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Ecology

ASSESSMENT OF THE ABIOTIC COMPONENTS OF THE DANUBE RIVER AND MAIN TRIBUTARIES FROM SOUTHERN PART OF ROMANIA

E. STANESCU[a*], F. VOSNIAKOS[b], D. SCRADEANU[c], I. PAUN[a], I. LUCACIU[a], B. STANESCU[a], L. CRUCERU[a], G. VASILE[a], V. IANCU[a], M. NICULESCU[a]

[a]*National Research and Development Institute for Industrial Ecology ECOIND, Bucharest, Romania*
E-mail: *dcpcalitate@gmail.com*
[b]*Environmental Committee of Alexander Technological Education Institute of Thessaloniki, P.O. Box 141, 57 400-Sindos, Thessaloniki, Greece*
[c]*Faculty of Geology and Geophysics, University of Bucharest, 6 Traian Vuia Street, District 2, Bucharest, Romania*

Abstract. This paper presents a systemic assessment for abiotic components of the complex ecosystems in the year 2014; the investigated area is the Danube River from Bazias to Calarasi and its tributaries from Southern Romania – rivers Jiu, Olt and Arges. A sampling and monitoring program was performed for representative control sections, whose geographic locations were established with a portable GPS receiver. The impact elements considered for ecological status of water bodies investigated were: the thermal conditions, acidification, oxygenation conditions, salinity, nutrients and specific pollutants, according to the EU Water Framework Directive (WFD) and the requirements set by the Romanian Law 310/2004 which amends the Law 107/1996.

Keywords: Danube river and tributaries, biotic components, aquatic ecosystems.

AIMS AND BACKGROUND

The Danube is the second longest river of Europe (after the Volga) and is the only European river that flows from West to East. The continent geographical location of the Danube river basin is between the oceanic climate in the west, temperate-continental influences from the East and the Baltic in the North, the Danube hydrological regime is characterised by the existence of significant variations in the level and flow during the year and over the time. In Europe, the European Commission has adopted since 2000 the Directive 2000/60/EC amended by Directive 2008/32/CE, which establishes the framework for Community action in the field of water policy[1]. The general aim of this directive is to establish a framework for the

[*] For correspondence.

protection and management of surface waters in the European Union by reaching ‘good’ condition of all bodies of water in the natural scheme of Europe until 2015 (Ref. 1). In Romania in recent years is found a decrease of the industrial pollution sources impacting water bodies, due to the closure of numerous industrial activities in large industrial areas.

EXPERIMENTAL

The investigation area proposed for evaluating the quality of the Danube river and main tributaires in the Southern part of Romania is shown in Fig. 1. In Table 1 are presented the locations of the sampling points/sections with GPS coordinates. Investigations were carried out in relation to scientific concerns and all methods applied are nationally and internationally recognised[2,3]. Concerns of this study are correlated with similar research activities conducted at national and international level[4–9].

