

SEASONAL CHANGES IN SELECTED INDICATORS OF WATER QUALITY OF THE ŁYDYNIA RIVER

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ABSTRACT

The objective of the research was to compare seasonal changes in selected indicators of water quality of the Łydynia river against Regulation of the Minister of Environment of 9 November 2011 on classification method for waterbody of surface waters and environmental quality standards for priority substances (Dz. U. [Journal of Laws] 2011, No. 257, item 1545). Water samples were taken in Ciechanów in the spring and autumn from 2009 to 2011. Water pH, specific conductance and calcium ion (Ca²⁺) and magnesium ion (Mg²⁺) concentrations were determined as part of physical and chemical analysis. The study results were compared with the limit values of water quality indicators established in annex no. 1 for the aforementioned regulation. The water quality of the Łydynia river was found to be class I water (class I being the highest purity class). Additionally, colour and turbidity (the parameters not included in the aforementioned regulation) were determined in water samples.

Keywords: river, physical and chemical indicators, water quality, seasonality.

INTRODUCTION

Surface waters, which provide the habitat for many plant and animal organisms, are polluted due to human activity. An increasing anthropogenic impact results in permanent changes in water ecosystems [Bonisławska et al. 2008]. According to Natkaniec and Możdżeń [2013], pollution is not only due to excessive concentration of mineral or organic compounds but also unfavourable changes in water temperature, turbidity and colour. The author believes that rivers which receive industrial waste waters and surface and ground waters sent from arable land are the most threatened with pollution.

Ecological assessment of water quality is carried out using physical and chemical, biological as well as hydromorphological indicators [Directive 2000].

Data of the Chief Inspectorate of Environmental Protection indicate that in 2013 only 27 (3%) of homogenous parts of surface waters (HPSW), which include rivers, met standards set for class I waters (class I being the highest purity

class). A total of 252 rivers (27.6%) were classified as good quality water bodies, 439 rivers (48.1%) were in a moderate ecological condition, and the status of 46 rivers (5%) was poor.

The objective of the research was to compare seasonal (spring, autumn) changes in physical and chemical parameters of water quality of the Łydynia river against Regulation of the Minister of Environment of 9 November 2011 on classification method for waterbody of surface waters and environmental quality standards for priority substances (Dz. U. 2011, No. 257, item 1545).

STUDY AREA

The Łydynia river is located in the north-eastern part of the Mazovian Lowland and runs across the Ciechanów Highland. It is 72 km long. Along the river, extends the natural and scenic area 'Łydyna River Valley' which covers 57.31 ha.

The Łydynia river starts in Mława District in the proximity of Budy Garwolińskie, the Zieluń-Rzęgnów Area of Protected Landscape, and

flows into the Wkra river in Płoński District, 1.5 km south of Gutarzewo, the Krosno-Kosmowo Area of Protected Landscape. The whole river area varies in width from 250 to 800 m and cuts into a moraine upland to the depth of less than 20 meters. The valley is covered with glacial and Holocene deposits (respectively, sands and turfs).

MATERIALS AND METHODS

Water was examined in Ciechanów during two study periods (spring, autumn) from 2009 to 2011. Physical and chemical analysis included determination of colour, pH, turbidity, specific conductance, calcium ion (Ca^{2+}) concentration and magnesium ion (Mg^{2+}) concentration. Methods recommended by the Polish Standards were used and procedures described by Dojlido [1995] as well as Hermanowicz et al. [1996] were applied. Selected indicators of pollution were related to quality classes of surface waters based on the Regulation of the Minister of Environment of 9 November 2011 on classification method for waterbody of surface waters and environmental quality standards for priority substances (Dz. U. 2011, No. 257, item 1545).

RESULTS AND DISCUSSION

According to Borowski [2010], colour of surface waters is usually determined by substances which are either diluted or suspended in water. The analyses demonstrated that water colour in spring ranged from 22 to 25 $\text{mg Pt}\cdot\text{dm}^{-3}$, the highest value being recorded in 2010 and

the lowest in 2009. In the autumn, the indicator was higher and ranged from 27 to 32 $\text{mg Pt}\cdot\text{dm}^{-3}$ (Figure 1).

