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XI International Conference – Industrial Engineering And Environmental Protection (IIZS 2021)

Zrenjanin, 7th-8th October 2021.

University of Novi Sad
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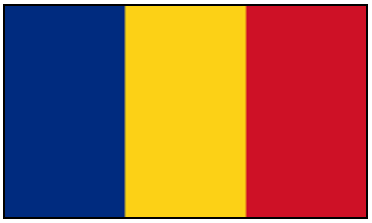

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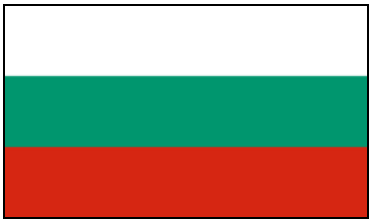

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PLENARY SESSION

I - INDUSTRIAL ENGINEERING

Session 1: Mechanical Engineering

SURFACE WATER QUALITY ON CERNA RIVER

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Abstract: The paper presents the results obtained during implementation of a research project coordinated by two relevant education and research Balkan institutions, University Politehnica Timisoara and University of Belgrade, project financed thru Interreg IPA-CBC Romania-Serbia programme.
The project teams performed extensive evaluation of environmental current situation in cross border "sister" Danube banks nature reservation Djerdap (Serbia) and national parks Iron Gate (Romania), and on several Danube tributaries and two wet lands: Carska-Bara special nature reserve and Delta Nera nature reservation. This paper presents in detail the results obtained for surface water quality analysis on Cerna River, the hart of nature protected area of national park Domogled – Cerna Valley, in Southern Carpatians.
Key words: Surface water quality, heavy metals, Cerna

INTRODUCTION

Cerna River flows thru The Domogled-Valea Cernei National Park is a protected area (national park category II IUCN) situated in Romania, on the administrative territory of counties Caras-Severin, Gorj and Mehedinti. The National Park stretches across over the Cerna Mountains and the Godeanu Mountains on the right side, and over the Valcan Mountains and the Medinti Mountains on the left side. It is located in the Retezat-Godeanu Mountains group, a group of mountains in the Southern Carpathians, in the Cerna River basin. Domogled-Valea Cernei National Park, with an area of 61211 ha was declared protected area by Law Number 5 of March 6, 2000 and represents a mountainous area what shelters a large variety of flora and fauna, some of the species very rarely or endemics. [1]
During the past decade, after communism fall in 1989 in Romania, national natural resources in faced a lack of protection and/or enforcement of protective rules. This started to change in early 2000's after constant NGO's endorsement and awareness activities, and the protection of natural areas became significant since Romania became part of EU. EU water policy has successfully contributed to water protection over the past three decades. Pollution from urban, industrial and agricultural sources is regulated and this has brought about significant improvements in the quality of European waters, particularly by reducing an excess of nutrients. As a result, iconic fish species such as salmon and sturgeon have, in some places, returned to European rivers. [2]
As a sensitive topic, our team analyzed in 2020 the surface water quality on Danube (in Iron Gate / Djerdap national park's) area and Danube's main tributaries in this area: Nera, Pek, Porecka, Cerna and Berzasca. In this paper the obtained on Cerna river are presented.

MATERIALS AND METHODS

Sampling is a vital part of monitoring the quality of water. Every precaution must be taken to ensure that the sample collected is as representative as is feasible of the water source or process being examined.
The in-situ analysis (for pH, temp, total hardness and dissolved oxygen) were performed on site. All samples were preserved in-situ for laboratory analysis with acids: HNO_3 (nitric acid) for metal concentration analysis on ZEEnit 700P, H_3PO_4 (phosphoric acid) for Total Nitrogen analysis on

Analytik Jena Multi N/C 3100 and H_2SO_4 (sulfuric acid) for Chemical Oxygen Demand analysis on Velp Eco6 and ammonia, phosphor, nitrite, nitrate, phosphate, a.o. on Analytik Jena Specord 250plus. All samples taken were analyzed in-situ or at the end of the sampling day.
Surface water sampling on Cerna River was conducted in 19 October 2020 in 6 sampling points/locations upstream river. Samples were analysed in situ or preserved for laboratory analysis. In figure 1 the sampling points coding and geographical position can be observed.

