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CONTENT OF HEAVY METALS IN BOTTOM SEDIMENTS OF BINOWSKIE LAKE

ZAWARTOŚĆ METALI CIĘŻKICH W OSADACH DENNYCH JEZIORA BINOWSKIEGO

Abstract: The studies of chemical composition of bottom sediments of Binowskie Lake (located within area of protection zone of Szczecin Landscape park "Fagus Forest") was carried out in 2003 year. The contents of Cr, Zn, Co, Mn, Cu, Ni, Pb, Hg and Fe were examined. Sediments samples from 4 stands have been taken at spring, summer and autumn seasons. Obtained results of heavy metals concentrations do not exceeded permitted values. Bottom sediments of examined lake can be classified as low contaminated.

Keywords: Binowskie Lake, bottom sediments, heavy metals

Water sediments are integrated part of water environment. Their composition and properties have been formed as a result of long-term physical, chemical and biological processes occurring at reservoir itself as well as within its catchment. Sediments are accumulation medium of pollutants occurring in water environment, mainly biogenic compounds, organic matter as well as specific pollutants like heavy metals. Bottom sediments play important role in water systems, both as reservoirs in which pollutants can be deposited and as well as sources for water organisms pollution [1-3].

That is why the chemical composition knowledge, especially the total content of heavy metals in surface layers of bottom sediments, is an essential condition for water ecosystems biogeochemical balance prognosis [4, 5].

Water sediments of Binowskie Lake have been taken and investigated in 2003 year. Binowskie Lake is a postglacial, interior water region reservoir located within area of protection zone of Szczecin Landscape park "Fagus Forest". It belongs to catchments of Plonia-Odra rivers [6]. Water surface of investigated lake has 53 ha, and its average depth is 5.5 m. Formerly this lake had ideal clean water and was a habitat of very rare plant species, big amount of fish and crayfishes. On the lake bottom *Charetea* vast meadows have been formed. This is the most beautiful object of this type in Poland. At present due to biogenic compounds flow from Binowo town progressive eutrophication can be observed [7, 8].

The main aim of our study was determination of heavy metals (Cr, Zn, Co, Mn, Cu, Ni, Pb, Hg, Fe) content in bottom sediments of studied reservoir. These were the first studies of heavy metals content in sediments of Binowskie Lake, so far this type of analysis have not been provided.

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Material and methods

Sediments samples have been taken at spring (30.05.2003), summer (08.10.2003) and autumn (03.12.2003) seasons from 4 sites located at following altitudes and longitudes: 1 - N 53°18.423'; E 14°37.758', 2 - N 53°18.509; E 14°38.266', 3 - N 53°18.767'; E 14°38.180', 4 - N 53°18.560'; E 14°38.620' (Fig. 1). Samples have been taken by van Veen grab with buck surface of 0.06 m^2. After drying in air condition samples were sieved by 1 mm sieve and this fraction were used for further analyses. Bottom sediments samples were digested in nitric(V) and chloric(VII) (perchloric) concentrated acids at MILESTONE microwave stone. Content of Cr, Zn, Co, Cu, Mn, Ni, Pb and Fe in mineralized sediment samples were determined using the AAS method on Solaar 929 apparatus. Total mercury content was determined by using of AMA 254 apparatus.

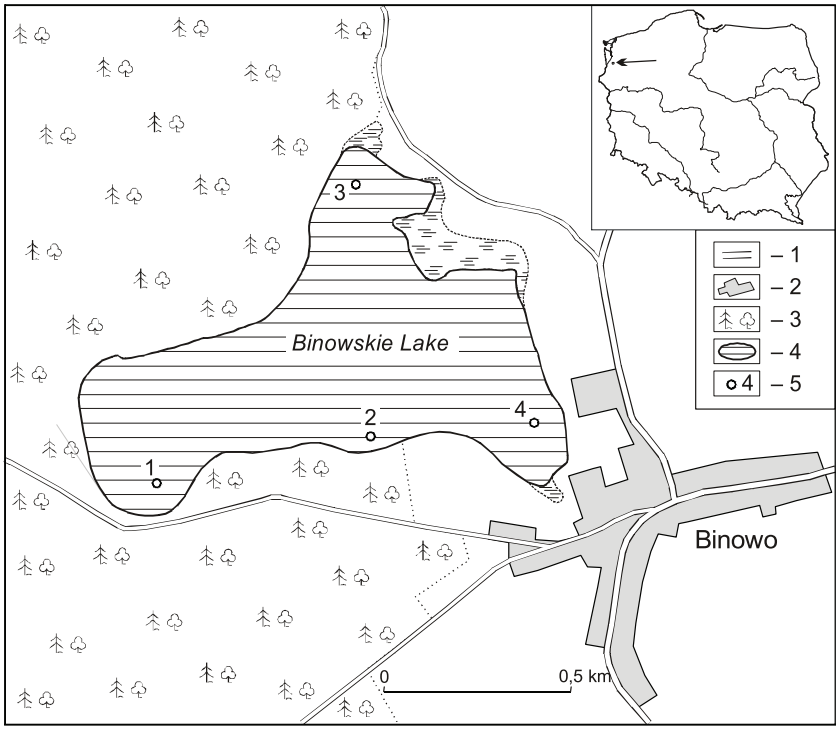

Fig. 1. Location of sampling sites on Binowskie Lake. Explanation: 1 - roads, 2 - urban areas, 3 - forests, 4 - lakes, 5 - sampling sites

Results and disscussion

Obtained results indicate on spatial and seasonal differentiation in heavy metals content. At the 1st and 3rd sites heavy metals concentrations were higher than those at the 2nd and 4th site (Fig. 2). These sites differed between themselves by substratum - on the 1st and 3rd sites sediments were organic origin and on the 2nd and 4th - mineral ones.

