RISCURI ŞI CATASTROFE, NR. X, VOL. 9, NR. 1/2011

THE VARIATION OF NITROGEN CHARACTERISTICS INDICATORS IN THE SURFACE WATER FROM BARCAU HYDROGRAPHICAL BASIN DURING THE 1993-2009 PERIOD

SIMONA GABRIELA ANDRIŞCA[1]

ABSTRACT. The variation of nitrogen characteristics indicators in the surface water from Barcau hydrographical basin during the 1993-2009 period. The purpose of this paper is to determine the variation of nitrogen forms characteristic indicators, from surface water of the Barcau River, and their interacting with the environment. The evolution of these parameters was analyzed for eight first level monitoring sections (Boghis, Suplacu de Barcău downstr., Marghita downstr., Parhida, Kismarja, Pocsaj, Berettyóújfalu and Szeghalom), located on the main course; it characterizes large sections of the river and the influence of a different points of wastewater discharge, like anthropogenic influence factors. String data used is homogeneous, obtained by the systematic observations, between 1993-2009.

Keywords:ammonia, nitrites, nitrates, monitoring sections, water contamination

1. Introduction

The main feature of the watercourses is to have a variable load with suspended solids and organic substances, a relationship which is closely related to meteorological and climatic factors. Their concentration increases during the rains, reaching a peak in the floods period and a minimum during the frost periods. The insufficiently treated effluent discharge leads to impaired watercourses quality and the appearance of a wide range of contaminated: poorly degradable organic substances, nitrogen compounds, phosphorus, sulfur, micronutrients (copper, zinc, lead), pesticides, organo-chlorinated insecticides, detergents etc. Also, in more cases, it was identified bacteriological contamination. A specific feature of water from rivers is the self-purification capacity that is due to a series of natural biochemical processes favored by the air-water contact.

Nitrogen forms indicators are water quality parameters characterized by a relatively low toxicity, that generating effects on the eutrophication processes.

[1]*Crisuri Waters Autority,, Oradea, Romania,*
e-mail:andriscasimona@yahoo. com

Nitrogen forms occur in water, specially, from the decomposition and mineralization protein compounds process, derived from sewage or industrial effluents water. Indirectly, they can get into water as a result of a diffuse pollution from agriculture and animal farms. The existence in water of the ammonia and nitrite deficiency, indicate a recent water contamination (Varduca, 1997). Ammonia comes from mineral or vegetable substances. In the ponds waters, ammonia form appears from vegetable substances decomposition. Some algae species bounds the nitrogen or a various forms of this in the presence of organic substances. The biggest demand of ammonia is in the spring and for the nitrogen in autumn. The denitrification bacteria activity is reducing the nitrogen to ammonia. Ammonia is oxidized under aerobic conditions and the resulting energy is used in the synthesis of organic substances.

In Barcau hydrographical area, for the characterization of nitrogen forms specific indicators, were used a string data, obtained by the systematic observations, from the monitoring programs activity realized by the responsible authorities Crisuri Waters Authority (for Romanian monitoring sections) and Environment Protection Authority-Tikofe Debrecen (for Hungarian monitoring sections). The measurements were made by the water quality laboratory within the same institutions. The evolution of this parameters were analyzed for 8 first level monitoring sections (Boghis, Suplacu de Barcău downstr., Marghita downstr., Parhida, Kismarja, Pocsaj, Berettyóújfalu and Szeghalom), located on the main course, that characterize important parts of the river and the influence of a different points of wastewater discharge, like anthropogenic influence factors. The used data string is homogeneous one, obtained by the systematic observations in the 1993-2009 period.

2. Ammonium nitrogen ($N\text{-}NH_4^+$)

Under the action of an oxidative process, the ammonium is transformed through two stages of oxidation in nitrites and, then, into nitrates. The ammonium lake indicates an older water contamination, but the presence of nitrites and nitrates proved the natural self-purification capacity of watercourse. Ammonium ion concentration is highest during autumn and winter seasons, compared to summer, when vegetative processes are large consumers of nitrogen. In figure no. 1 is exemplified seasonal variation of ammonia, in Szeghalom and Parhida sections. The rationale choice of these two sections is that they are closing the basin for each of the two territories crossed by the Barcau waters.

During the studied period, recorded maximum were observed between 1993-1996. After this period, the ammonia concentration starts to decrease. The highest value recorded in the downstream Marghita section in 1995, 1.94 mg / l. This situation can be explained by wastewater effluent discharging from municipal treatment plant Marghita, contaminated water or insufficiently treated. In subsequent years, the trend of parameters variation is decreasing, such as an effect

of re-engineering of industrial and wastewater treatment plants, reducing of the economic activity or more rigorous methods used in the water quality field, harmonized with European legislation.