Fig. 2. Sampling points for water quality analysis on Cerna River.

RESULTS AND DISCUSSION

The results obtained from sampling campaigns, in 19 October 2020 are given in Tables 1.

Table 1. Results obtained for parameter analysis in samples of Cerna, on 19th October 2020

Parameter	Unit	Measured values – 19th October 2020						Eco state
		C1	C2	C3	C4	C5	C6	
pH	-	7.34	7.33	7.38	7.42	7.38	7.31	-
Conductivity	µS/cm	372	394	388	389	378	377	-
		Oxygen concentration						
Dissolved oxygen (DO)	mgO_2/l	5.7	6.8	9.9	10.1	10.5	10.2	**I st – II nd**
Biochemical oxygen demand (BOD – CBO5)	mgO_2/l	7.4	6.5	3.1	2.3	2.2	2.2	**I st – III rd**
Chemical oxygen demand (COD – CCO-Cr)	mgO_2/l	18.1	16.5	8.4	7.2	6.9	6.9	**I st – II nd**
		Nutrients and general ions concentrations						
Sodium (Na+)	mg/l	3.6	3.2	3.2	3.5	3.4	3.4	**I st**
Calcium (Ca2+)	mg/l	41.2	38.9	39.1	29.8	33.4	27.9	**I st**
Ammonia (NH_4^-)	mg/l	0.74	0.65	0.11	0.09	0.07	0.09	**I st – II nd**
Nitrates (NO_3^-)	mg/l	0.34	0.33	0.22	0.14	0.12	0.12	**I st**
Nitrites (NO_2^-)	mg/l	0.028	0.028	0.017	0.012	0.014	0.014	**I st**
Orto phosphate ($P\text{-}PO_4^{3-}$)	mg/l	0.09	0.08	0.06	0.06	0.06	0.05	**I st**
Sulphates (SO_4^{2-})	mg/l	37.2	40.5	34.1	22.4	5.4	4.8	**I st**
Chloride (Cl^-)	mg/l	0.6	0.6	0.3	0.2	0.2	0.2	**I st**
Total Nitrogen (TN)	mg/l	0.89	0.77	0.54	0.52	0.49	0.51	**I st**
		Heavy Metals concentrations						
Mercury (Hg)	µg/l	0.030	0.026	0.015	0.011	0.014	0.011	**I st**
Arsenic (As_3^+)	µg/l	0.088	0.087	0.087	0.088	0.086	0.079	**I st**
Lead (Pb)	µg/l	0.054	0.016	0.018	0.014	0.016	0.017	**I st**
Zinc (Zn_2^+)	µg/l	12.1	12.8	10.1	8.9	8.8	7.5	**I st**
Cadmium (Cd)	µg/l	0.007	0.005	0.006	0.005	0.005	0.006	**I st**
Manganese (Mn - total)	mg/l	0.057	0.061	0.055	0.049	0.051	0.032	**II nd**
Iron (Fe – total)	mg/l	0.462	0.511	0.499	0.397	0.421	0.394	**II nd**

In the next figures graphical representation of results obtained on surface water analysis on Cerna River are presented.

