science is the only way to contribute to a better ecological understanding of running waters along a long river journey over huge distances from its source to its mouth. I am convinced that both nature and people benefit from exchanging ideas from their expertise about field surveys, nature conservation, ecosystem health assessment, sustainable ecosystem service management, landscape planning or implementation of environmental policy rules. IAD has a long tradition in scientific collaboration between 14 countries of the Danube River Basin. The mission of IAD is to serve as a platform for a better understanding for saving this second largest river in Europe. This mission reflects a still ongoing attempt in today's changing world. From this perspective, I would like to support the Danube Research collaboration by contributing as general secretary of the IAD.

No doubt about it – the Danube River Ecosystem is changing

When I first joined an IAD meeting, which was held in Bratislava, in my function as expert group leader for algae, another expert group leader said that he would soon retire from his job in the south of Germany, Bavaria, and he continued by saying that something had happened to the Bavarian stretch of the Danube River over time. What had happened, we wanted to know – he didn't look amused and told us that he had had a look at the list of fish species in recent days. He realised that no single fish species, which was recorded in the year when he started with his work on the Bavarian stretch of the Danube River about 30 years ago could now be found in the recent species list. All the previous fish species he had found have been lost?! Lost forever there? Are there more such stories about the Danube River? I am not a good story teller but what I realized then is that there is a silent vanishing of impressions and species I have had in my mind from childhood or as young researcher – and I was thinking: is this really all gone or is it because I have just changed my perspective in observing my environment?

We are experienced in advanced methods for monitoring the environment – so far the knowledge is much larger than that in the years before – but is this satisfying, is this enough? To reclaim Stephen Covey's saying adjusted to Danube Science: to learn about the Danube system but not to act is really not to learn! IAD has a 63-years tradition. Its foundation relied on the wish from people in the Danube riparian countries to study the Danube river not country by country but along the whole stretch and to build standard methods and exchange ideas after Danube surveys. Many things have changed meanwhile – lots of countries linked to about two thirds of the length of the Danube River have remarkably changed their policy – now we are all together on a round table, can openly and knowledgeably discuss the recent environmental issues for the whole Danube River Basin. This may sound good but the recent awareness about habitats in and around the Danube River together with a new critical understanding of nature conservation, sustainable ecosystem management and use of ecosystem services in recent days brings us again together on a round discussion table. The strongest arguments for IAD can be derived from its statutes, being a scientific network observing the Danube River and its main tributaries. I thank the presidium and the members for their confidence to vote for me as general secretary in June 2018. In this function, I will help to support the manifold activities of the IAD-presidium, of the IAD-expert group leaders and also of the IAD-members in the IAD-countries – so that we learn and accordingly also act – as there is no doubt – the Danube River Ecosystem is changing.

Katrin Teubner

Comparison between long-term monitoring data and «snap-shot» data from investigative monitoring of Joint Danube Surveys – Case study for nutrient forms along the Romanian stretch of the Danube River

Carmen Postolache: *University of Bucharest, Faculty of Biology, Bucharest, Romania, e-mail: carmen_postolache83@yahoo.com*
Carmen Hamchevici: *National Administration «Apele Romane», Bucharest, Romania, e-mail: carmenhamchevici@yahoo.com*

Abstract

Assessment of nutrient forms in the Danube River has a well-known and long-term history at the basin-wide level, especially in view of the link between the nutrient loads of the Danube and the eutrophication of the Black Sea. According to the Water Framework Directive (WFD), investigative monitoring is primarily a national task, but at the basin-wide level, ICPDR launched the concept of Joint Danube Surveys (JDS), carried out every six years, starting from 2001. One of the specific objectives of the investigative monitoring surveys is to increase the comparability between a homogenous data set produced by a single sampling procedure and laboratory analysis (JDS measurements) and data generated by long-term surveillance type of monitoring (Trans-National Monitoring Network/TNMN data) carried out by the basin-wide network of TNMN laboratories from each Danube country. In this paper, we provide a comparative view of nutrient levels along the Romanian stretch of Danube River. The analysis showed similar spatial and temporal nutrient dynamics

obtained in the frame of TNMN-Program and JDS measurements. Low concentrations of nitrogen forms were found, with a minimum of the average values of the entire stretch of 0.14 mg/L N-NH_4. Phosphorous forms present a decreasing spatial profile from upstream to downstream monitoring sections, from 0.077 mg/L P-PO_4 and 0.122 mg/L P upstream to 0.027 mg/L P-PO_4 and 0.072 mg/L P downstream.

