

## **ECOLOGICAL SITUATION OF SOME LAKES FROM CHISINAU MUNICIPALITY, REPUBLIC OF MOLDOVA AND MEASURES OF ITS IMPROVEMENT**

**Tatiana Dudnicenco<sup>1</sup>**

**Key words:** eutrophication, lakes, pollution.

**Abstract.** Chisinau's lakes represent aquatic basins with high eutrophication level. Ghidighici Lake has higher self-epuration capacity, and thanks to this its waters are cleaner than others urban studied lakes. The reducing of phosphor and nitrogen contribution from waste waters is the base factor to combat eutrophication of Chisinau municipality lakes.

### **Introduction**

In Chisinau municipality are placed a limited number of aquatic resources. The surface waters are represented by Bac river with its tributaries, which cross the urban area, dams lakes Ghidighici and Ialoveni wich are situated in the periurban area, and 18 lakes with small sizes. In the parks from Rascani and Botanica residential districts and Sculeni Barrier have been constructed waterfalls with small lakes. Also there are 3 big lakes with volumes over 300 000 m<sup>3</sup>, 4 medium lakes (100 000-300 000 m<sup>3</sup>) and 10 small lakes (volume up to 100 000 m<sup>3</sup>). The total volume of aquatic basins from Chisinau municipality is equal with 3,4 million m<sup>3</sup> and its total area is of 121 hectares. The coast length is of 18,7 km. Ecological situation of lakes from Chisinau municipality is influenced by anthropogenic activities, being degraded from the quantitative, qualitative and biologic aspects.

One of the biggest dangers for artificial lakes is eutrophication. Eutrophication is one of the normal phases in the evolution of lacustrian system. In the accelerated evolution, it is a degradation process. Eutrophication is a syndrome of ecosystem responses to human activities, that fertilize water bodies with nitrogen (N) and phosphorus (P), often leading to changes in animal and plant populations and degradation of water and habitat quality. Nutrients can come from many sources, such as fertilizers applied to agricultural fields, suburban lawns;

---

<sup>1</sup> Moldova State University, Chişinău, R. Moldova, dudnicenco@yahoo.com

deposition of nitrogen from the atmosphere; erosion of soil containing nutrients; and sewage treatment plant discharges. Eutrophication generally promotes excessive phytoplankton growth (algal blooms), disrupts the normal functioning of the ecosystem, causing a variety of problems such as a lack of oxygen in the water, needed for fish and shellfish to survive. Human society is impacted as well: eutrophication decreases the resource value of rivers, lakes, and estuaries, such that recreation, fishing, hunting, and aesthetic enjoyment are hindered. Eutrophication appears especially in lakes where aeration is reduced (Malacea, 1969).

### **1. Materials and methods**

For the study of the ecological situation of some lakes from Chisinau municipality, have been selected 4 lakes: the lower lake from Valea Trandafirilor park, the lower one from Rascani park, the upper one from La izvor park and Ghidighici lake.

The determination of water quality category and of water trophicity were done by forecasts of *Hygienic rules. The protection of water basins against pollution* (Sireteanu ș.a., 1997), in accordance with stipulations of STAS 4706/88 "The quality categories and conditions for surface waters" (1988).

The determination of total phosphorus, total nitrogen, dissolved oxygen in water and of oxygen saturation were conducted using the methods described by Sandu et al., 1992. The determination of  $Fe^{3+} + Fe^{2+}$  sum and manganese quantity were conducted using the methods described by Friptuleac et al., 1998.

The samples were taken from the studied lakes in two seasons: winter and summer. For each lake were fixed three permanent stations of sample collection and visual observation – in the upper part of the lake, in the middle and in the lower parts. The samples were taken from superficial horizon of water (15-20 cm). All samples were collected in glass vessels and were fixed with 2-4 ml chlorophorm at 1 l of sample.

### **2. Results and discussions**

One of the recent studies on the approached problem was conducted by Prunici P. and Drumea D. (1998) who studied the nutrient conditions in the Chisinau's lakes. Ample investigations on these lakes were done in the direction of quantitative and qualitative studies of phytoplankton. Thus the phytoplankton of the La izvor lake was recently studied by Grabco (2003). The phytoplankton of the Ghidighici lake was studied from thirteenth years after construction till present and described by Danilov (1970, 1989), Grimalski and Danilov (1966), Shalari (1971), Cocirta (1988), Grabco (2003). During 2005-2007 the activity of water quality monitoring included 4 artificial lakes. Global characterization of water quality of

these lakes was done by interpreting analyses conducted in seasonal campaigns, with reference at framing quality categories.

