

DIFFERENCES IN THE CHEMICAL COMPOSITION OF BOTTOM SEDIMENTS IN THREE LAKES IN THE POLESIE LUBELSKIE REGION

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A b s t r a c t. Over the spring and autumn season in the year 2000, investigations were conducted on the bottom sediment chemical composition in the littoral and on the middle part of three lakes in the Polesie Lubelskie. In the bottom sediments the content of organic matter, biogenic elements (total nitrogen and total phosphorus), macroelements (Ca, Mg, Na, K) as well as pH values were determined. The objective of the present work was the analysis of the seasonal variability and zone distribution of chemical components in the bottom sediments of the lakes studied. Differences were observed of the chemical composition of the bottom sediments of the lakes. Both the zonal and seasonal variability of the chemical composition of the bottom sediments proved to be different with regard to the lake researched.

K e y w o r d s: lakes, bottom sediments, chemical composition

INTRODUCTION

Bottom sediments are of great importance for the functioning of water ecosystems. They link the process of change and circulation of auto- and allochthonic matter and participate in the circulation cycle of the elements of a lake. The composition and properties of bottom sediments depend on the hydro-mechanical, physicochemical and biological conditions in a lake and its catchment area, hence they can be considered as an important indicator of the activity of the water environment [3,5,10,11].

Current investigations on the chemical status of the lakes in the Polesie Lubelskie have focused on water quality evaluation and there are only a few works concerning the chemical properties of bottom sediments.

The research aimed to determine and compare the seasonal and zonal variability of the chemical composition of the bottom sediments of Lakes Syczyńskie, Kleszczów and Rotcze.

MATERIAL AND METHODS

Some chosen morphometrical qualities of the lakes studied are presented in Table 1 [9].

Table 1. Selected morphometrical and limnological data of studied lakes [9]

Name of lake		Syczyńskie	Kleszczów	Rotcze
Area (ha)		5.65	53.9	42.7
Length (m)		280	1092	873
Width	maximum (m)	260	700	644
	average (m)	214	494	489
	length (m)	895	3042	2449
Shoreline	development	1.02	1.17	1.06
	maximum (m)	2.9	2.35	4.3
Depth	average (m)	1.8	1.3	1.9
	Miestic type	polymictic	polymictic	polymictic
Trophic type	hypertrophic	eutrophic	eutrophic	
Fishery type	crusian carp lake	tench-pike lake	tench-pike lake	
Catchment area (ha)		458.17	253.38	157.19

The bottom sediment samples were collected from stands located in the littoral and in the middle part of each lake during two seasons, spring (May) and autumn (October) 2000. The sediment was collected by means of a Kajaks Corer. Each sample was obtained after a fivefold collection of 20 cm bottom sediment columns.

A chemical analysis of bottom sediments was performed according to the methods prevailing as commonly applied [1,6].

From air dried and ground sediment a representative sample was collected, then dried at 105°C temperature to constant weight. Afterwards 1-2 g of weighed amounts were prepared for each determination. The organic matter content was established electrometrically (as loss on ignition at 550°C for 2 h), hydrogen ions concentration (in pH units), the total nitrogen according to Kjeldahls method, the total of phosphorus after the colorimetric method with ammonium molybdate and stannous chloride and finally, after mineralization with a mixture of perchloric and nitrogen acids, the macroelements were fixed: Ca, Mg, Na, K by means of spectro-

photometry of atomic absorption (ASA). The results presented (Figs 1, 2, 3a, 3b) constitute the average values of the three parallel determinations.

RESULTS AND DISCUSSION

The bottom sediments of Lake Syczyńskie demonstrated increased (compared to the other lakes) total phosphorus – 2.4 mg g⁻¹ d.w. in the littoral and 3.8 mg g⁻¹ d.w. in the middle part of lake during the spring season and 3.1 mg g⁻¹ d.w. in both the littoral and middle part of the Lake in the autumn. A slight degree of afforestation, the great percentage of agricultural land in the structure of the Lake Syczyńskie catchment area is likely to cause a quite high phosphorus compound content in this basin. The qualitative parameters of water and bottom sediments of this Lake are much influenced by the geological structure of its catchment area [2]. A little alkaline reaction (7.2-7.5 pH) together with raised a cation content in the bottom sediment result from the susceptibility of the catchment area chalk substrate to hydrolysis. The lack of submerged macrophytes resulted in the low concentration of organic matter, in comparison to the remaining lakes.