Introduction

One of the major objectives of the comprehensive monitoring activity carried out by the Danube countries within the frame of TNMN of the International Commission for the Protection of the Danube River (ICPDR) is to monitor the pressures given by nutrients in the Danube River Basin District and the extent to which the nutrient loads into the Black Sea are being reduced. Tailored as a long-term surveillance monitoring, TNMN provides a general overview of the selected water quality parameters in terms of concentrations and loads, mainly in transboundary context.

In recent years, the nutrients issue at district level is underlined in the Danube Basin Analysis - WFD Roof Report (ICPDR 2004). The results of this preparatory analysis for the River Basin Management Plans according to the WFD showed that relatively significant proportions of the river Danube River were at «risk of failure» or «possibly at risk» of the WFD environmental objectives due to four types of pressure. In total, 58 % of the length of the Danube River was classified at risk because of organic pollution, 65 % due to nutrient pollution (especially the lower river section, 74 % due to dangerous substances and 93 % due to hydro-morphological changes. Subsequently, according to the Danube River Basin District Management Plan (ICPDR 2015), the four types of pressures identified in 2007 and confirmed in 2013 by the Update of the Danube Basin Analysis (ICPDR 2014) as Significant Water Management Issues (SWMI) can directly or indirectly impact the status of both surface water and transboundary groundwater. Results presented in the DRBM Plan (ICPDR 2015) show that nutrient pollution still represents an on-going pressure for 20 % of the length of waterbodies (catchment size larger than 4000 km^2) being at risk of failure to achieve good surface water status by 2021. Therefore, the nutrients problematic at the basin wide level still represents an issue of concern.

In this respect the present case study aims to provide a comparative view of the nutrients levels along the Romanian stretch of the Danube main course.

Data source

The study is based on national data collected in the frame of long-term surveillance TNMN-Program of the ICPDR during 1996 – 2015 in comparison with investigative data obtained during the three monitoring programmes known as Joint Danube Surveys (JDS) 1, 2 and 3, coordinated by ICPDR in 2001, 2007 and 2013 respectively. In order to have an optimal way of data comparison and given the survey timing of the different JDSs (August – September), the momentary results obtained during the three investigative surveys are compared with TNMN data set from each September from the above-mentioned time period.

We used monitoring data for four nutrients forms: N-ammonium, N-nitrates, P-orthophosphates and Total Phosphorous. They were obtained within the TNMN-program during 1996 – 2014, for eight monitoring stations located along the Romanian stretch of the Danube River, between river km 1071 and the end of the three arms in the Danube delta (km 18 and 0): Bazias (km 1071), Pristol (km 834), upstream Arges (km 434), Chiciu (km 375), Reni (km 120), Valcov (km 18), Sulina (km 0) and Sf. Gheorghe (km 0) (www.icpdr.org). In addition, nutrients concentrations measured during the three investigative monitoring surveys JDS 1, 2 and 3 were compiled. According to the TNMN-Yearbooks and JDSs (1 and 2) Technical Reports, analytical methods used for determination of nutrients forms within the TNMN-program are EN ISO standardized methods based on molecular spectrophotometry. The JDS3 data set was obtained using ion chromatography. Detailed information on the analytical methods used for determination of the investigated nutrients forms in water samples as well as performance characteristics are presented in TNMN Yearbooks and the JDSs corresponding technical reports from 2002, 2008 and 2015 respectively (ICPDR 1999–2016, Lazlo 2002, Hamchevici & Craciun 2008, Hamchevici et al. 2015).