Water turbidity is determined by the occurrence of insoluble non-organic and organic particles which disperse or absorb light rays. Values of this parameter depend on river bed type and river water state. Figure 2 demonstrates changes in the turbidity of the Łydynia river throughout spring and autumn. Values of the indicator were found to be similar and ranged from 1.5 to 2.0 $\text{mg SiO}_2\cdot\text{dm}^{-3}$. Moreover, pH in spring fell within the range of 7.4–8.3, the fluctuations occurring possibly due to the development of algae and depletion of carbon dioxide diluted in water resulting in calcium carbonate transformations. In autumn, pH ranged from 7.1 to 7.5 (Figure 3). The values of the indicator were found to relate to class I water [Regulation of the Minister of Environment of 9 November 2011]. In studies by other authors, pH of natural waters ranged from 6.5 to 8.5. Chomutowska and Wilamowski [2014] obtained pH values (the Łutownia river) ranging from 7.59 to 7.83. By contrast, Płytko et al. [2013] reported values for the Bochońniczanka river in the range from 7.29 to 8.29.

Specific conductance is a physical indicator which is indicative of mineral contamination of water. Augustyn et al. [2012] have stressed that its value is affected by quantitative contaminants occurring in a given area. According to Dojlido [1995], Olszewska and Krzemińska [2007], Ostrowski et al. [2007], specific conductance of surface waters ranges from 50 to 1000 $\mu\text{S}\cdot\text{cm}^{-1}$.

The results obtained in the present work indicate that there were seasonal fluctuations in the values of this parameter. The highest specific