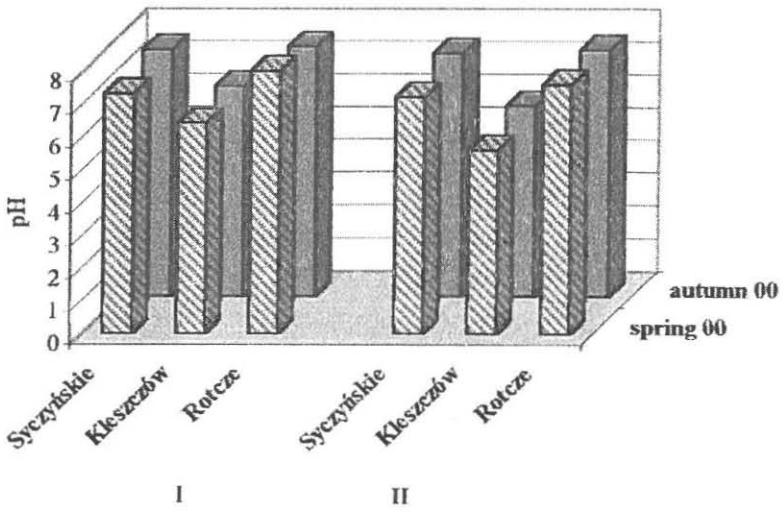
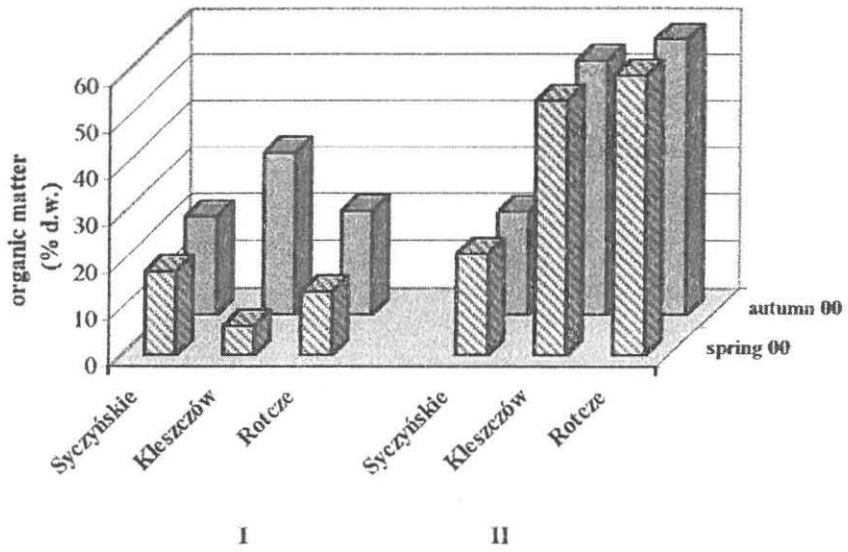
The lowest reaction – pH 6.0 was shown by the bottom sediment in Lake Kleszczów. The low total phosphorus content in the bottom sediment of this Lake, in both the zones studied, testifies to the great phosphorus requirement in water depths, as well as the protective function of the forest barrier in reducing the entry of pollutants.

The bottom sediment in Lake Rotcze revealed the highest reaction (7.7 pH) and a great amount of total nitrogen and magnesium ions – 1.08 mg g⁻¹ d.w. in the littoral, whereas 1.56 mg g⁻¹ d.w. in the middle of the Lake in the spring and 1.28 mg g⁻¹ d.w. in the littoral and 1.45 mg g⁻¹ d.w. in the middle part of the Lake in the autumn.

The organic matter content in Lake Syczyńskie remained at the same level, while in Lakes Kleszczów and Rotcze it showed zonal differences which tended to increase, together with depth growth in the autumn. The variability of the biogenic element concentrations acted similarly. There was no great difference in the pH values in any of the Lakes researched.

It can be stated that sediments from the middle part of the lake zone contain analysed components in higher concentrations (except for the content of Ca ions from Lakes Kleszczów and Rotcze, the total P of Lakes Syczyńskie and Rotcze, Mg ions of Syczyńskie) and lower pH values than littoral sediments.