Tab. 1 - The indicators for eutrophication process of some lakes from Chisinau municipality

Indexes	Date of sample draw	The place of water sample draw			
		Rascani	La izvor	Valea Trandafirilor	Ghidighici
Total P, mg P/l	14.01.05	0,024±0,002	0,029±0,001	0,020±0,002	0,009±0,001
	10.08.05	0,071±0,007	0,092±0,019	0,042±0,011	0,022±0,008
	23.01.06	0,028±0,001	0,030±0,001	0,013±0,001	0,010±0,002
	12.08.06	0,083±0,005	0,096±0,007	0,054±0,010	0,029±0,009
	19.01.07	0,020±0,001	0,032±0,003	0,018±0,002	0,008±0,001
	17.08.07	0,089±0,009	0,087±0,006	0,048±0,001	0,019±0,003
Total N, mg N/l	14.01.05	0,58±0,05	0,60±0,03	0,49±0,03	0,45±0,02
	10.08.05	1,33±0,03	1,55±0,01	0,75±0,04	0,67±0,03
	23.01.06	0,62±0,02	0,64±0,01	0,51±0,05	0,40±0,04
	12.08.06	1,30±0,04	1,43±0,02	0,89±0,01	0,72±0,02
	19.01.07	0,50±0,02	0,52±0,01	0,59±0,03	0,37±0,01
	17.08.07	1,24±0,03	1,49±0,01	0,95±0,02	0,80±0,03
Minimum saturation with oxygen, %	14.01.05	17,2±0,06	14,7±0,07	69,5±0,15	96,4±0,12
	10.08.05	9,4±0,03	2,9±0,04	8,4±0,23	11,1±0,01
	23.01.06	19,2±0,09	12,3±0,05	68,3±0,11	84,2±0,17
	12.08.06	8,1±0,01	3,2±0,03	7,9±0,09	6,4±0,02
	19.01.07	22,3±0,04	15,1±0,02	52,7±0,11	83,4±0,12
	17.08.07	10,2±0,24	4,2±0,15	10,5±0,13	5,8±0,01

It was studied the minimum saturation with oxygen, on the base of calculation of dissolved oxygen in water. If we analyze the obtained results on a period of 3 years of investigation, we can mention that the best insurance with oxygen was that of Ghidighici lake (96,4±0,12%) in winter period, and the worst (2,9±0,04%) in La izvor lake, during the summer of 2005 and also in 2006-2007. During the summer algal blooms occurred in all examined lakes, with the exception of Ghidighici lake, at the different stage of manifestation. This can explain why the quantity of oxygen in all cases is bigger in winter period and decreasing in summer period (for the example in Ghidighici lake in summer of 2005 the quantity of oxygen in water decreased with 85,3% in comparison to the winter period). The excessive death of algae after their intensive multiplication, determined an important increase in organic substances, which respectively require a big quantity of oxygen for oxidation. It was established the strong seasonal variation of this index. By this index Ghidighici lake in winter is in mezzotrophic

stage, and in the summer is oligotrophic. In summer Valea Trandafirilor, Rascani and La izvor lakes are eutrophic, and in the winter they are mezzotrophic.

Tab. 2 - The concentration of iron and manganese ions from some lakes from Chisinau municipality

Indexes	<i>Maximum admissible concentration (MAC)</i>	Date	The place of water sample draw			
			Rascani	La izvor	Valea Trandafirilor	Ghidighici
Iron	1,0 mg/l	14.01.05	1,7±0,04	1,9±0,02	1,1±0,02	0,7±0,01
		10.08.05	2,2±0,08	2,4±0,03	1,5±0,04	1,2±0,02
		23.01.06	1,8±0,01	2,0±0,05	1,4±0,01	1,1±0,05
		12.08.06	2,5±0,02	2,8±0,08	1,9±0,06	1,4±0,03
		19.01.07	1,5±0,01	1,8±0,09	0,7±0,02	0,4±0,04
		17.08.07	2,4±0,01	2,7±0,05	1,6±0,05	0,3±0,02
Manganese	0,1 mg/l	14.01.05	0,14±0,01	0,17±0,03	0,09±0,01	0,06±0,01
		10.08.05	0,28±0,02	0,32±0,01	0,14±0,06	0,08±0,01
		23.01.06	0,16±0,02	0,19±0,07	0,13±0,02	0,07±0,01
		12.08.06	0,33±0,04	0,38±0,05	0,19±0,03	0,09±0,05
		19.01.07	0,11±0,01	0,21±0,01	0,12±0,04	0,05±0,01
		17.08.07	0,29±0,03	0,35±0,02	0,22±0,01	0,07±0,02

The biggest quantity of total phosphorus in summer was determined such in case of total phosphorus in 2006 year in La izvor lake – 0,096±0,007 mg/l.