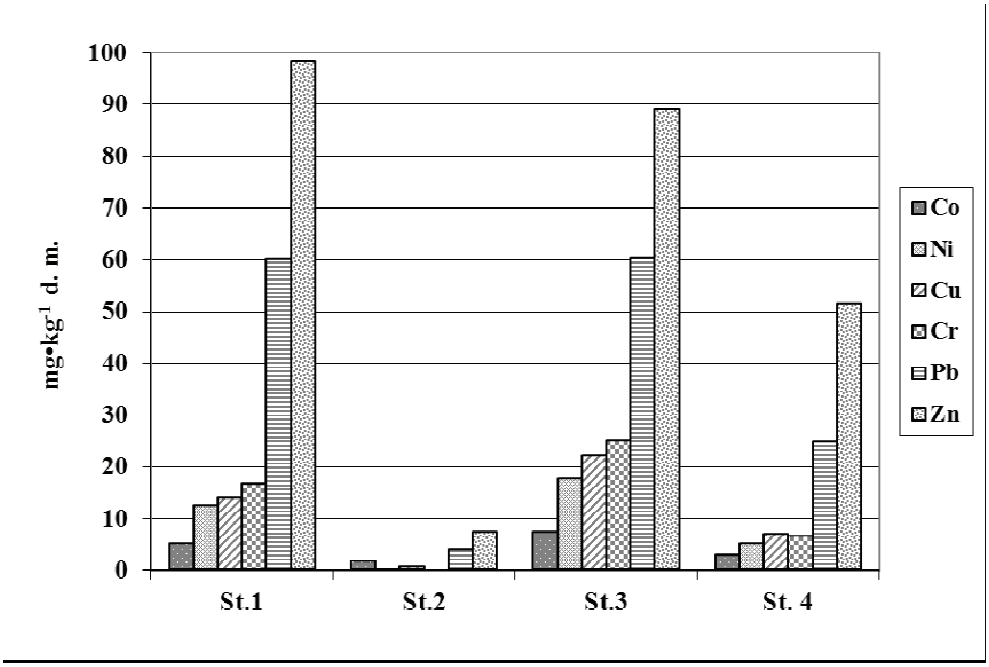

Fig. 2. Average concentration of selected heavy metals in bottom sediments of Binowskie Lake

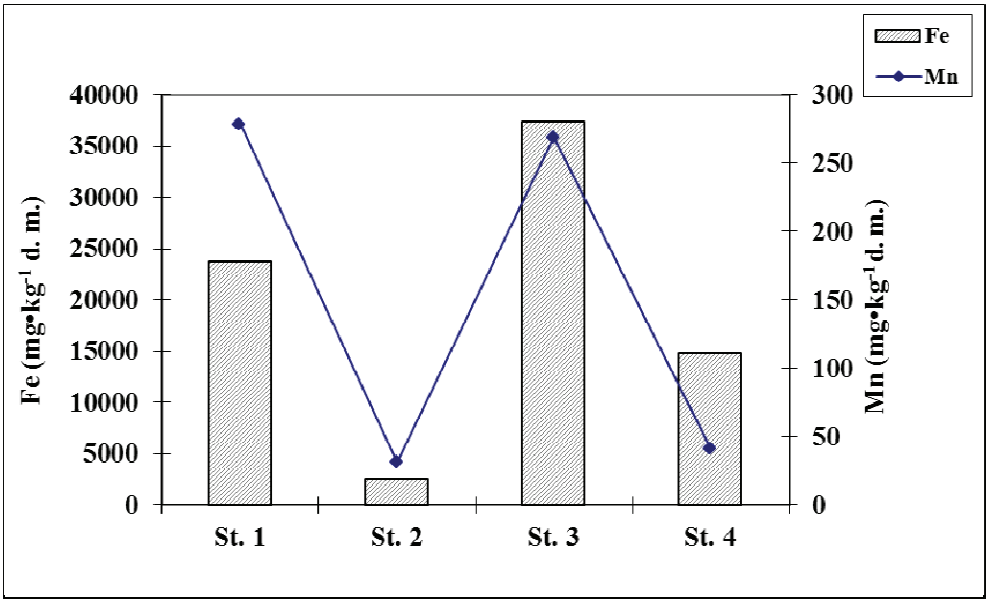

Fig. 3. Average concentration of Fe and Mn in bottom sediments of Binowskie Lake

Iron and manganese dominated among investigated elements (Fig. 3). Iron content was between 2442 and 41 000 mg·kg^{-1} d.m. and manganese from 24.84 to 321 mg·kg^{-1} d.m. Contents of zinc, lead, chromium, copper, nickel, cobalt and mercury were much lower, respectively: Zn 5.55÷133.35 mg·kg^{-1} d.m., Pb 2.85÷76.02 mg·kg^{-1} d.m., Cr <0.01÷26.30 mg·kg^{-1} d.m., Cu 0.01÷25.33 mg·kg^{-1} d.m., Ni 0.15÷18.42 mg·kg^{-1} d.m., Co 0.37÷7.95 mg·kg^{-1} d.m. and Hg 0.0072÷0.2155 mg·kg^{-1} d.m.