Although, the values are high, from Suplacu de Barcau downstream to Parhida sections, we can observe a decreasing of values (0.11 mg/l - 1.36 mg/l), showing that the phenomenon of self-purification of the river occurs, transforming ammonia into nitrites and then nitrates. Thus, in Hungarian sections, the variation values decreases steadily (from 1.27 mg/l at Pocsaj in 1994 and 0.14 mg/l at Szeghalom in 2002). It is, however, the influence of domestic waste water discharges from Berettyóújfalu and the fertilization with chemical fertilizers used in agriculture, in the area. Changes in annual average values of nitrogen from ammonia in the analyzed sections, is shown in Figure 2.

3. Nitrogen from Nitrites ($N\text{-}NO_2^-$)

The presence of nitrite ions in water indicates recent contamination of water and the reducing substances presence. The formation of nitrites is the first step of ammonia oxidation. Maximum recorded output is measured at Marghita, 0.19 mg / l in 1995 (Figure 3). After the year 2000, the concentration of nitrogen forms in water decreases because of the modernization process of the wastewater treatment plant from the SC Petrom Service, which serves the city Suplacu de Barcău, and also of the wastewater treatment plant from Marghita city.

Although, as a result of the data analysis obtained by systematic observations made between 1993-2009, there are compounds of nitrogen pollution in the studied area and a various point and diffuse pollution sources; nitrogen from the water, however, falls within the maximum permitted provided the quality standards, with some exceptions can be explained by the ammonia oxidation processes. Relatively low nitrogen concentration is due to environmental oxidant activity, in which ammonium ions are transformed into two phases, nitrites and then nitrates. For Hungarian sections there is no large variations, the spread of values fits a range of small amplitude.

4. Nitrogen from Nitrates ($N\text{-}NO_3^-$)

Nitrates are found in relatively large proportions of water chemical composition. They are the result of advanced oxidation of ammonium ion, indicating that older water pollution. Together, with nitrite, are components of the denitrification process.

Analyzing the annual average variation of nitrate ions in the monitoring sections on Romanian territory is seen, in generally, no high amplitude variations. Extreme values indicate a water pollution case, which is produced by waste water from water treatment plants. There is, however, the only cause of water

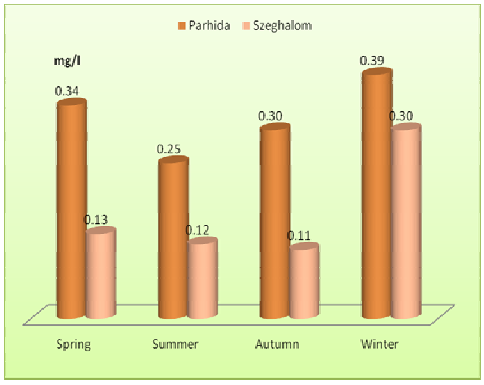

Figure 1. $N\text{-}NH_4^+$ seasonal average content in sections Parhida and Szeghalom *(source: processed data from the archive of Crisuri Waters Authority and Tikofe Debrecen)*

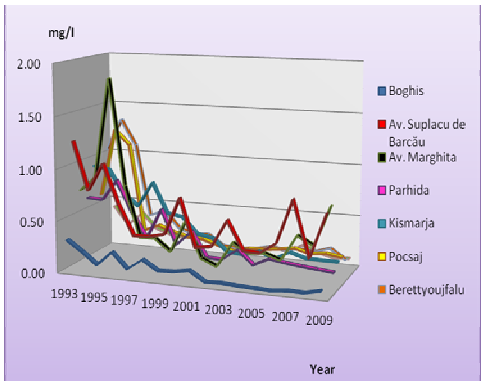

Figure 2. Annual average content of the ammonium nitrogen ($N\text{-}NH_4^+$)*(source: processed data from the archive of Crisuri Waters Authority and Tikofe Debrecen)*

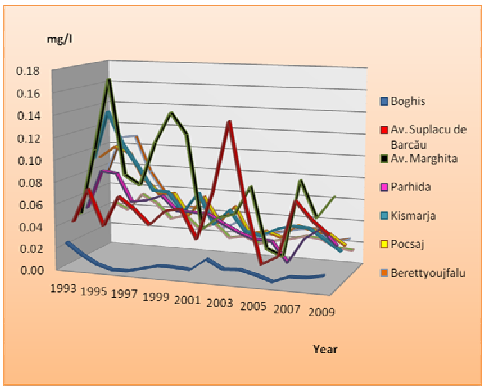

Figure 3. Annual average content of the nitrogen from nitrites ($N\text{-}NO_2^-$) *(source: processed data from the archive of Crisuri Waters Authority and Tikofe Debrecen)*