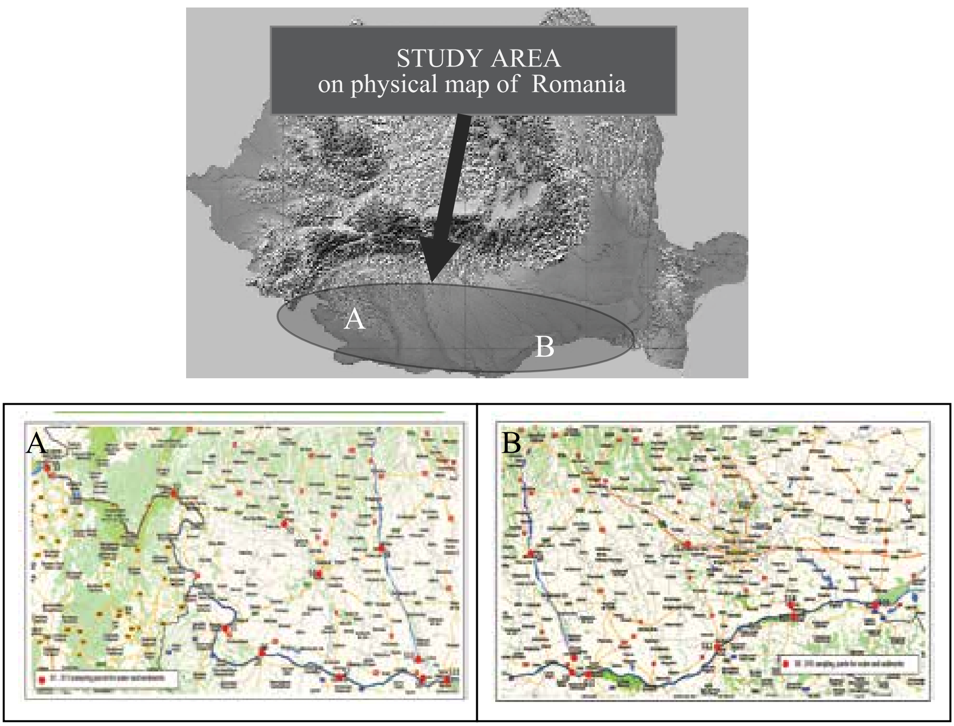

Fig. 1. Study area on physical Romanian map

Table 1. Descrition of the sampling points and geographical coordinates

Sampling points	Latitude north	Longitude east	Sampling points	Latitude north	Longitude east
S1 – Bazias locality on Danube River	44°47′32.61″	21°23′20.07″	S9 – Izbiceni, upstream confluence with Danube river	43°48′41.71″	24°42′27.71″
S2 – Gura Vaii locality on Danube River	44°40′7.40″	22°33′10.74″	S10 – Islaz (Danube), upstream confluence with r. Olt	43°42′22.72″	24°44′4.01″
S3 – Calafat locality on Danube River	43°57′50.94″	22°54′15.72″	S11 – Turnu Magurele (Danube), downstream confluence with r. Olt	43°43′2.69″	24°48′56.65″
S4 – Filiasi, r. Jiu upstream Craiova	44°34′8.32″	23°27′18.14″	S12 – Km 36 r. Arges	44°28′45.25″	25°40′47.87″
S5 – Podari, r. Jiu downstream Craiova	44°15′18.48″	23°47′25.08″	S13 – Giurgiu (Danube), upstream confluence with r. Arges	43°52′37.50″	25°58′49.92″
S6 – Rast (Danube), upstream confluence with r. Jiu	43°51′24.84″	23°17′18.79″	S14 – Chirnogi r. Arges	44° 6′38.09″	26°38′15.33″
S7 – Bechet (Danube), downstream confluence with r. Jiu	43°45′11.32″	23°56′30.69″	S15 – Oltenita, downstream confluence with r. Arges	44° 3′51.89″	26°38′45.49″
S8 – Olt river downstream Slatina / bridge	44°23′29.63″	24°21′4.84″	S16 – Calarasi (Danube)	44° 8′15.69″	27°20′8.26″

RESULTS AND DISCUSSION

Evaluation of the chemical state of the surface waters has considered priority substances by applying the previsions of the Directive on environmental quality standards in the field of water (Directive 2008/105/EC) and compliance with environmental quality standard values (SMC) for both arithmetic average, as and maximum allowable concentration value. Chemical status was determined by the most unfavourable situation (SCM overcoming body of water falls in poor chemical status). In this case, the classification was made according to the following requirement: very good, good, moderate condition.

In 2014 were performed 4 campaigns for investigation the quality of the water bodies (February, April, June and October), were taken samples from the 16 sampling points and were determined in laboratory the quality indicators by applying the standardised test methods: thermal conditions (water temperature); acidification (pH); oxygen conditions (dissolved oxygen); salinity regime; concentrations of nutrients ($N–NH_4$, $N–NO_2$, $NO_3–N$, N_{total}, $P–PO_4$, total P); specific pollutants.