Element concentrations and pH value in the bottom sediment of Lake Kleszczów proved to be higher in the autumn as compared to the spring in both



I - littoral

II - middle part of lake

Fig. 1. Organic matter content and pH value in the bottom sediments of studied lakes

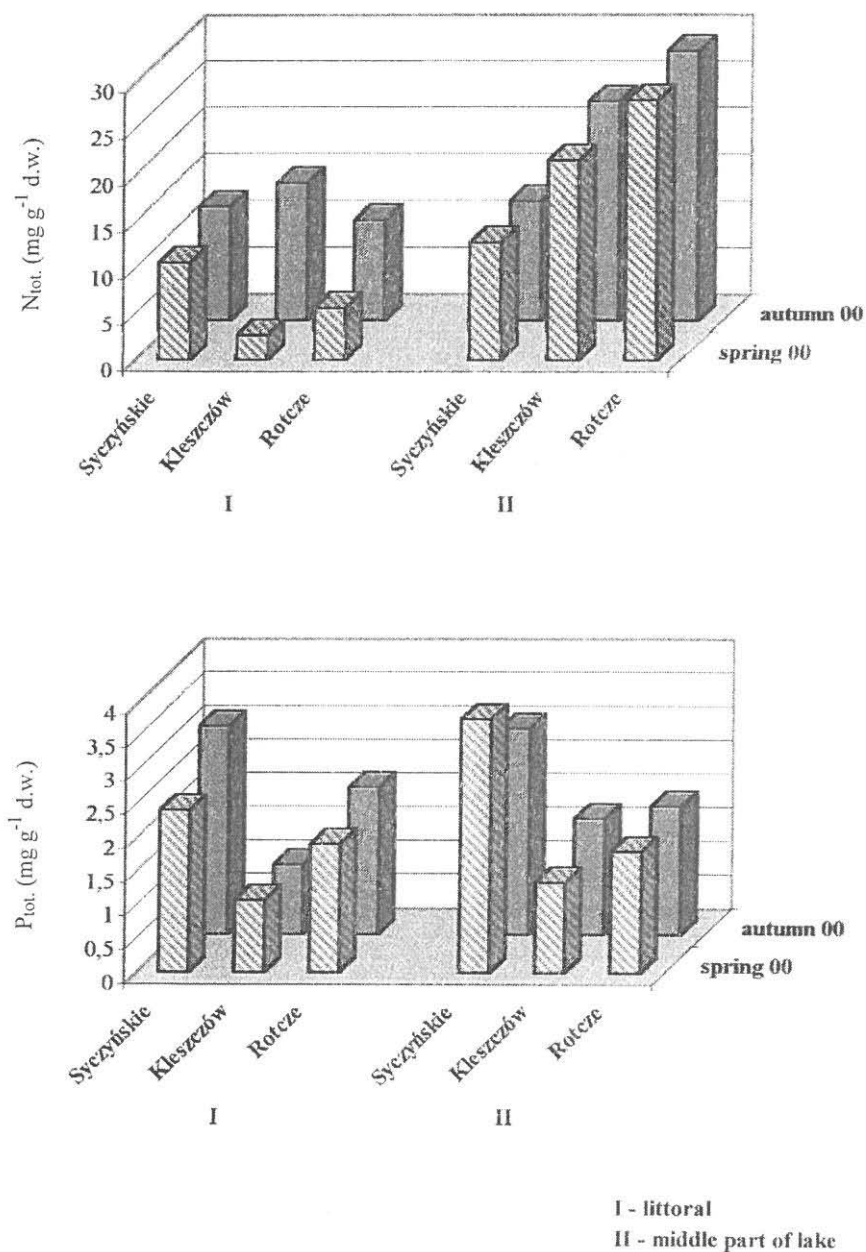


Fig. 2. Biogenic elements (P and N) content in the bottom sediments of studied lakes

