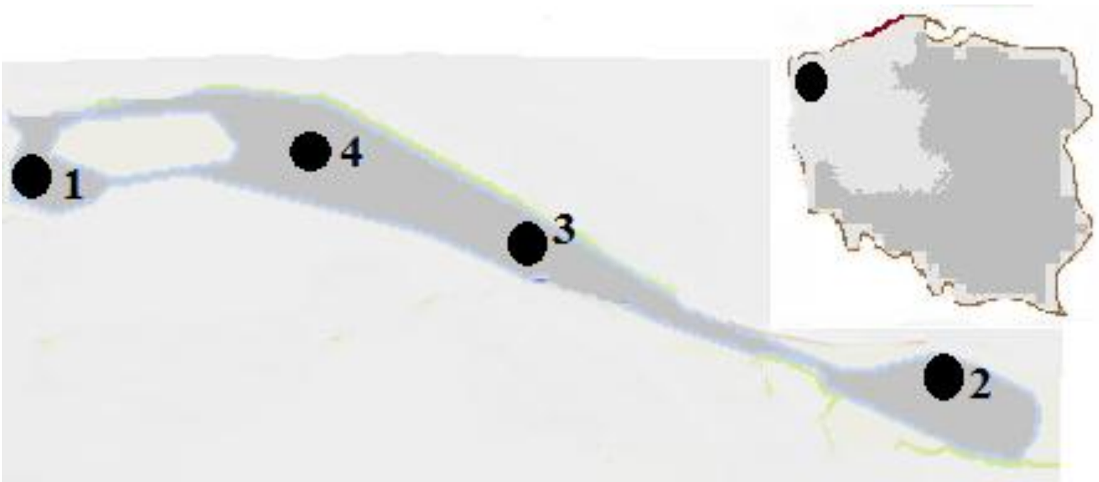
A majority of previous studies shows that alkaline phosphatase is chiefly responsible for the rate of organic phosphorous mineralization, both in the pelagic zone and in the bottom sediment of water bodies with pH > 7 [1-9, 11, 13, 14, 15, 20, 23]. However, some authors report, e.g. Yiyong [15], that abiotic factors can also play a part in the process. Jones [15] suggests that the level of phosphatase activity in the water is linked to the degree of lake trophicity. Whereas phosphatase activity in bottom sediment, according to Kobari and Taga [16], can indicate their enzymatic potential [11].

The assumption for this cycle of study was also to demonstrate the usefulness of the applied enzymatic test as a biological indicator of the degree of lake trophicity and possibly of progressing eutrophication of the analyzed water bodies.

2. EXPERIMENTAL

Szczecin is situated in North-Western Poland, in the western part of West Pomeranian Voivodeship in the Polish-German border [24].

Rusalka Lake, otherwise called the sea Eye, is located in Szczecin Kasprowicz Park in Niebuszewo district. This is the reservoir formed by the medieval Mill River House Osówka [24]. Lake morphometric data: Length - 670 m, width - 70 m, the height of the mirror - 16 m above sea level, type of lake: prohibitive [24]



Map 1. Location of the measuring point in Rusalka lake.
Source: Google maps 2012/develop your own.

Littoral sediment was sampled with a Kajak core sampler with a surface of 20 cm^2, while sublittoral sediment with Borucki apparatus with the surface of 225 cm^2. Activity of that enzyme in bottom sediments was established in accordance with Tabatabai and Bremmer [23], using the aforementioned buffer solution. The study was conducted during 2008-2012.

The analyses were carried out 7 times a year (April, May, June, July, August, September and October), in three repetitions.

3. RESULTS AND DISCUSSION

Results of the General activity of the alkaline phosphatase in the Deep in bottom sediment of the Lake in Rusalka are presented in Tables 1 to 5.

The results presented in in tables 1 to 5 demonstrate that total alkaline phosphatase activity in the bottom sediment of Rusalka lake over the five-year period of study oscillated between 774.2 to 7935.9 nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$.

