THE NITROGEN REGIME OF THE SASAR RIVER, IN BAIA MARE SECTION, THE PERIOD 2000-2010

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ABSTRACT – The Baia Mare city - the residence of Maramures county, is known as one of the most polluted cities from Romania, following a long history of mining activities and ores processing. The improper treatment of wastewater from flotation and treatment with cyanide ores and their discharge into the river Sasar led, slowly, but surely destroying the ecosystem. In addition to mining activities have contributed of course, and the metallurgical activities in the area. One of constant pollutions is and disposal of sewage waste water (treated poorly or not at all) in the mass water of the Sasar river. The nitrogen regime may provide clues as to the possibility of developing various forms of life, being an indicator of the nutrient regime of aquatic life. This study aims at assessing the quality of the nitrogen regime of Sasar river, in the section upstream and downstream of Baia Mare, in the period 2000-2010, with reference to the Order 161/2006 - regarding the classification of surface water quality to determine the ecological status of water bodies .

Keywords*: river, pollution, ecosystem, nitrogen regim, classification, quality water.*

1. INTRODUCTION

The Baia Mare town - the residence of the Maramures county,one of the most important urban center in northwestern of Romania, situated at the foot of the Carpathians, it was developed historically as a result of mining process and ore processing the gold-silver and nonferrous ores.

The Baia Mare town it was first time documented in 1329, as "Ladies River" (Rivulus Dominarum) in an act of the chancery of King Charles and was developed as a center of gold-silver processing ores, in the XIV-XV centuries.

Exploitation of the ores was done by digging galleries in the shaped of wells; the extracted ore has was crushed in fulling mills, grinding and washing. However, the native gold ore was found both in solid form, "quite clean and pure from nature" and same time, in ores.

The washing operations of gold sand in riverbeds from region was preponderant activity undertaken by women, the wives of miners. This "image" has been captured by foreign tourists and historians who visited the Baia Mare, and was the basis for awarding the name "River of the Ladies " of river who crossing the town; today the name is Sasar river, at the last village crosses before the junction with Lapus river. [1]

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In the second half of the twentieth century, mining process became unprofitable, but the communist regime decided to subsidize the sector. After the fall of (in 1989) and under the terms of accession to EU structures, mining process has ceased; all mining perimeters entering into conservation.

Almost all rivers situated in vicinity of major industrial sites, have exceeded allowable concentrations of metals of the first quality grade of surface water; the industrial development has led to an increase in active population in the area and, then related activities. As a result, discharges into the Sasar river (the main river that crosses the city) are not only with metal loading. Discharges of domestic sewage water, untreated or treated improperly are present today. All these activities leave their mark in the structure and functioning of ecosystems in the region. The permanent or temporary pollution of water bodies, the life, in whole ecosystem suffers; some species can not tolerate the large variations of the abiotic factors.

This study will present the evolution of the indicators of nitrogen regime (ammonium, nitrate and nitrite) of the river Săsar in the section upstream of Baia Sprie and downstream of Baia Mare, the sector who was most intensively exploited.

2. MATERIAL AND METHOD

The Sasar river springing from the Gutii Mountains, from the altitude of 1005 m, with the following geographic coordinates at the springing : 47º41’28" north latitude and 23º48’31" east longitude. The shedding quota in Lapus River (155 m) reveals the difference from altitude - 850 m, and develop so, an catchment of 306 km^2, strongly asymmetric. [2]

The lenght a 31 km of the river Sasar allows crossing by four cities (listed from upstream to downstream): Baia Sprie, Tautii de Sus, Baia Mare and Sasar village, and collecting the waters of rivers Firiza and Chiuzbaia, St. John, Racos and Borca. In each of the above mentioned cities, the river Sasar collect, directly and indirect wastewater from mining activities (from preparation ores or storage of tailings), but and waste water from production units as well as from individuals.

Modernization and extension of the sewage and the treatment plant of wastewater of the city, should be reflected directly in changes in concentrations of nitrogen regime indicators, mainly ammonium indicator.

