

CHANGES OF NITRATES AND ORTHOPHOSPHATES  
CONCENTRATION IN LITTORAL WATER OF THE LAKE MOSZNE  
(ŁĘCZNA-WŁODAWA LAKE LAND) AND THE PIEZZOMETRIC  
OF THE SHORE ZONE

Modest Misztal<sup>\*</sup>, Sławomir Ligęza<sup>\*\*</sup>, Halina Smal<sup>\*\*</sup>,  
Elżbieta Jolanta Bielińska<sup>\*\*</sup>

<sup>\*</sup>Katedra Hydrobiologii i Ichtiologii  
Akademia Rolnicza, ul. Akademicka 15, 20-033 Lublin  
<sup>\*\*</sup>Instytut Gleboznawstwa i Kształtowania Środowiska  
Akademia Rolnicza, ul. Króla Leszczyńskiego 7, 20-069 Lublin

**Summary.** During 7 years the concentration of nitrates and orthophosphates in the littoral water of the Lake Moszne (The Łęczyńsko-Włodawskie Lake District) and the shallow ground water of the peatbog surrounding the lake was studied. Seasonal changes in the chemical content were studied in the seasons: spring, summer, and autumn.

**Key words:** lakes, ecotone, water chemistry, nitrates, orthophosphates

## INTRODUCTION

Transition zones between terrestrial and aquatic ecosystems are very interesting subjects of studies as a place of interpenetration of elements and chemical compounds [Sławski 2001, Raspopov *et al.* 2002, Misztal *et al.* 2003]. Differentiation of ecosystems is the main reason why several kinds of contact forms and borders between them exist [Traczyk 1960]. In the case of Lake Moszne, the transition between lake water and a peatbog is relatively sharp. A terminal, located directly at the lake part of peatland is the border of the peatbog that has contact with the lake littoral.

Mineral phosphorus and nitrogen compounds are very dangerous for the water protection and its quality. The scale of migration of nutrients from the catchment to the interior lake basin decides about the eutrophication rate within the reservoir. The overflow of the nutrient level, which is accepted and may be introduced in a natural way into the autochthonous processes of lakes, may cause the loss of ecological balance, very sensitive to the action of external agents.

The aim of our study was determination of seasonal changes in the nitrates and orthophosphates concentration in the littoral water of the Lake Moszne and in the shallow ground water sampled in a piezometer located on the area of peatbog, close to the lake water table.

## STUDY AREA AND METHODS

Lake Moszne is one of the most valuable areas of Łęczyńsko-Włodawskie Lake District in respect of the nature world. The lake is a part of Poleski National Park and is a nature reserve [Radziejowski 1996]. The water body is utterly surrounded by peatbog, which forms affloat layer in the contact zone with lake littoral. The second important plant community within catchment basin area is a marshy coniferous forest.

Water samples were collected (Fig. 1) from the littoral of Moszne Lake and from piezometer installed on the peatbog from 1992 to 1999, excluding 1995. Samples of water were analyzed in the spring season (material was collected in April or May), summer (water sampling in the July), and in autumn (September or October).

Nitrates were determined colorimetrically as the complex with phenoldisulphonic acid [Prince 1955], and orthophosphates as the blue molybdate- $\text{PO}_4$  complex [Hermanowicz *et al.* 1999].

## RESULTS AND DISCUSSION

The numerical data from the study by Harasimiuk *et al.* [1998] describing a percentage share of Lake Moszne water table in relation to the total area of its catchment basin indicates that the lake collects water from the territory many times larger than the lake basin. The peatbog completely surrounds the waterbody so it is a specific natural filter, which periodically can immobilize a significant charge of the nutrients inflowing there. Some selected physico-chemical parameters of water show that both the lake and the peatbog keep autonomy in their functioning. This regularity is also observed within transitional zones of other lakes of the Polesie Lake District region [Ligęza *et al.* 2003].