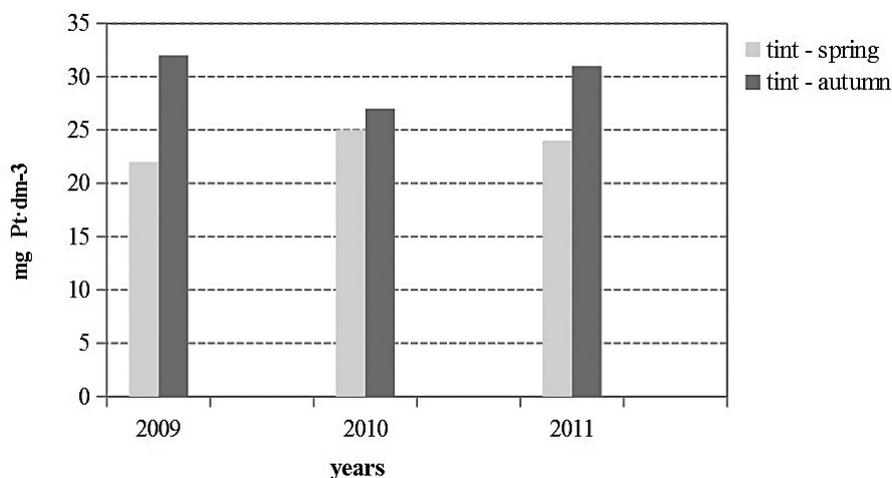


Figure 1. Seasonal changes in the tint in the Łydynia River in 2009–2011

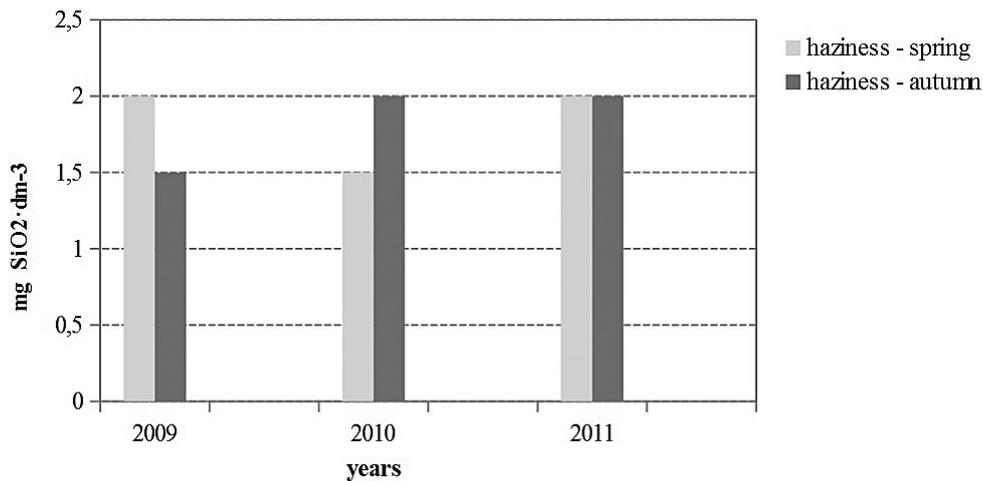


Figure 2. Seasonal changes in the haziness in the Łydynia river in 2009–2011

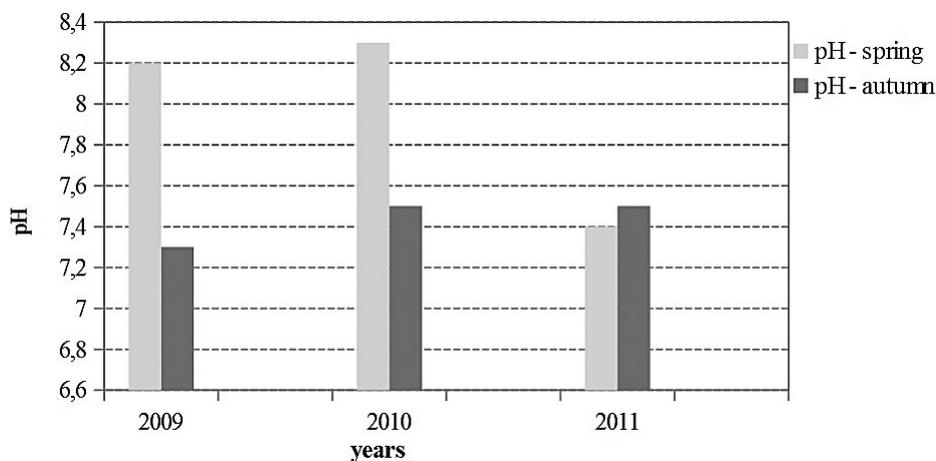


Figure 3. Seasonal changes in the pH in the Łydynia river in 2009–2011

conductance was recorded in the spring of 2010 ($145.9 \mu\text{S}\cdot\text{cm}^{-1}$) and the lowest in the autumn of 2011 ($58.1 \mu\text{S}\cdot\text{cm}^{-1}$). Contrasting results were reported by Augustyn et al. [2012] who demonstrated a tendency for the indicator to increase in the period from spring to winter. Augustyn et al. [2012], Chomutowska and Wilamowski [2014], Płytko et al. [2013] demonstrated that specific conductance for the following rivers: Łutownia, Wisłoka and Bochońniczanka fell within the following respective ranges: $338\text{--}434 \mu\text{S}\cdot\text{cm}^{-1}$, $397.8\text{--}599.0 \mu\text{S}\cdot\text{cm}^{-1}$, and around $750 \mu\text{S}\cdot\text{cm}^{-1}$. Wysocka-Czubaszek [2014] found the values of the indicator to range from 459 to $838 \mu\text{S}\cdot\text{cm}^{-1}$ throughout the whole study period (the Biała river). The values for specific conductance obtained in the study reported here were lower compared with other Polish rivers and demonstrated that the Łydynia river has got class I water [Regulation of the Minister of Environment of 9 November 2011].