Nitrogen is one of the main elements for supporting life on our planet, intervening in various of life phases of plant and animal life. Because the indicators: ammonium, nitrites and nitrates are important steps of the presence the nitrogen in his biogeochemical cycle from the nature and water, only these parameters were considered in this study.

All forms of the nitrogen who present results from 2000 were determined by molecular absorption spectrometry using the spectrometer Hach – DR 2000 type, and in 2010, using the spectrophotometer Agilent - type 8453; both devices were checked and calibrated, in accordance with legal metrology provisions. As a result, this study consider that the results is reproducible.

The monthly values of the indicators considered were reported at the 5 quality classes of the Order no. 161/2006 approving the "Norms on surface water quality classification to determine the ecological status of water bodies" and were plotted.

2.1. The ammonium parameter

The ammonium indicator is one of parameters who indicating a recent pollution (hours-days) of the waters. His presence in water is due to incomplete degradation of organic substances containing nitrogen or may originate from soil, as a result of inappropriate agricultural activities. [4]

In 2000, the chemical analysis of ammonium indicator was made in accordance with the standard in force, at that time: STAS 8683/70 - Surface water and wastewater. Determination of ammonium indicator with Nessler reagent.

Since 2001, the romanian standard STAS 8683/70 has been replaced by european standard SR ISO 7150-1/2001 - Water quality. Determination of ammonium. Part 1: Manual spectrometric method.

From the analysis of data obtained for 2000 [8], we can say that:

- in the upstream section of Baia Sprie, the minimum of value is 0.365 mg N-NH4/l in February,and the maximum is 0.823 mg N-NH4/l in June, the annual average value being 0.604 mg N-NH4/l;

- in the downstream section of Baia Mare, the minimum value is 0.839 mg N-NH4/l in July, the maximum is 2.671 mg N-NH4/l in December, and the annual average value being 1.343 mg N-NH4/l

For 2010 year [9], the comments reflect that:

- in the upstream section of Baia Sprie the minimum value is 0.068 mg N-NH4/ l in January, the maximum is 0.738 mg N-NH4/l in October, and the annual average value being 0.339 mg N-NH4/l;

- in the downstream section of Baia Mare the minimum value is 0.680 mg N-NH4/l in February, maximum is 2.019 mg N-NH4/l in November, and the annual average value being 0.756 mg N-NH4/l.

The variation of ammonium indicator in this two sections and and in the two moments, is shown in the following graphs (fig. 1).

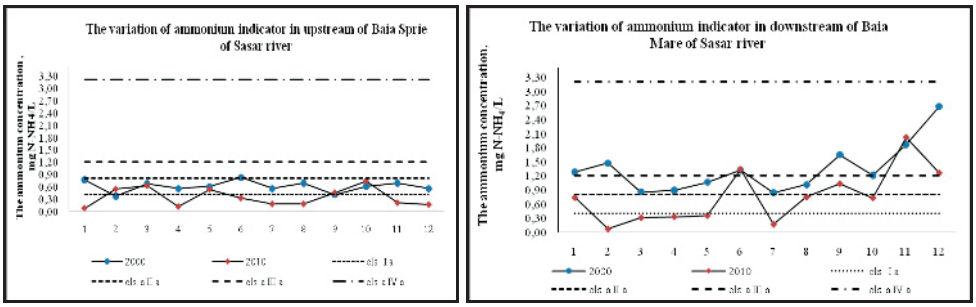

Fig. 1. ***The variation of ammonium indicator of the Sasar river in Baia Sprie upstream section (2000 and 2010) and in Baia Mare downstream section (2000 and 2010)***

2.2. The nitrites parameter

The nitrites are an important stage in the metabolism of the nitrogen compounds and intermediate stage between ammonia and nitrate, in the biogeochemical cycle of nitrogen. Their presence is due either the reactions of bacterial oxidation of the ammonium or of the reduction reactions of the nitrates.