Analyzing the quantity of total phosphorus and total nitrogen determined in water of analyzed lakes in 2005-2007, we could observe that the values of these indexes didn't varied in large limits. Under the aspect of assignment to trophicity stage, the situation was approximately the same as the situation with the minim saturation with oxygen. Thus, Ghidighici lake in winter is mezzotrophic and in summer oligotrophic, in the summer Valea Trandafirilor, Rascani and La izvor lakes are eutrophic, and in winter mezzotrophic.

To confirm the accuracy of our affirmations, we determined two more indexes – the concentration of iron ions and of manganese, which in eutrophication lead to decreases of water quality.

The biggest outrunning of MAC (*Maximum admissible concentration*) in the case of iron ions was in La izvor lake – with 180% (2,8±0,08 mg/l) in the summer of 2006. In the period of investigations only in the winters of 2005 and

2007 the quantity of iron ions in Ghidighici lake didn't exceed the MAC value (Tab. 2).

Only in Ghidighici lake didn't established the manganese outrunning of the MAC value, indifferently by seasonal period. The biggest manganese quantity was in La izvor lake, with the MAC value outrunning with 280 % ( $0,38 \pm 0,05$ ) (Tab. 2). The most polluted lake from studied lakes of Chisinau municipality is La izvor.

The appearance of some stratus of floating algae with intensive multiplication at surface, unpleasant smells of water, diminution of water transparence, deoxygenation of water were represents in summer period of investigation the most evident symptoms of eutrophication process.

The main agents of eutrophication are compounds containing the elements phosphorus and nitrogen. It is these elements that, under natural conditions, usually limit the primary production in ecosystems. Increasing their supply therefore increases productivity. The solutions to resolve the eutrophication problem are: to restore wetlands and riparian buffer zones between farms and surface waters, reduce livestock densities, improve efficiencies of fertilizer applications, treat urban runoff from streets and storm drains, reduce N emissions from vehicles and power plants, and further increase the efficiency of N and P removal from municipal wastewater.

### Conclusions

From the analyses of obtained data results that from 4 investigated lakes all are included in the 2<sup>nd</sup> category of quality, the clearest is Ghidighici lake and then in decreasing order: that from Valia Trandafirilor park, Rascani lake and La izvor lake. The Ghidighici lake in winter is mezzotrophic and in summer oligotrophic, in summer Valea Trandafirilor, Rascani and La izvor lakes are eutrophic, and in the winter mezzotrophic stage. The lakes from Chisinau municipality represent aquatic basins with high level of eutrophication.. Probably, the Ghidighici Lake has higher self-epuration capacity, and thanks to this its waters are cleaner then other urban studied lakes.

### Bibliography

- Friptuleac, Gr., Alexa, L., Babalau, V. (1998). *Environment hygiene (Practical proceedings)*. Chisinau: Stiinta, 360 p.
- Grabco, Nadejda. (2003). *Bacilariophytaes Phylum Bacillariophyta) from aquatic basin of inter-river Nistru-Prut*. Ph. D. thesis in biology sciences. Chisinau, 194p.
- Malacea, I. (1969). *The biology of impure waters*. Bucureşti: Ed. Acad. RSP, p. 65.
- Prunici, P., Drumea, D. (1998). *Balance sheet of mineral nitrogen and phosphorus and biogenic load of urban aquatic ecosystems // Abstracts Book. The third International scientific-practical conference "Waters of Moldova"*. Chisinau, p. 204-206.

- Sandu, Maria, Lozan, R., Ropot, V. (1992). Methods and instructions for control of water quality. Chisinau: Stiinta, 160 p.
- Sireteanu, D. ș. a. (1997). *Hygienic rules. Water basins protection against pollution*. Chisinau: Tipogr. AȘM.
- STAS 4706/88 „*The categories and conditions of surface waters quality*”, Chisinau, (1988).
- Grumaliskii, V. L., Danilov, I. E. (1966). *Phytoplankton of Ghidighici lake* // Materials of scientific conference of Moldova State University from 1965 year. Chisinau, 73-74 p.
- Danilov, I. E. (1989). *Algae from Ghidighici lake* // Botanical investigations. Chisinau: Stiinta, p. 116-123.
- Danilov, I. E. (1970). *Phytoplankton of small lakes from Moldova* // Report of Ph. D. thesis in biology sciences. Chisinau, 21 p.
- Cocarta, P. N. (1988). *The development of Phytoplankton in Ghidighici lake* // Investigations on ecology, floristic, biochemistry and physiology of plants from Moldova. Chisinau: Stiinta, p. 56-60.
- Salaru, V. M. (1971). *Phytoplankton of lakes from Moldova* // Chisinau: Stiinta, 204 p.