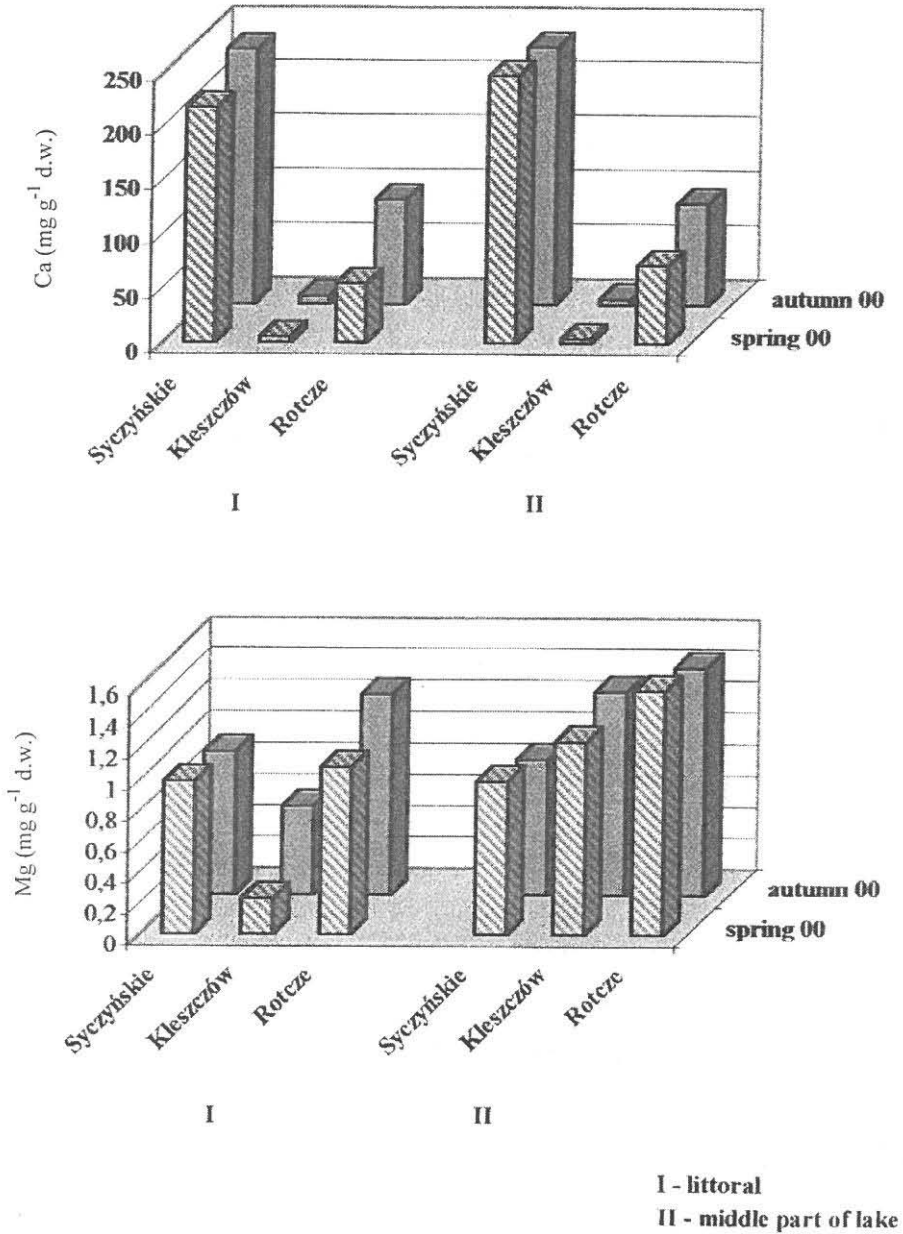


Fig. 3a. Mg and Ca content in the bottom sediments of studied lakes

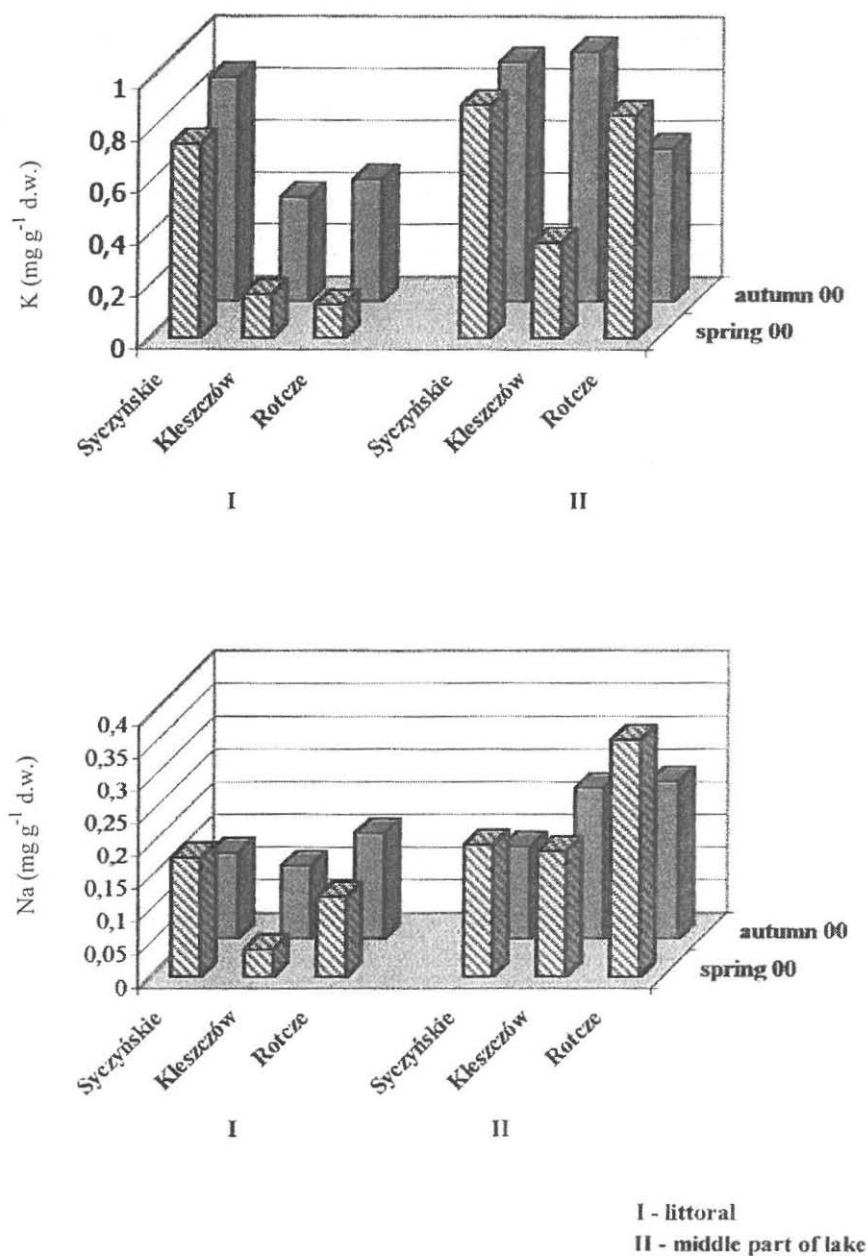


Fig. 3b. Na and K content in the bottom sediments of studied lakes

the zones analysed. The variability of biogene concentrations in the middle of Lake Rotcze and the content of all the components of the littoral sediment acted similarly. In the bottom sediments of Lake Syczyńskie there was no such dependence of Mg and Na content in any of the zones researched. However, in the middle part of Lake Rotcze, higher concentrations of macroelements were recorded in the spring.

The organic matter content in Lake Syczyńskie remained at the same level, while in Lakes Kleszczów and Rotcze it showed zonal differences which tended to increase, together with depth growth in the autumn.

CONCLUSIONS

1. The element concentrations in the bottom sediments of the Lakes studied acted at different levels. No great differences in pH values in any of the Lakes researched was stated.

2. Both seasonal and zonal differences in the content of nutrients in the bottom sediments of all the Lakes were observed.

3. In the middle part of the lake, higher concentrations of chemical components and a lower pH value than in the littoral part were determined.

4. In spring, the content of the components analysed in the bottom sediments of Lake Kleszczów was lower as against that from the autumn. Such a dependence was not observed for all components analysed in Lakes Syczyńskie and Rotcze

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ZRÓŻNICOWANIE SKŁADU CHEMICZNEGO OSADÓW DENNYCH TRZECH JEZIOR POLESIA LUBELSKIEGO

