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Assessment of Water Quality in the Lakes Along Colentina River

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Abstract. The purpose of this study is to evaluate the water quality in the lakes along Colentina River according to MO 161/2006. To achieve this goal, two sampling sections (entry and exit points) for each lake have been established, and the following indicators have been determined: pH, water temperature, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, nitrites, nitrates and ammonium nitrogen, total nitrogen, orthophosphates, total phosphorus, electrical conductivity, filterable residue, chlorides, sulphates, calcium, magnesium and sodium. Following this study, the variation of the concentrations of determined indicators in the two sampling sections for each lake has been assessed, as well as the classification into quality classes according to the before mentioned order.

Introduction

The differential distribution of global water resources along with its unsustainable usage as well as the population growth have led in some regions to a social and ecologic collapse, posing a severe risk to the environment [1, 2].

Water quality is very important for human life, water being the major constituent of all living organisms, and thus, water quality assessment is a major objective in the management of water bodies [3].

Pollution of surface waters leads to severe effects on biosphere, affecting the aquatic life from microorganisms to insects, birds and fish, and also the health of animals and terrestrial plants [4-6].

Currently, under European Union law, many research studies are focused on finding ways to prevent and reduce pollution of aquatic ecosystems [7].

Despite the progress of the primary pollution control systems using municipal and industrial wastewater treatments, secondary pollution such as eutrophication has continued to deteriorate lately, becoming a significant problem for the biodiversity of aquatic ecosystems [8-10].

The process of eutrophication is generally understood as a nutrient enrichment of water bodies (especially with chemical forms of nitrogen and phosphorus) [11] that can determine the production of algae and superior plants, and thus the production of biomass, leading to an increased turbidity and in some cases to an increased odor of water [12, 13]. Algal development affects water clarity and dissolved oxygen concentration, such phenomena being accompanied by the disappearance of aquatic fauna and finally, by the formation of swamps [14].

The lakes are open systems whose physicochemical and dynamic characteristics are influenced by the synergistic action of several factors [15], one of them being represented by the climate changes [16].

There are numerous natural and artificial lakes around Bucharest that have been used for economic and also recreational purposes. The Colentina River has a length of around 101 km from source to discharge, of which approx. 37.4 km being situated within the area of Bucharest city. The water from this river is primary used for irrigations and fishery, and also for direct consumption.

There are several anthropic lakes on the Colentina River route, including Mogosoaia Lake, Herastrau and Pantelimon Lakes.

The purpose of this study was to evaluate the water quality of these three rivers from the physicochemical point of view.

Materials and Methods

Samples

The water samples have been collected from two sections: entry point (Section I) and exit point (Section II) of each lake, according to sampling standards [17]. The samples have been collected from approximately 30 cm below water level and stored in plastic bottles, keeping them at 4^0C until being analyzed.

Reagents and quality assurance

Table 1 Analytical techniques applied for determination of physicochemical parameters [3]

Parameter	Abbreviation	Applied analytical techniques
Thermal regime and acidification		
Temperature	T	thermometer
pH	pH	pH-meter
Salinity		
Electrical Conductivity	EC	conductivity meter
Filterable residue	TDS	gravimetric method
Chlorides	Cl^-	titrimetric method
Sulphates	SO_4^{2-}	gravimetric method
Calcium	Ca^{2+}	titrimetric method
Magnesium	Mg^{2+}	titrimetric method
Sodium	Na^+	atomic absorption spectrometry
Oxygen regime		
Dissolved oxygen	OD	Winkler titration, DO meter
Chemical oxygen demand	COD	permanganate titration
5-days biochemical oxygen demand	BOD	incubation, Winkler titration
Nutrients		
Ammonium-nitrogen	NH_4-N	sodium nitroprusside, spectrophotometry
Nitrite-nitrogen	NO_2-N	4-aminobenzene sulphonamide, spectrophotometry
Nitrate-nitrogen	NO_3-N	sulphosalicylic acid, spectrophotometry
Total nitrogen	TN	titrimetric method
Orthophosphates	PO_4-P	spectrophotometry
Total phosphorus	TP	peroxydisulphate oxidation, spectrophotometry

The following indicators have been assessed for the evaluation of water quality: pH, water temperature, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, nitrites, nitrates and ammonium nitrogen, total nitrogen, orthophosphates, total phosphorus, electrical conductivity, filterable residue, chlorides, sulphates, calcium, magnesium, and sodium (Tabel 1).

All reagents used for the determination of the above mentioned indicators were of analytical purity and their determinations were performed using standardized methods of analysis.