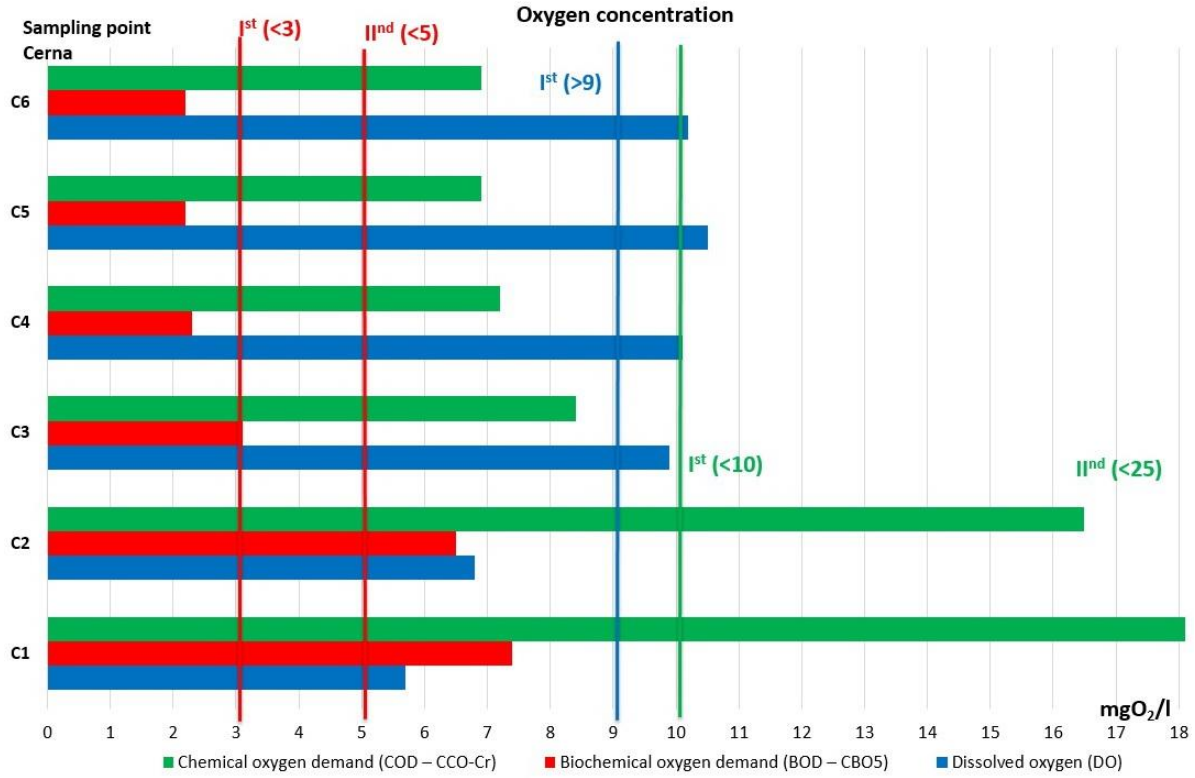

Fig. 3. Cerna River. Concentrations obtained for DO, COD and BOD5.