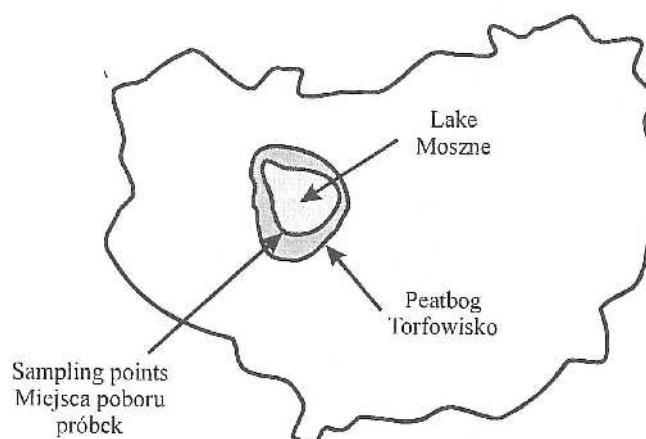


Fig. 1. Catchment basin of the Lake Moszne and water sampling points  
Rys. 1. Zlewnia jeziora Moszne i punkty poboru próbek wody

Table 1. Mean values of nitrates and orthophosphates concentration in the lake and ground water  
 Tabela 1. Średnie stężenie azotanów i ortofosforanów w wodach jeziora i wodach gruntowych

	Spring Wiosna	Summer Lato	Autumn Jesień
Nitrates – Azotany (mg N dm <sup>-3</sup> )			
Littoral Litoral	0.089	0.079	0.078
Ground water Wody gruntowe	0.577	0.635	0.658
Orthophosphates – Ortofosforany (mg PO <sub>4</sub> dm <sup>-3</sup> )			
Littoral Litoral	0.115	0.096	0.081
Ground water Wody gruntowe	0.250	0.158	0.150

A sequence of the seasons is an important factor influencing the chemical properties of lake water. The seasonality of changes is connected with the life cycles of organisms and intensity of their vital functions (assimilation and excretion of elements and nutrients) [Bucka and Wilk-Woźniak 2002, Misztal *et al.* 2003]. The average values for all the studied period were used in the description of our study.

The lake water sampled in the littoral zone showed a lower concentration of both nitrates and orthophosphates in comparison to ground water from piezometer. In the case of both studied anions the differences were on a significant level. Also the seasonal distribution of NO<sub>3</sub> and PO<sub>4</sub> content in the water pointed out to varied forms. The concentration of nitrates increased in the piezometer water from spring to autumn while orthophosphates decreased. In the littoral lake water concentration of nitrates and orthophosphates decreased with the passage of time. That gives the basis to think that from spring to autumn the assimilation of NO<sub>3</sub> and PO<sub>4</sub> by lake autotrophs and the building of both compounds into biomass increased. The ground water sampled in piezometer was enriched with nitrates in the time of vegetational season, probably as the results of the intensive organic matter mineralization.

There is no clear explanation why a similar regularity was not observed with reference to phosphorus. Phosphate compounds in aquatic environment can have a very short time of fixation by organisms (even a period of minutes for phytoplankton) and recirculation of PO<sub>4</sub> could be very fast. Orthophosphates limit the plant growth more than nitrogen compounds [Wilk-Woźniak and Ligęza 2003] because some organisms, for example cyanobacteria, can assimilate atmospheric N<sub>2</sub> and transform it into the mineral, easy accessible forms for other organisms.

The deficits of PO<sub>4</sub> built in plant bodies may be supplemented only by water influxes from the catchment basin area of the lake because the decomposition organisms and release phosphorus *in situ* has no greater significance. Free phosphates are at once absorbed by organisms. A comparison of NO<sub>3</sub> and PO<sub>4</sub> amount in the water of Moszne Lake and in the ground water of its shore site zone indicates that peatbog is an important reservoir of nutrients, which may influence the concentration of them.

## CONCLUSIONS

1. Ground water sampled in piezometer installed on the peatbog surrounding Lake Moszne showed a significantly higher concentration of nitrates and orthophosphates in comparison to the littoral lake water.

2. The content of  $\text{NO}_3$  and  $\text{PO}_4$  decreased in the littoral lake water from spring to autumn, whereas seasonal changes of those compounds in ground water were different.