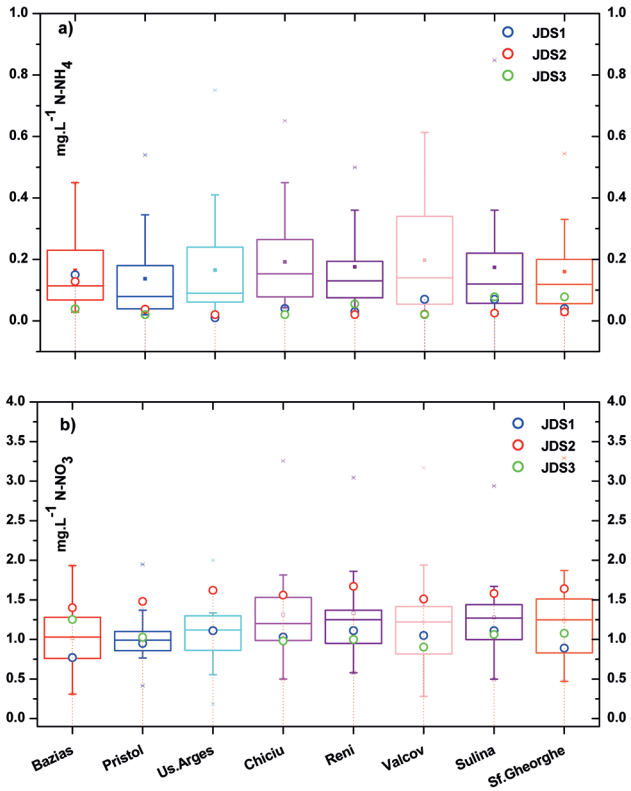

Figure 1. Comparison of selected nitrogen forms (a) N-ammonium and b) N-nitrates) between surveillance monitoring (each September from 1996–2015) and investigative monitoring (JDS1, JDS2 and JDS3) along the Romanian stretch of the Danube River (box is determined by the 25th and 75th percentiles, whiskers are determined by the 5th and 95th percentiles, also minimum, mean, median and maximum values are plotted)

Results and discussions Spatial variation

Longitudinal profiles of N-ammonium and N-nitrates concentrations *(fig. 1a and b)* show a decreasing shape at monitoring section Pristol, as a direct consequence of denitrification occurring in the Iron Gates reservoir from upstream area. This is especially described by the TNMN concentrations: a mean of 0.14 mg/L N-NH_4 is the minimum of the average values of the entire stretch; also during JDS1 and JDS3, low N-ammonium and N-nitrates were measured in this section (0.02 mg/L N-NH_4 and 0.95 and 1.03 mg/L N-NO_3 respectively). The rest of the stretch shows relatively elevated profiles of TNMN N-ammonium concentrations at monitoring sections Chiciu and Valcov – 0.19 mg/L N-NH_4, partially confirmed by the concentrations measured in JDS1 (0.07 mg/L N-NH_4). During JDS2 and JDS3, low values were measured for both nitrogen forms along most of the river.

Phosphorous forms *(fig. 2a and b)* present a decreasing spatial profile from upstream to downstream monitoring sections when TNMN averages concentrations from 1996–2015 are considered: from 0.077 mg/L P-PO_4 and 0.122 mg/L P at Pristol section to 0.027 mg/L P-PO_4 and 0.072 mg/L P at Sf. Gheorghe section. This decreasing tendency is noticed also during JDS2 in the case of P-ortho-phosphates, while during JDS1 the decreasing profile was present between Bazias and Reni, followed by a slight increase along the rest of the river stretch. For JDS3, P-orto-phosphates presented a more constant variation range in the lower Danube, between 0.046 mg/L P-PO_4 at section Chiciu and 0.062 mg/L P-PO_4 at section Sf. Gheorghe. A distinctive situation is present for Total Phosphorous at section upstream Arges, with very high concentrations measured during both JDS1 and JDS2 (0.61 and 0.41 mg/L P respectively). These concentrations are not confirmed by the long-term surveillance monitoring during which the most elevated concentrations from September (above 0.200 mg/L P) were measured in 2002, 2005 and 2011.