Space-time variations of the physical and chemical quality parameters determined in surface water and sediment for year 2014 in the investigated area – Danube and mains tributaries of the Danube in Southern Romania, highlight the following issues:

Thermal conditions: the water temperature showed seasonal variations, the minimum values varied in the range 4.0–7.0ºC, and the maximum values in the range 19.8–25.3ºC in summer period. It is important to mention that the distance from shore and water depth had a significant effect on water temperature measurements.

Acidification: for entire study period, the hydrogen ions concentrations of the water in the Danube aquatic ecosystems tributaries recorded values between 6.50 and 8.97 pH units.

Oxygen regime: the amount of the dissolved oxygen in aquatic ecosystems investigated was characterised by a significant range of variation: 3.70 mg O_2/l in the fall of the control sections located on Arges at Chirnogi locality and 10.7 mgO_2/l in winter on the Danube river at Bazias.

The values determined as organic load expressed by chemical oxygen demand (COD) – Fig. 2, and biochemical oxygen demand (BOD) – Fig. 3, in the control investigation indicates very good ecological status good for most sections control, except : moderate ecological status in October on Arges river at Chirnogi locality for COD; BOD: moderate ecological status in June on the Danube at Calafat and Islaz localities; Chirnogi Arges; moderate ecological status in October Turnu Magurele and Danube at Oltenita; Olt to Izbiceni; poor ecological state in October on Chirnogi on Arges river.

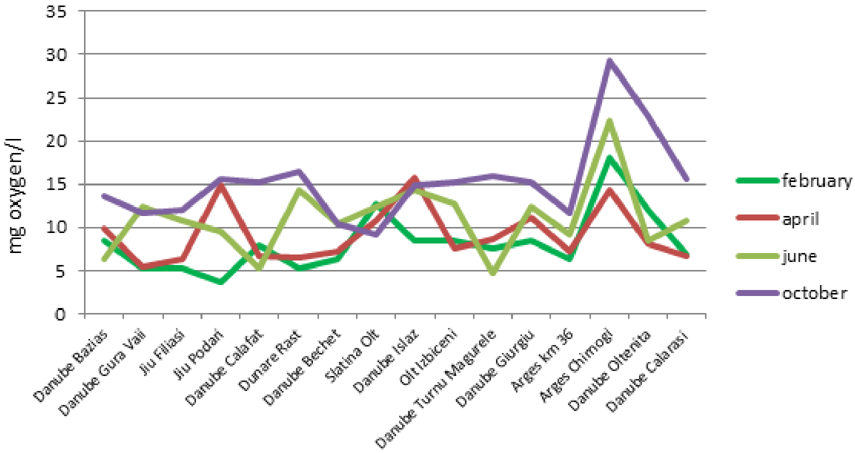

Fig. 2. Variations of the organic load expressed by COD of the surface waters samples in the study area in 2014

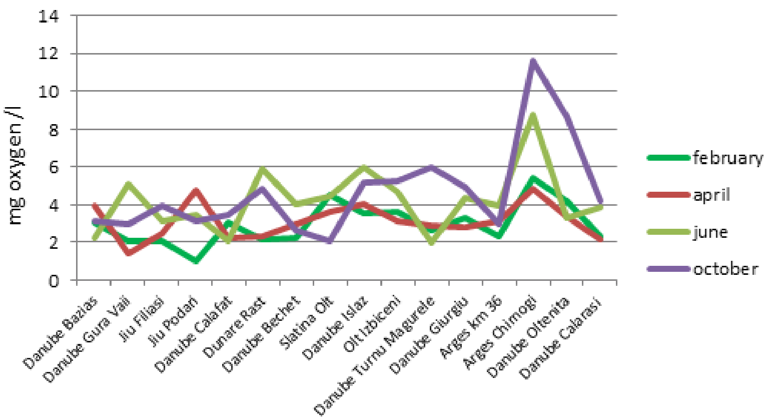

Fig. 3. Variations of BOD of the surface waters samples in the study area in 2014

Values of the quality indicators filterable residue, ammonium (Fig. 4) and nitrites induce a good ecological status in all sections analysed.