Results and discussions

The quality assessment of monitored waters was performed using the M.O. no. 161/2006 [18] from Romanian Legislation. Table 2 presents quality classes of monitored indicators for the two sampling sections: entry (Section I) and exit (Section II) points of each evaluated lake.

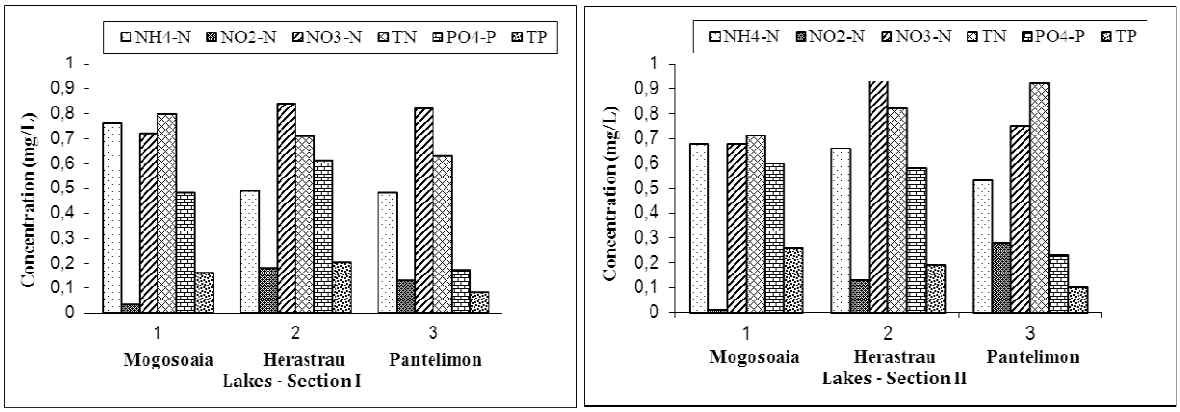
Table 2 Framing of monitored quality indicators in quality classes for the three lakes

Parameter	Mogosoaia Lake		Herastrau Lake		Pantelimon Lake	
	Section		Section		Section	
	I	II	I	II	I	II
	Quality Class according MO 161/2006					
T	not standardized					
EC						
pH	7.22-7.91					
DO	I	I	I	I	I	I
BOD	II	II	II	I	II	I
COD	II	II	II	II	II	II
NH_4-N	II	II	II	II	II	II
NO_2-N	II	I	IV	IV	IV	IV
NO_3-N	I	I	I	I	I	I
TN	I	I	I	I	I	I
PO_4-P	IV	IV	IV	IV	II	III
TP	II	II	II	II	I	I
TDS	I	I	I	I	I	I
Cl^-	II	II	II	II	III	II
Sulphates	I	I	I	I	I	I
Ca^{2+}	I	I	I	I	I	I
Mg^{2+}	I	I	I	I	I	I
Na^+	II	II	II	II	II	II

As an overall assessment, the investigations of Mogosoaia, Pantelimon and Herastrau lakes have led to a general classification of the monitored sections as quality classes I-IV, according to MO 161/2006. The evaluation of nitrites concentration in the Mogosoaia and Herastrau lakes and orthophosphates concentration in Herastrau and Pantelimon lakes resulted in a classification of monitored sections as quality class IV, according to the above mentioned order.

From the graphical representation of the nutrients variation in the monitored lakes (Fig. 1) the downward trend in concentrations of NH_4-N in both sampling sections of the three monitored lakes can be observed. The NO_2-N concentration recorded a maximum of 0.28 mg/L in sampling section II of Pantelimon Lake.

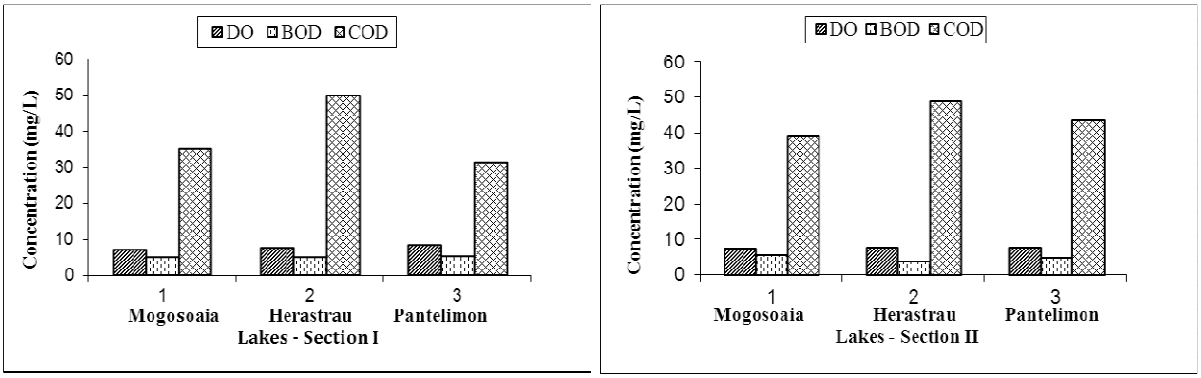
The concentration of total nitrogen in sections monitored varies as: Mogosoaia L.> Herastrau L.> Pantelimon L. Total phosphorus concentration in the first section varies as follows: Herastrau L. > Mogosoaia L. > Pantelimon L. (Fig. 1a) and concentration determined in the second section is as follows: Mogosoaia L. > Herastrau L. > Pantelimon L. (Fig. 1b).