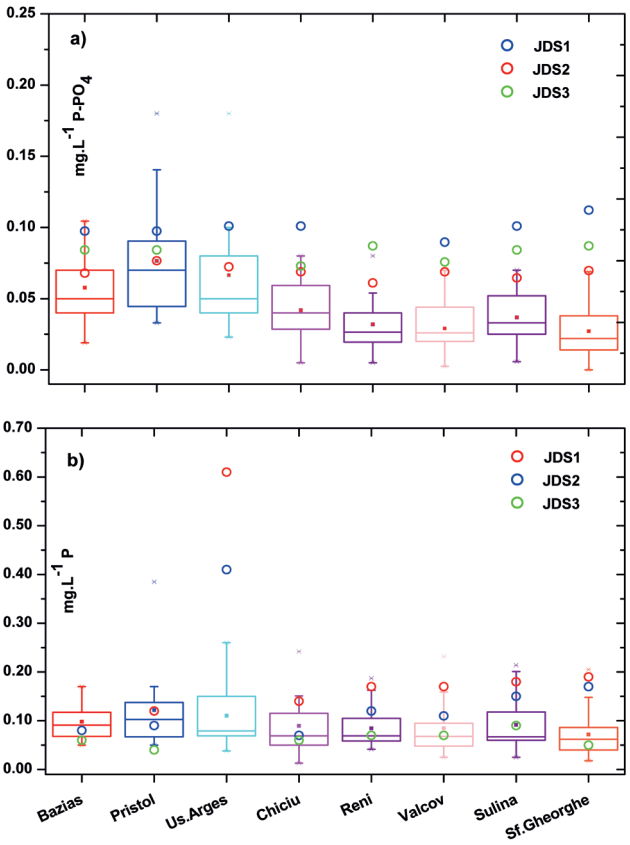

Figure 2. Comparison of phosphorous forms (a) P-ortophosphates and b) Total Phosphorous) between surveillance monitoring (each September from 1996–2015) and investigative monitoring (JDS1, JDS2 and JDS3) along the Romanian stretch of the Danube River (box is determined by the 25th and 75th percentiles, whiskers are determined by the 5th and 95th percentiles, also minimum, mean, median and maximum values are plotted)

JDS snap-shot data in the temporal dynamic of surveillance monitoring

Although one single measurement (as the JDSs measurements are) does not give fully reliable information on the temporal dynamic of concentrations, yet the nutrients forms investigated during the three JDSs could be put in comparative view with the monthly data provided by the long-term TNMN programme. This comparison is given here for only one monitoring station only – Bazias, additional information will be given in a more comprehensive future paper dealing with nutrients temporal variations in the lower Danube (Postolache et al., under preparation). In figure 3a and b selected nitrogen forms concentrations monthly measured in each September during 1996–2015 are compared with the «snap-shot» data

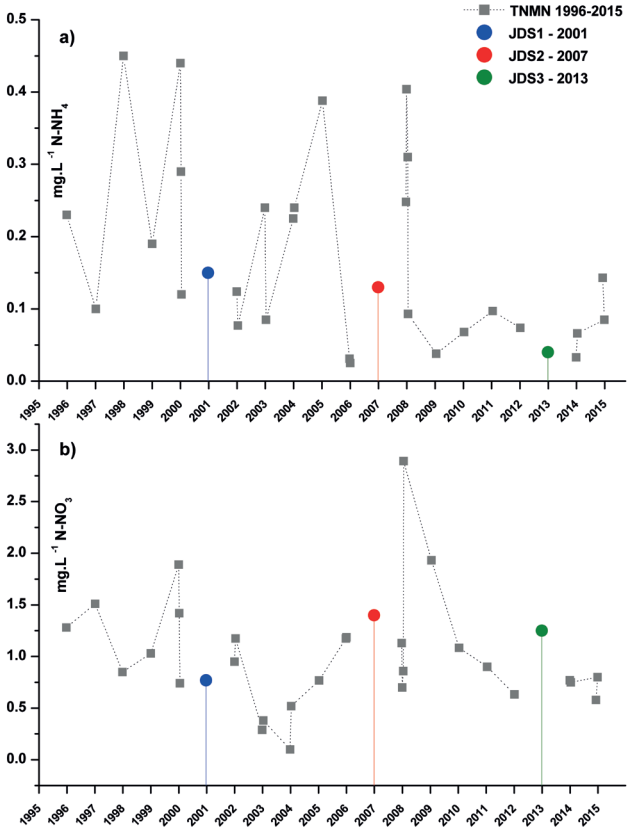

Figure 3. Comparison of selected nitrogen forms (a) N-ammonium and b) N-nitrates) from monthly measurements in each September during 1996–2015 within the long-term TNMN programme with the JDSs measurements from September 2001, 2007 and 2013 along the Romanian stretch of the Danube River

from JDS1, JDS2 and JDS3 measured in 2001, 2007 and 2013 respectively. As it can be noticed, the general view is that the concentrations from the three JDSs are highly comparable with the surveillance monitoring of the TNMN for both nitrogen forms. For instance, N-ammonium concentration from JDS1 (0.15 mg/L N-NH_4 is very close with the value recorded in 2000 and 2002 (0.12 mg/L N-NH_4) the concentration from JDS2 (0.13 mg/L N-NH_4) is higher than the average of 2006 (0.03 mg/L N-NH_4) but much lower than the average of 2008 (0.26 mg/L N-NH_4). The N-ammonium concentration from JDS3, much lower than the ones from previous surveys (0.046 mg/L N-NH_4) is close to the average value from September 2014 (0.050 mg/L N-NH_4). The N-nitrates concentration measured in 2001 (0.77 mg/L N-NO_3) was lower than the averages of 2000 and 2002 (1.35 mg/L N-NO_3 and 1.06 mg/L N-NO_3 respectively); the value recorded in JDS2 (1.40 mg/L N-NO_3), slightly higher than the average of 2006 (1.18 mg/L N-NO_3) was equal to the average of 2008 (1.40 mg/L N-NO_3) while the value measured in JDS3 (1.25 mg/L N-NO_3), which was higher than the concentrations from September 2012 and 2014 respectively (0.63 mg/L N-NO_3 and 0.76 mg/L N-NO_3).