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S t r e s z c z e n i e. Badano skład chemiczny osadów dennych trzech jezior: Syczyńskie, Kleszczów i Rotcze położonych na Polesiu Lubelskim. Celem badań było określenie składu chemicznego oraz stwierdzenie, czy występuje strefowe i sezonowe zróżnicowanie stężeń wybranych składników chemicznych w osadach dennych tych jezior. Próby osadów dennych pobierano w dwóch sezonach, wiosennym (maj) i jesiennym (październik) 2000 roku ze stanowisk zlokalizowanych w strefie litoralnej i śródzieżerza poszczególnych jezior. Osad pobierano za pomocą aparatu rurowego Kajaka. Pięciokrotnie, z każdego punktu, pobierano 20 cm warstwę osadu dennego. Powietrznie suchy osad mielono, a następnie homogenizowano. Oznaczano zawartość materii organicznej (jako straty po prażeniu przez 2 godziny w 550°C), stężenie pierwiastków biogenych – azotu ogólnego metodą Kjeldahla i fosforu ogólnego metodą kolorymetryczną z molibdenianem amonu, makroelementów (Na, Ca, K, Mg) metodą spektrofotometrii absorpcji atomowej (ASA). Wartość pH wyznaczono metodą elektrometryczną. Zaobserwowano wzrost stężeń makroelementów, biogenów i materii organicznej oraz wartości pH w osadzie dennym jeziora Kleszczów w okresie jesiennym, w porównaniu z sezonem wiosennym. Nie stwierdzono takiej prawidłowości zróżnicowania składu chemicznego osadów dennych jezior Syczyńskie i Rotcze. Wyższe stężenia poszczególnych pierwiastków oraz niższe pH osadów dennych odnotowano w śródzieżerzu, co jest zgodne z wynikami badań innych autorów.

S ł o w a k l u c z o w e: jeziora, osady denne, skład chemiczny