Figure 5 shows changes in calcium ion content in 2009–2011. In the spring, the calcium ion concentration in the water studied was between 100.6 and $102.2 \text{ mg}\cdot\text{dm}^{-3}$ whereas in the autumn the range was 95 to $95.9 \text{ mg}\cdot\text{dm}^{-3}$. Average values of calcium ion content in the study periods were typical of class I water (Figure 5). Wysocka-Czubaszek [2014] obtained the range from 46.8 to $68.6 \text{ mg}\cdot\text{dm}^{-3}$ for water in the upper part of the Biała river whereas in the lower part, the values ranged from 85.8 to $216 \text{ mg}\cdot\text{dm}^{-3}$. The concentration of magnesium ions in the water of the Łydynia river was higher in the autumn, the highest being in 2010 ($27.9 \text{ mg}\cdot\text{dm}^{-3}$) and the lowest in 2009 ($19.2 \text{ mg}\cdot\text{dm}^{-3}$). The values recorded in autumn ranged from 16.2 to $21.9 \text{ mg}\cdot\text{dm}^{-3}$ (Figure 6). The indicator of pollution did not exceed the limit value for class I water. Wysocka-Czubaszek [2014] reported the values for the Biała river ranging from 11.5 to $13.2 \text{ mg}\cdot\text{dm}^{-3}$.