In 2000 the analysis of nitrites from water were performed in accordance with standard ISO 6777/1996. In 2010, the principle of chemical analysis remained the same, but the standard has undergone a transformation and notification - SR EN 26777/2002 + C91/2006 – Water quality. Determination of nitrite. Molecular absorption spectrometric method.

Analyzing the results obtained in 2000 [8] I can say that:

- in the section upstream of Baia Sprie the minimum value is 0.009 mg N-NO_2/l in August, and the maximum is 0.016 mg N-NO_2/l in May; the annual average value was 0,008 mg N-NO_2/l;

- in the section downstream of Baia Mare the minimum value is 0,007 mg N-NO_2/l in March, the maximum is 0.064 mg N-NO_2/l in September, the annual average value was 0.020 mg N-NO_2/l.

For 2010 [9], the results shows that:

- in the upstream section of Baia Sprie the minimum value is 0.005 mg N-NO_2/l in January, the maximum is 0.010 mg N-NO_2/l in May and July, and the annual average values is 0.011 mgN-NO_2/l;

- in the downstream section of Baia Mare the minimum value is 0.003 mg N-NO_2/l in February, the maximum is 0.157 mg N-NO_2/l in August, and the annual average value is 0.035 mg N-NO_2/l.

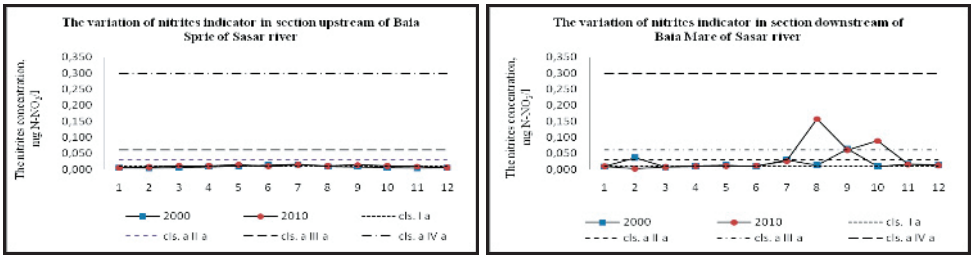

Fig. 2. ***The variation of nitrite indicator of the Sasar river in Baia Sprie upstream section (2000 and 2010) and in Baia Mare downstream section (2000 and 2010)***

The monthly evolution of the nitrites indicator for Sasar river in the section upstream of Baia Sprie and downstream of Baia Mare, in 2000 and 2010, is shown in the graphs from figure 2.

2.3. The nitrates parameter

The nitrates come mainly from soil, after mineralization of organic substances (eg. protein), from fertilizers and/or pesticides containing nitrogen. They can be a factor in the development of algae and aquatic flora.

The nitrates represent the final stage of decomposition of organic substances containing nitrogen in their molecule, indicating an old pollution, even dangerous.

The standard of analysis is the SR ISO 7890-3/2000 – Water quality. Determination of ammonium. Part 1: Manual spectrometric method.

The results obtained in 2000 [8] are defining:

- in the upstream section of Baia Sprie the minimum value is 0.14 mg N-NO_3/l in August and October, the maximum is 0.52 mg N-NO_3/l in July, with annual averaging of the 0.30 mg N-NO_3/l;

- in the downstream section of Baia Mare the minimum value is 0.27 mg N-NO_3/l in September, the maximum is 1.29 mg N-NO_3/l in July, and the annual average value is 0.71 mg N-NO_3/l.

For 2010 [9], the results reflect that:

- in the upstream section of Baia Sprie the minimum value is 0.44 mg N-NO_3/l in June, the maximum is 1.45 mg N-NO_3/l in February, and the average value is 0.828 mg N-NO_3/l ;

- in the downstream section of Baia Mare the minimum value is 0.29 mg N-NO_3/l in July, the maximum is 2.19 mg N-NO_3/l in September, and the average value is 1.01 mg N-NO_3/l.