Values of the quality indicators nitrates (Fig. 5), total nitrogen and total phosphorus (Fig. 6) indicate very good and good ecological states for all control sections for the entire period investigated.

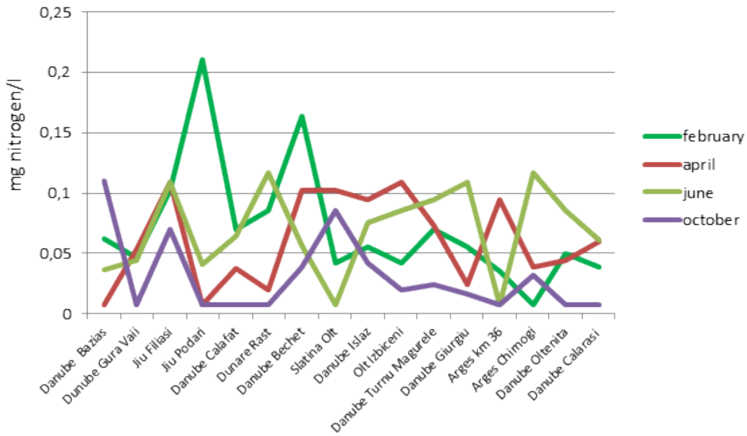

Fig. 4. Variations of the quality indicator ‘ammonium’ of the surface waters samples in study area in 2014

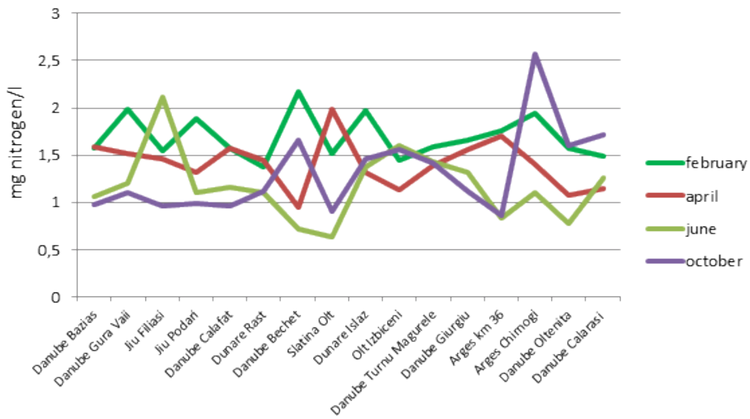

Fig. 5. Variations of the quality indicator ‘nitrates’ of the surface waters samples in the study area in 2014

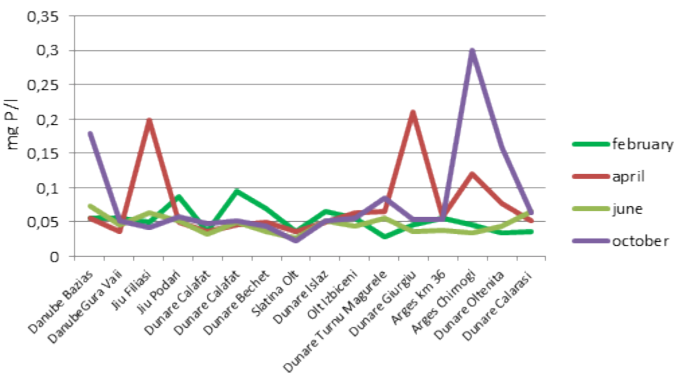

Fig. 6. Variations of the quality indicator ‘total phosphous’ of the surface waters samples in study area in 2014

Another category of quality indicators refers to specific non-synthetic pollutants concentration (metals – nickel, total chromium, copper, lead, arsenic, mercury, zinc and cobalt) in the water system studied in 2014 expressed as total concentration dissolved in water and the determined concentrations showed a good ecological status for the whole area.

The same ecological status (very good – good quality) indicates the concentration determined for quality indicators: oil products, organochlorine pesticides, PCBs and polycyclic aromatic hydrocarbons.