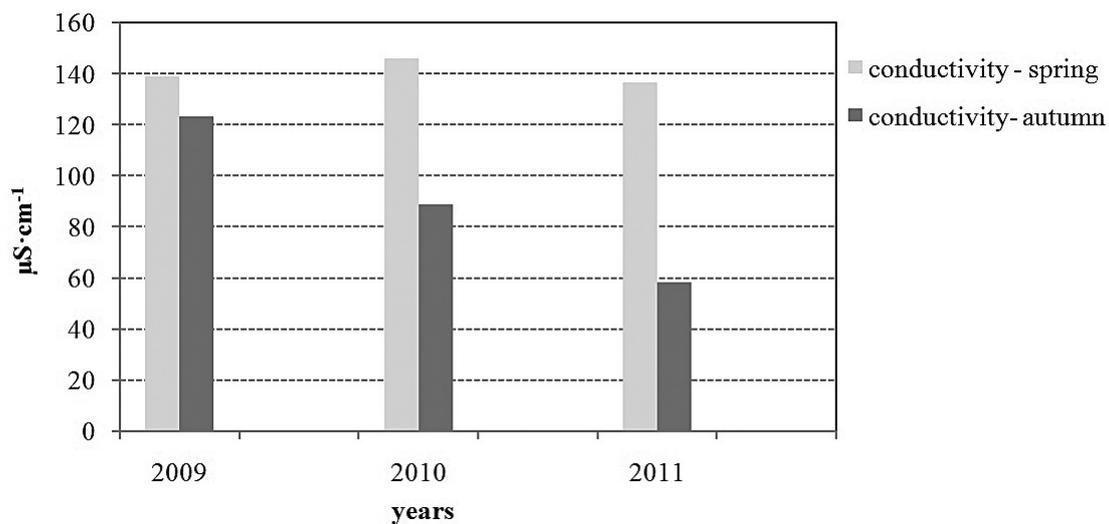


Figure 4. Seasonal changes in the conductivity in the Łydynia river in 2009–2011

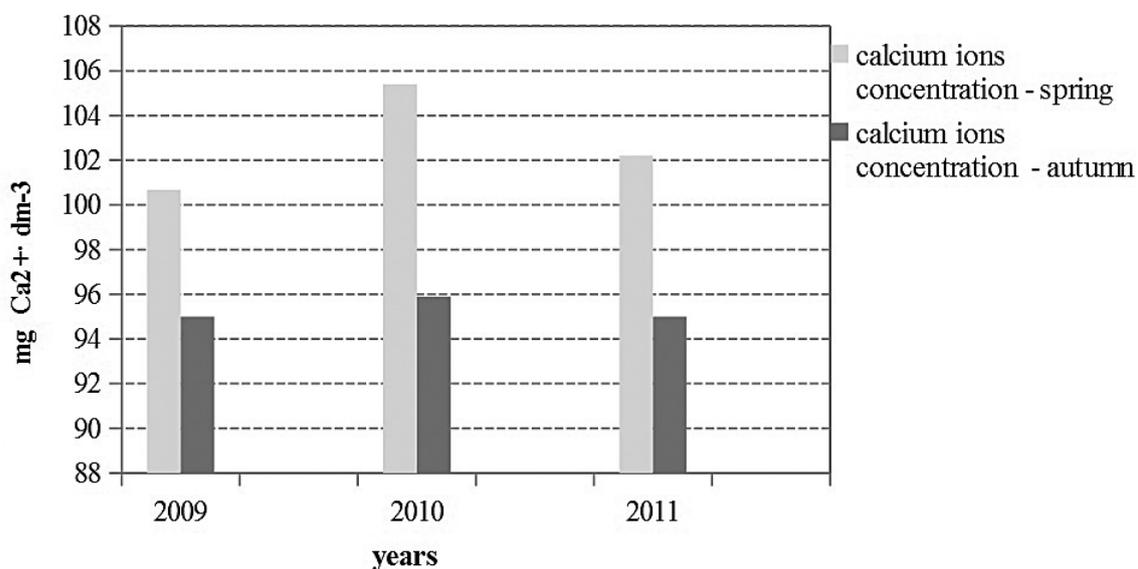


Figure 5. Seasonal changes in the content of calcium ions in the Łydynia river in 2009–2011

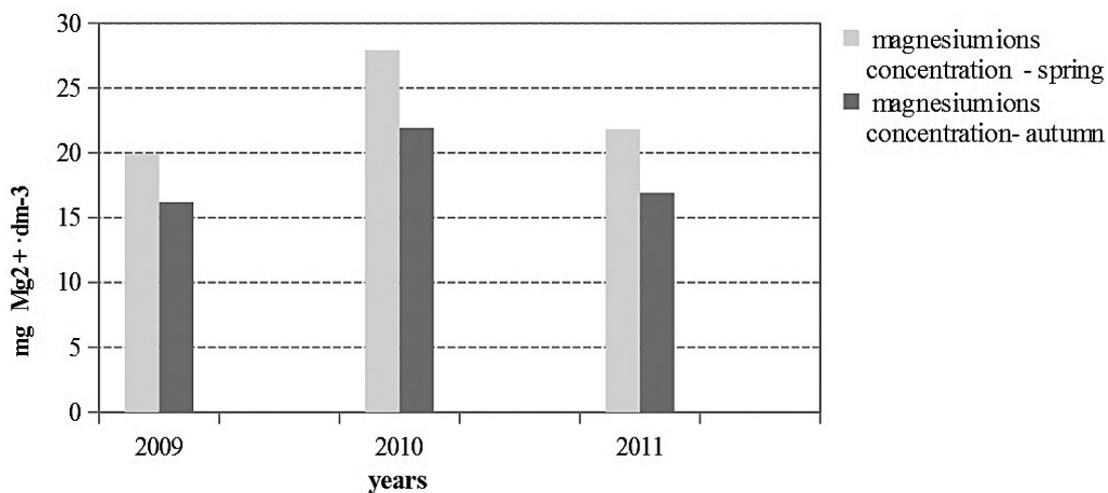


Figure 6. Seasonal changes in the content of magnesium ions in the Łydynia river in 2009–2011

CONCLUSIONS

1. Physical and chemicals indicators which demonstrated that the water of the Łydynia river was of very good quality were: pH, concentration of calcium and magnesium ions, and specific conductance. Their values did not exceed the limit values of class I waters set for waterbody of natural surface waters such as rivers.
2. The study results varied and depended on seasons of the year and study years.
3. Higher values of pollution indicators were recorded in autumn.

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