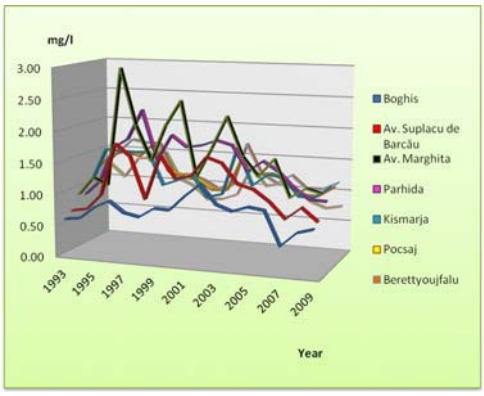

Figure 4 Annual average content of the nitrogen from nitrates ($N\text{-}NO_3^-$) *(source: processed data from the archive of Crisuri Waters Authority and Tikofe Debrecen)*

contamination, increasing values from the upper to the lower basin due to runoff and diffuse pollution by waste water from households. It must be important that this complex form of nitrogen pollution is the effect of using large quantities of fertilizers in agriculture, which can reach the river by diffuse pollution with water from the rain. This phenomenon is present and easily observable in the sections on Hungarian territory, which are variations on a constant spacing of values between 0.99 mg / l in 2001 to 1.73 mg/l in 2003 at Kismarja. Changes in annual average concentrations of nitrates in river basin are shown in Figure 4.

5. Conclusions

- the evolution of characteristic parameters of nitrogen forms in the studied area is determined and, in some subject, conditioned by natural factors (the natural environment, climate, drainage system) and various socio-economic activity that taking place in this geographic area, in relation to soil and subsoil resources (agriculture, industry, urban planning);
- based on the data interpretations from the period 1993-2009, I noticed a decrease in the concentration of nitrogen forms specific indicators, especially after 2002;
- the decrease is due to harmonized monitoring methods of the parameters, according to new European regulations. Essentially, however, is that in recent years there has been a decrease in the industrial production field or closure of more industrial units with the greatest impact on the environment and, thereby, reduced the amount of wastewater loaded with pollutants which, the Barcau river represent an emissary;
- the changes from agriculture field through the rational use of fertilizers, switching from the traditional to the intensive production had, also, beneficial effects on reducing the nutrients concentration in the water;
- it can say that, in terms of parameters analyzed, Barcau river basin is characterized by low concentrations of nitrogen forms in the upstream sectors (for this situation is representative Boghis section, where there are almost no changes occur, the concentration remains constant throughout the period for the three parameters) and satisfactory in the downstream areas, as a result of water contamination, caused by some pollutants.

REFERENCES

1. Bucur, A. (1999), *Water chemistry elements*, H.G.A. Publishing House, Bucureşti;
2. Trufaş, V., Trufaş, C. (2003), *Hydrochemistry*, Agora Publishing House, Bucureşti;
3. Varduca, A. (1997)*, Hydrochemistry and water chemical contamination,* H.G.A. Publishing House Bucureşti;
4. Varduca, A. (1999)*, Water quality integrated monitoring,* H.G.A. Publishing House, Bucureşti;
5. Varduca, A. (2000)*, Water quality protection,* H.G.A. Publishing House, Bucureşti;
6. *** *Agreement between Romania and Republic of Hungary Governments* on cooperation for the protection and sustainable use of transboundary waters, signed in Budapest on September 15th, 2003, entered into force on May 17th, 2004 by Romanian Governement Decision 577/2004;

7. *** *A Víz Keretirányelv hazai megvalósítása VÍZGYŐJTİ-GAZDÁLKODÁSI TERV2-17. jelő, Hortobágy-Berettyó vízgyőjtı*, marcius 2009/ Management Plan of Barcau river, Tikővizig Debrecen, March, 2009;
8. *** *National Report of România – River basin characteristics, impact of human activities and economic analysis required under Article 5, Annex II and Annex III and inventory of protected areas required under Article 6, Annex IV of the EU Water Framework Directive (2000/60/EC),* National Administration "Romanian Waters", 2004*;*
9. *** *Crişuri hydrographical basin water quality synthesis,* (1992-2009), Crisuri Waters Authority.