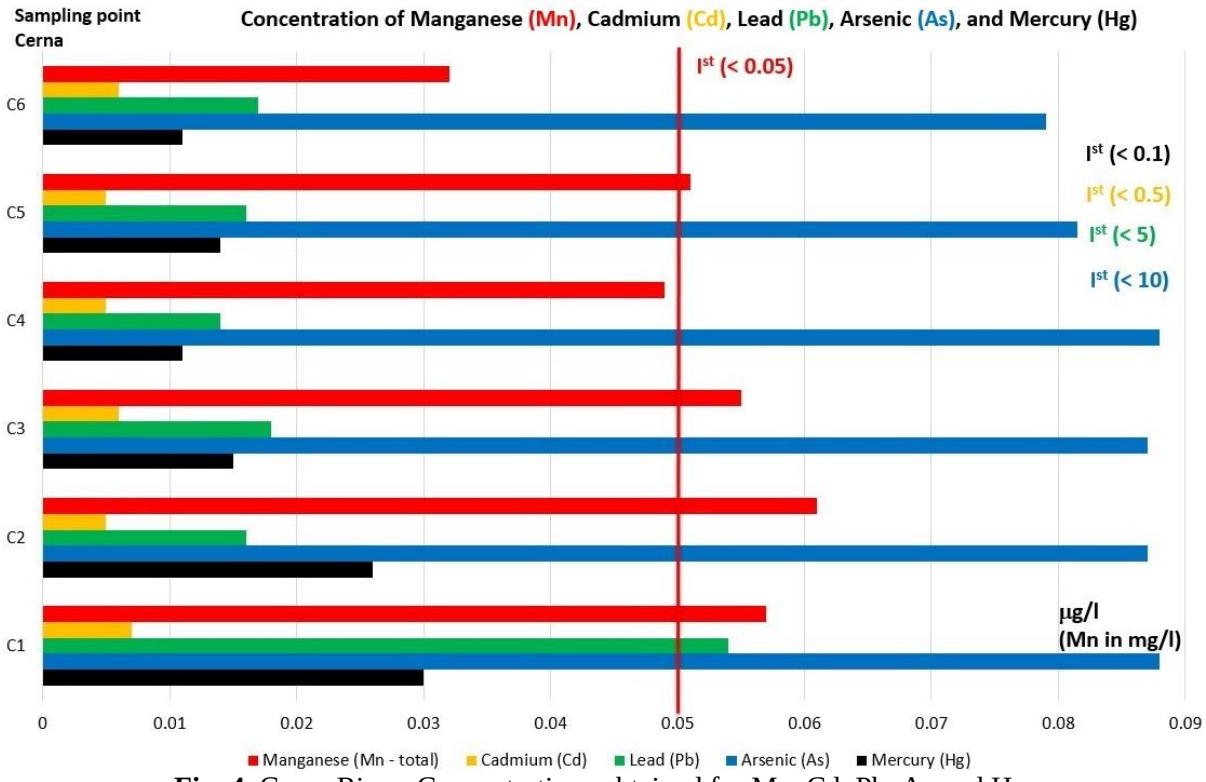

Fig. 4. Cerna River. Concentrations obtained for Mn, Cd, Pb, As and Hg.

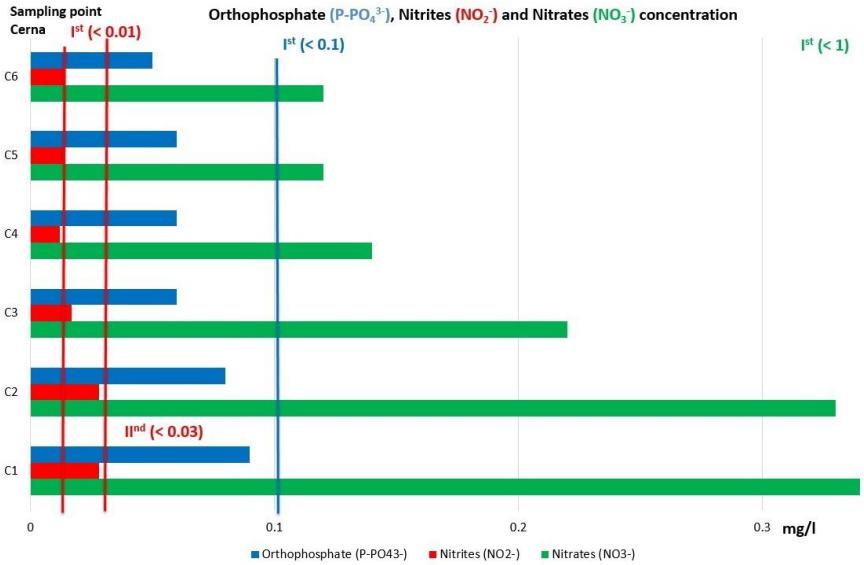

Fig. 5. Cerna River. Concentrations obtained for $P\text{-}PO_4^{3-}$, NO_2^- and NO_3^-.

In terms of water quality Cerna River can be considered a "text book" river. In its upper (wilder) part all analyzed parameters (dissolved oxygen, biological oxygen demand, chemical oxygen demand, nitrites, nitrates, ammonia, phosphates, and total nitrogen) were all in Ist class, HIGH water quality. However, after Cerna passes first human settlements, Baile Herculane, Toplita and gets tributary from Belareca river, on its last ~20 km the water quality decreases dramatically, "transforming" itself into GOOD/MODERRATE quality river.

CONCLUSION

The surface water quality of Cerna river can be classified as HIGH -quality in its upper side (largest portion of river while it's quality decreases immediately as the Cerna river passes thru Baile Herculane city and becomes MODERATE.
The main stresses identified on Cerna river are from Baile Herculane city and Barza and Toplet villages waste waters, as not all houses are connected to the waste water system, contributing to pollution of surface waters.

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