3. The peatbog surrounding Lake Moszne functions as the filter detaining nutrients inflowing from the area of catchment basin of the lake. Some unfavourable changes within peatland can release the accumulated nitrates and orthophosphates influencing the same on the trophy state of the lake.

## REFERENCES

- Bucka H., Wilk-Woźniak E., 2002: Cosmopolitan and ubiquitous species among pro- and eukaryotic algae from water bodies in southern Poland. Monograph, ZBW PAN, Kraków, pp. 233 (in Polish).
- Harasimiuk M., Michalczyk Z., Turczyński M., 1998: Łęczyńsko-włodawskie lakes. Natural monograph. Biblioteka Monitoringu Środowiska, Lublin, pp. 176 (in Polish).
- Hermanowicz W., Dojlido J., Dożańska W., Koziorowski B., Zerbe J., 1999: Physico-chemical analysis of water and wastes. Arkady, Warszawa, pp. 556 (in Polish).
- Khan N., Masroor J.I., Khan S.H., Ahmen I., 2002: Effect of different levels of nitrogen on the physico-chemical characteristics of pond productivity. *Inter. J. Agr. Biol.* 4(3), 40-412.
- Ligeza S., Smal H., Misztal M., 2003: Seasonal changes of selected physicochemical properties of peatbog and Piaseczno lake littoral water (Łęczyńsko-Włodawskie Lakeland, SE Poland). *Acta Agrophys.* 88, 1(3), pp. 465-470 (in Polish).
- Misztal M., Smal H., Ligeza S., Dymińska-Wydra P., 1998: Mineral and organic fractions in the catchment area of Piaseczno, Łukie, and Moszne Lakes. *Freshwater ecotones. Structure-types-functions.* Wydawnictwo UMCS, Lublin, pp. 177-181 (in Polish).
- Misztal M., Smal H., Ligeza S., Dymińska-Wydra P., 2003: Influence of land-lake ecotone on mineral and organic compounds in groundwater and lake water. *Pol. J. Ecol.* 51(2), 129-136.
- Prince A.L., 1955: Appendix. Methods in soil analysis. In Bear F.E. *Chemistry of the soil.* ACS Monographs 126, 328-362.
- Radziejowski J., 1996: Protected areas in Poland. IOŚ, Warszawa, pp. 234 (in Polish).
- Raspopov I.M., Adamec L., Husak S., 2002: Influence of aquatic macrophytes on the littoral zone habitats of the lake Ladoga, NW Russia. *Preslia* 74(4), 315-321.
- Sławski M., 2001: Forest edge as a protection zone of forest ecosystem. Analysis of plant communities of chosen ecotones in Pomerania. *Sylvan* 145, pp. 77-87 (in Polish).
- Traczyk T., 1960: Investigation on transitional zone of forest communities. *Ekol. Pol.* 8, pp. 88-125 (in Polish).
- Vymazal J., 1995: *Algae and element cycling in wetlands.* CRC Press Inc. Boca Raton, Florida, pp. 720.
- Wilk-Woźniak E., Ligeza S., 2003: Phytoplankton-nutrient relationships during the early spring and the late autumn in a shallow and polluted reservoir. *Oceanological and Hydrobiological Studies* 32(1), 75-87.

ZMIANY ZAWARTOŚCI AZOTANÓW I FOSFORANÓW W WODACH PRZYBRZEŻNYCH  
JEZIORA MOSZNE (POJEZIERZE ŁĘCZYŃSKO-WŁODAWSKIE)  
I PIEZOMETRYCZNYCH JEGO POBRZEŻA

**Streszczenie.** Przez 7 lat badano stężenie azotanów i fosforanów w wodach przybrzeżnych jeziora Moszne (Pojezierze Łęczyńsko-Włodawskie) oraz w płytkich wodach gruntowych jego pobrzeża. Wody gruntowe były pobierane z piezometru zainstalowanego w obrębie mszaru sąsiadującego z litoralem jeziornym. Analizie poddano sezonowe zmiany stężeń, biorąc pod uwagę okresy: wiosenny, letni, jesienny.

**Słowa kluczowe:** jeziora, chemizm, azotany, fosforany