The sediment is the main reservoir of a cycling system of the aquatic pollutants at levels which have a high absorption capacity than the storage compartment. Heavy metals, pesticides and petroleum hydrocarbons are among the most frequent pollutants existing in sediment. In the complex ecosystems in the investigated area (Danube and its main tributaries) in the tank cycling specific pollutants were analysed represented by metals and organic compounds (petroleum hydrocarbons, pesticides and compounds such as organochlorine and polychlorinated biphenyls).

The copper concentration exceeds the limits from specific environment legislation in Romania, in the sections control from Jiu river at Filiasi and Danube at Calafat (Fig. 7); values over the limits were recorded and in the case nickel concentration in the case of section located on the Danube at Calafat and Bechet and also Jiu river at Filiasi (Fig. 8).

Determined concentration values for arsenic, zinc, lead and chromium were within the limits imposed by national legislation.

Also, concentration values for pesticides and PCBs recorded are situated in lower threshold of the test methods limits.

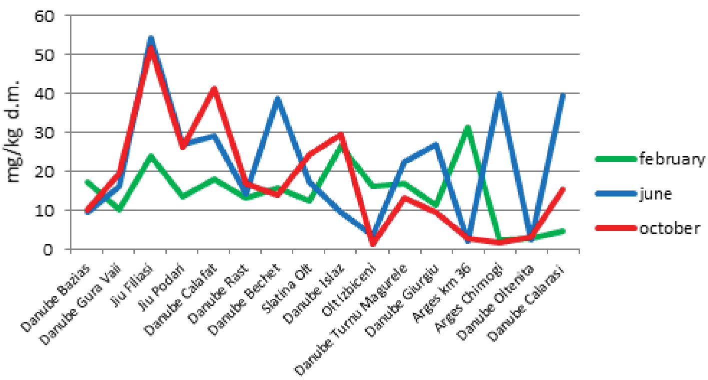

Fig. 7. Variations of the quality indicator ‘copper’ in sediments in 2014

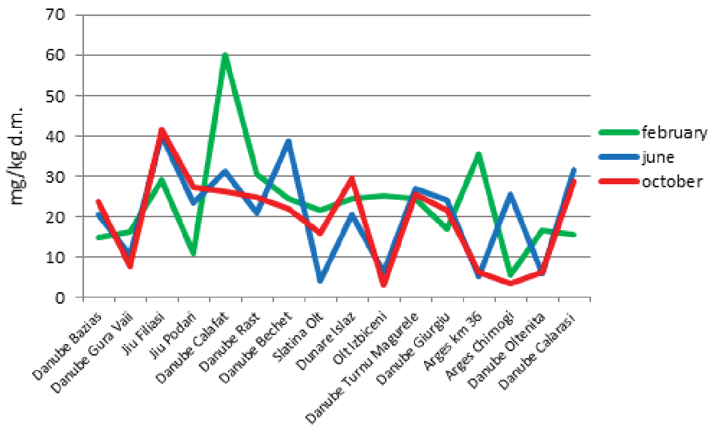

Fig. 8. Variations of the quality indicator 'nickel' in sediments in 2014

CONCLUSIONS

The main conclusion that emerges consists of important systemic assessment study – time and space evolution – to highlight the complexity of the ecological ecosystems of investigation (Danube Bazias-Calarasi section and the Danube tributaries from southern part of Romania – rivers Jiu, Olt and Arges). The variations in space and time of the quality indicators do not show significant changes of the ecological states analysed, which reveals a significant endorsement of anthropogenic pressure decreased by a decline in industrial activities.

In placing of the control sections were taken into account upstream and downstream location of the Danube river confluence points, and its tributaries Jiu, Olt and Arges; also the control sections were placed upstream and downstream reported of the major urban areas whose sources of the pollution may affect aquatic ecosystems. The results confirmed low intake of the pollutants coming from industrial sources and in the same time important possibilities for self-purification of the water bodies.

Favourable conditions met in synergy: the decline of the industrial activities, the increasing of treatment of the waste waters in localities from Romania by expanding rural water supply and waste waters services and/or upgrade of the existing ones brought major benefits to achieve the European target a 'good' waters quality in Europe in 2015.

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