For phosphorous forms, from figure 4a and b the same high comparability of investigated data can be noticed. P-orthophosphates from JDS1 (0.074 mg/L P-PO_4) is close to the average from September 2000 and one concentration from September 2002 (0.077 mg/L P-PO_4 and 0.071 mg/L P-PO_4); slightly different is the situation from 2007, when

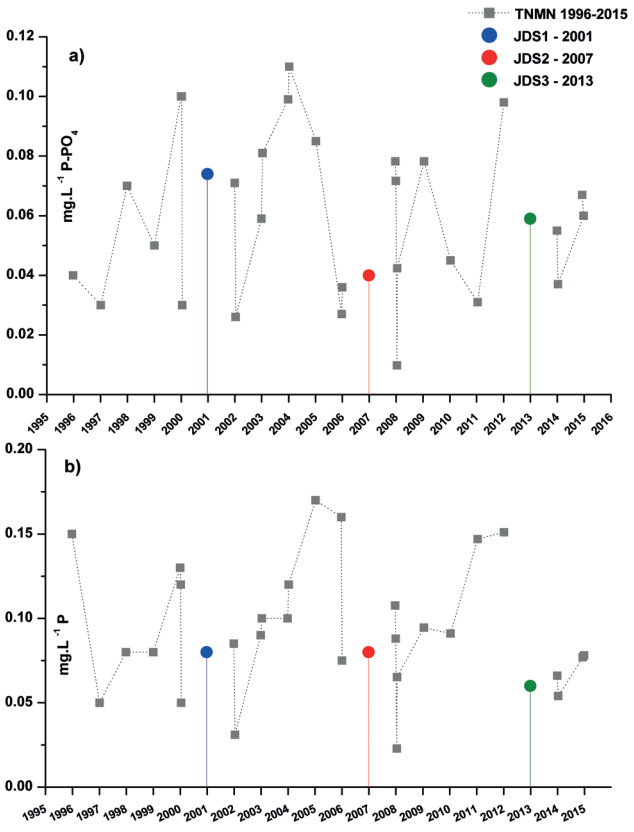

Figure 4. Comparison of phosphorous forms (a) P-ortophosphates and b) Total Phosphorous) from monthly measurements in each September during 1996–2015 within the long-term TNMN programme with the JDSs measurements from September 2001, 2007 and 2013 along the Romanian stretch of the Danube River

the JDS2 value (0.040 mg/L P-PO_4) was higher than the average of 2006 (0.032 mg/L P-PO_4), but lower than the average of 2008 (0.051 mg/L P-PO_4). In JDS3, the P-orto-phosphates concentration (0.059 mg/L P-PO_4) was lower than the one from 2012 (0.098 mg/L P-PO_4), but similar with the average between 2014 and 2015 (0.055 mg/L P-PO_4). Total P in JDS1 (0.08 mg/L P was similar with the average between 2000 and 2002 (0.083 mg/L P), while the value measured in JDS2 (0.080 mg/L P) was lower than the average of 2006 (0.118 mg/L P) but similar with the average of 2008 (0.071 mg/L P). In JDS3, Total P concentration (0.060 mg/L P) was much lower than the one from 2012 (0.151 mg/L P), but equal to the average of 2014 (0.060 mg/L P).

Conclusions

One of the specific objectives of the investigative monitoring surveys is to increase the comparability between a homogenous data set, produced by a single sampling procedure and laboratory analysis (JDS measurements), and data generated by long-term surveillance type of monitoring (TNMN data) carried out by the basin-wide network of TNMN laboratories from each Danube country. In this respect, the present paper briefly compares these two types of data sets corresponding to four nutrient forms measured along the Romanian stretch of the Danube River. Both in terms of spatial variation and temporal dynamic, analysis of monitoring data showed a highly comparable degree, with JDSs values generally lower than the ones given by the monthly TNMN values. Therefore, as regards the general physico-chemical parameters (and nutrients among them), the future investigative monitoring survey from 2019 (JDS4) will fully rely on the national monitoring data provided by the TNMN laboratories at the basin-wide level.

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