(a) (b)

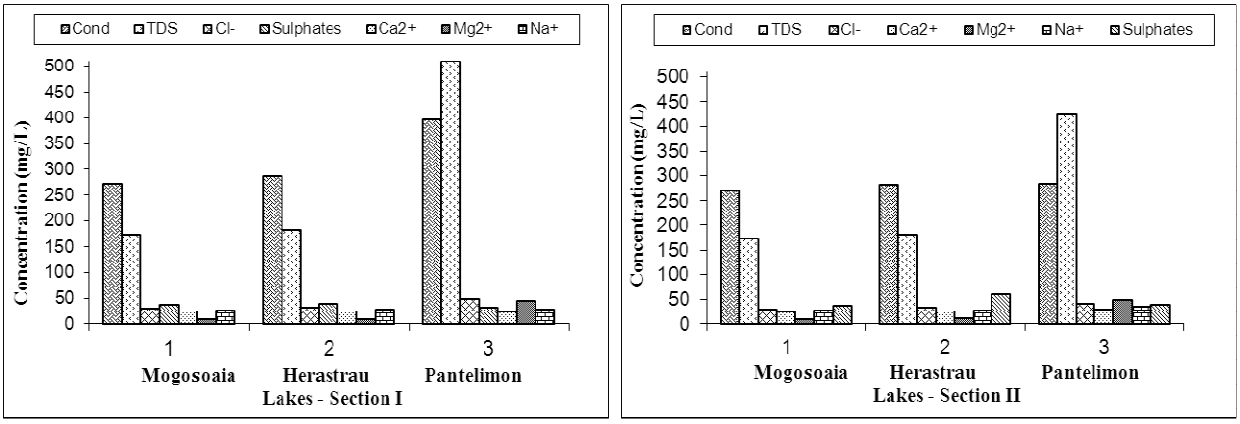
Fig. 1 Variation of nutrients in the monitored lakes for the two sections: entry point-Section I (a) and exit point -Section II (b)

Following the analysis of the oxygen variation (Fig. 2), the variation of the concentration of dissolved oxygen, biochemical oxygen demand and chemical oxygen demand in both sections is as follows: Mogosoaia L.< Herastrau L.< Pantelimon L. As for the specific indicators for assessing salinity, higher values were found in section I than in section II, for all the three lakes.



(a) (b)

Fig. 2 Variation of oxygen for the two sections: entry point - Section I (a) and exit point - Section II (b)



(a) (b)

Fig. 3 Variation of salinity specific indicators for the two sections: entry point - Section I (a) and exit point - Section II (b) of each lake

Quality indicators specific to salinity, such as calcium, magnesium, sodium and potassium, are substances of natural origin and are not related to pollution. Fig. 3 shows approximately similar values for Mogosoaia and Herastrau lakes, and higher values for Pantelimon Lake.

Conclusions

Based on the assessed quality parameters, their framing into quality classes for the two sections of each evaluated lake has been established. It has been found that the monitored indicators are generally included in the quality classes I and II according to MO 161/2006, although the concentration of nitrites in Mogosoaia and Herastrau lakes as well as the concentration of orthophosphates in the Herastrau and Pantelimon lakes are specific to values of quality class IV according to the above mentioned order.

For the upstream lakes (Mogosoaia and Herastrau), higher values for ammonium and orthophosphates, and lower values for nitrates, total nitrogen, filterable residue, chlorides and magnesium than the ones from Pantelimon Lake have been recorded. Other quality indicators had similar values for the 6 sampling points.

Following this study, Mogosoaia and Herastrau have been classified as eutrophic-hypertrophic type lakes and Pantelimon Lake has been classified as meso-eutrophic type.

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