Contents of investigated elements in bottom sediments of Binowskie Lake at diminishing sequence were as follows: Fe > Mn > Zn > Pb > Cr > Cu > Ni > Co > Hg.

Heavy metal concentration did not exceed the geochemical background for most taken samples. In Poland there is no uniform classification system for bottom sediments like valid classes of selected pollutants content as it is in case of sewage sludge [9]. That is why obtained results were compared with decree of Minister of the Environment (from 9 September 2002 concerning soil quality standards and ground quality standards) [10], to the most frequent elements content in sediment rocks according to Kabata-Pendias and Pendias [11] as well as to geochemical classes of water sediments worked out by PIG [12].

Comparing obtained results to values given at decree of Minister of the Environment from 9th September 2002, concentrations of chromium, cobalt, copper and mercury were below permissible concentration level. But concentrations of zinc (at sites 1st - taken in spring and autumn time, as well as 3rd and 4th taken in summer) and lead (1st site during all investigation period; 3rd taken in summer and autumn and 4th - taken in summer) were higher than permissible concentration level [10].

According to values given by Kabata-Pendias and Pendias [11] results obtained in our studies indicated that concentration of chromium, zinc, copper, nickel and mercury were below upper level of these elements natural concentration in sediment rocks. Obtained results of zinc content at all investigated sites indicated to considerable higher than natural concentration. In case of iron and lead content - the exceed of natural concentration level were observed, respectively during the summer at 4th site for Fe and 1st and 2nd site during the whole study period and 4th site in summer [11].

According to classification of water sediments worked out by PIG investigated sediments belong to I class - non polluted by chromium, zinc, copper, nickel and mercury, and to second class - mediocre polluted by lead [12].

Comparing obtained in our investigations results of heavy metals concentration from Binowskie Lake to results of these metals content at other lakes from Poland (Goreckie and Swarzedzkie Lakes near Poznan, Sumin Lake on Leczynsko-Wlodawskie Lakeland) no significant differences were found [2, 13, 14].

The concentrations of heavy metals in bottom sediments from Binowskie Lake were compared with these metals concentrations in bottom sediments of other lakes in West Pomerania province (investigated by the Regional Inspectorate of Environment Protection) as well as with sediments from lakes of Waleckie Lakeland and Drawska Plain studied by Cieslewicz and Rozanski [13, 14]. The obtained results of zinc, copper, lead and mercury were similar to the concentrations of these metals listed by WIOS, but were generally lower comparind with data obtained from sediments of lakes located at Waleckie Lakeland and Drawska Plain. Higher concentrations of Ni, Cr, and Co were similar in all compared lakes sediments.

Concentrations of zinc in bottom sediments of Binowskie Lake could be elevated due to surface runoff (corrosion of galvanized roofing sheets and car bodies), and hard coal burning in households [15].

However lead can get into surface waters with suspensions, created as a result of erosion. Other sources of lead occurrence in sediments in higher concentrations may also be local communication and domestic waste. Especially, the domestic wastes were introduced in recent years to the lake by the surrounding Binowo Resorts [4].

Conclusions

The most important factor which differentiated quantity of heavy metals concentration in bottom sediments of Binowskie Lake was the share of individual granulometrical fraction as well as organic matter content. The highest contents of examined elements occurred in organic sediments, which have strong sorption property.

Seasonal differentiation in heavy metals content were cause by natural and anthropogenic factors.

Content of majority examined heavy metals was on the level of none-polluted water reservoirs in Poland.

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ZAWARTOŚĆ METALI CIĘŻKICH W OSADACH DENNYCH JEZIORA BINOWSKIEGO

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Abstrakt: W 2003 r. zbadano skład osadów dennych z Jeziora Binowskiego, położonego w otulinie Szczecińskiego Parku Krajobrazowego „Puszcza Bukowa", oznaczając zawartość metali ciężkich (Cr, Zn, Co, Mn, Cu, Ni, Pb, Hg oraz Fe). Materiał do badań pozyskano z 4 stanowisk w sezonach wiosennym, letnim i jesiennym. Wyniki badań wykazały, że stężenia większości metali ciężkich w osadach Jeziora Binowskiego odpowiadają poziomowi stężeń występujących w niezanieczyszczonych zbiornikach wodnych w Polsce.

Słowa kluczowe: Jezioro Binowskie, osady denne, metale ciężkie