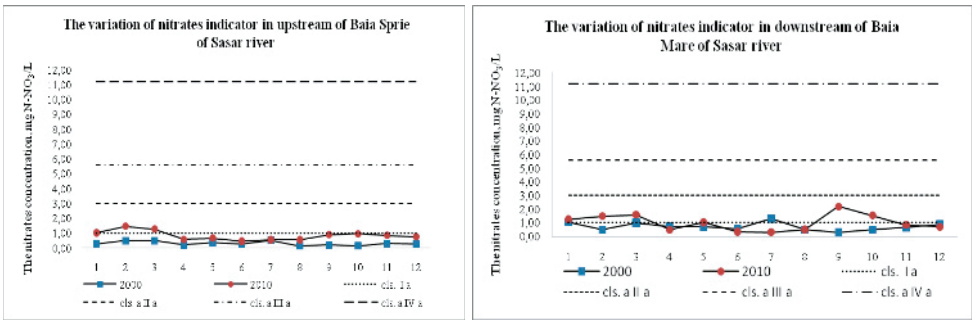

Fig. 3. ***The variation of nitrates indicator of the Sasar river in Baia Sprie upstream section (2000 and 2010) and in Baia Mare downstream section (2000 and 2010)***

The monthly evolution of the nitrates indicator for Sasar river in the section upstream of Baia Sprie and downstream of Baia Mare, for 2000 and 2010 is shown in the graphs in figure 3.

3. CONCLUSIONS

The Order no. 161 of 16.02.2006 approving the "Norms on surface water quality classification to determine the ecological status of water bodies", in paragraph C of table no. 6 - „Elements and Standards of Biological Quality, chemical and physico-chemical to determine the ecological status of surface waters", for nutrient regime - at the point C3, provid following limits:

Table 1. ***Extract from the table no. 6 - „Elements and Standards of Biological Quality, chemical and physico-chemical to determine the ecological status of surface waters”***

No.	Quality indicator	UM	Quality class				
			I	II	III	IV	V
C.3. **Nutrient**							
1.	Ammonium ($N\text{-}NH_4^+$)	mg N/l	0.40	0.80	1,2	3.2	>3.2
2.	Nitrites ($N\text{-}NO_2^-$)	mg N/l	0.01	0.03	0.06	0.3	>0.3
3.	Nitrates ($N\text{-}NO_3^-$)	mg N/l	1	3	5,6	11,2	>11,2

Source: Order no. 161/2006 approving the "Norms on surface water quality classification to determine the ecological status of water bodies"

Analyzing the average of values for the years 2000 and 2010 in both sections of the Sasar river and relating to the provisions of Order no. 161/2006, the classification is as follows:

Table 2. ***The quality class in the both section considered of Sasar river, in 2000 and 2010***

Indicator	Quality class in the Baia Sprie upstream section		Quality class in the Baia Mare downstream section	
	year 2000	year 2010	year 2000	year 2010
Ammonium	II	I	peste II	II
Nitrites	I	II	II	III
Nitrates	I	I	I	II

From data presented we conclude that:

- the concentration of the ammonium declined in both sections, water quality has returned from the class II in the first class quality, in upstream section of Baia Sprie and almost from the third class of quality, in the second class of quality in downstream section of Baia Mare;

- the concentration of nitrites shows an increase, reflecting an involution of the quality class; in 2010 the upstream section of Baia Sprie is framed in class II of quality and in class III of the quality in the section downstream of Baia Mare. This increase may be related and to decreased concentrations of ammonia (ammonium), which in the presence of oxygen in water, is converted by bacteria (Nitrosomonas) into nitrites.

- the concentration of nitrate in the section upstream of Baia Sprie remained constant; that which, can not be said for the section downstream of Baia Mare; the value of the annual average concentration in 2010 made be framed in class II of the quality the section downstream of Baia Mare;

- the concentration of ammonium and nitrates shows large seasonal variations; the higher values are in winter, probably due to reduced self-purification capacity of water;

- decrease the concentration of ammonium, can be linked to the permanent concern of local authorities about modernization the plant of wastewater treatment and expansion of the sewage system of Baia Mare.

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