In the littoral it ranged from 2584.7 to 7935.9 nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$, and in sublittoral from 774.2 to 3913.5 nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$. Total alkaline phosphatase activity in the bottom sediments of the analyzed water body was subject to seasonal oscillations. Irrespectively of the state of the environment aggregation, they typically demonstrated similar course in both analyzed zones.

Table 1. The total alkaline phosphatase activity in bottom sediment (nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$) in 2008.

Lp.	Dates of analyses	Littoral	Sublittoral
2008			
1.	April	4866.5	1935.4
2.	May	5720.6	2825.1
3.	June	6842.7	3946.8
4.	July	8832.1	1981.6
5.	August	7593.8	2784.4
6.	September	5925.5	1488.2
7.	October	4194.6	1058.1

Table 2. The total alkaline phosphatase activity in bottom sediment (nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$) in 2009.

Lp.	Dates of analyses	Littoral	Sublittoral
2009			
1.	April	5032.1	2125.4
2.	May	5628.3	2758.2
3.	June	5938.2	2462.8
4.	July	6583.4	3748.0
5.	August	7830.9	2161.5
6.	September	3859.3	1719.4
7.	October	2584.7	894.7

Table 3. The total alkaline phosphatase activity in bottom sediment (nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$) in 2010.

Lp.	Dates of analyses	Littoral	Sublittoral
2010			
1.	April	3782.8	2009.4
2.	May	4827.7	1941.3
3.	June	5437.3	3016.8
4.	July	7018.3	3913.5
5.	August	7935.9	1560.8
6.	September	3887.9	1010.5
7.	October	3046.7	951.3

Table 4. The total alkaline phosphatase activity in bottom sediment (nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$) in 2011.

Lp.	**Dates of analyses**	**Littoral**	**Sublittoral**
2011			
1.	April	4587.3	2782.1
2.	May	5862.4	1981.0
3.	June	6134.4	2305.4
4.	July	6993.0	3828.7
5.	August	7839.2	2304.9
6.	September	4081.3	1841.5
7.	October	3509.6	774.2

Table 5. The total alkaline phosphatase activity in bottom sediment (nmol $PO_4 \cdot dm^{-3} \cdot h^{-1}$) in 2012.

Lp.	**Dates of analyses**	**Littoral**	**Sublittoral**
2012			
1.	April	4902.1	2820.4
2.	May	5823.3	2094.0
3.	June	6034.0	2917.9
4.	July	6919.8	3853.6
5.	August	7539.0	1769.5
6.	September	3986.7	1413.8
7.	October	3249.2	791.5

An average value of two years of total alkaline phosphatase activity of the littoral deposits ranged at a higher level than that of the sublittoral. The observed phenomena was accompanied by more numerous occurrence of various groups of bacteria and saprophytic fungi in the sublittoral zone. It would indicate a closer relationship between phosphatase activity of the sediments and heterotrophic microorganisms growth [8,9,11].

Both in the bottom sediments a higher level of the activity was determined in spring (May) and in full summer period (July and August). In the pelagic zone a maximum of total alkaline phosphatase activity occurred in July, which is consistent with the results of research the author of this paper conducted on other lakes. What is noteworthy is the fact that higher values of the studied activity were not always accompanied by larger number of bacteria and saprophytic fungi [11,17,18], which would confirm the importance of algae affecting its level.

Whereas in the bottom sediment an increase in total alkaline phosphatase activity in July and August clearly showed a link between the number of heterotrophic bacteria, which most probably results from an influx into the sediments of phytoplankton, dying after spring blooms.

4. CONCLUSIONS

1. Total alkaline phosphatase activity in Rusalka lake in bottom sediment was the highest in the top layer of the littoral.
2. Total alkaline phosphatase activity both in the bottom sediment was subject to seasonal changes, and their course was of similar nature. A maximum activity was observed in both environments in the spring (May) and in the summer (July and August).

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