THE INFLUENCE OF THE HYDROTECHNICAL WORKS ON THE BIODIVERSITTY AND USES OF THE WATER ON THE MIDDLE COURSE OF THE CRIŞUL REPEDE RIVER

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Abstract
The paper presents the influence of the hydrotechnical works Leşu, Lugaş and Tileagd on the biodiversity and uses of the water in the middle basin of the Crişul Repede river.
The study evaluates the impact the mentioned accumulations manifests upon the flora and fauna diversity in the space situated between the place of Bulz and the city of Oradea.
One highlights the way in which the ecological state of the waters influences the uses from the downstream.

Key words: nutrients, eutrophycation, oxygen system, thermal system, pollutants, ecological state, quality categories.

INTRODUCTION

Crisul Repede springs at the altitude of 710 m, in the vicinity of the place of Izvorul Crisului, from a hilly area from the northern side of the Huedinului dingle(Atlasul cadastral al apelor din România, 1992).

From the Vlãdeasa mountains the main affluents of Crişul Repede are Hentul (30 km), which collects the waters of the north-eastern mountainside, Drãganul (39 km), which collects the waters from the central part and Iadul (42 km), which gathers its waters from the Western part of the massif.

The size of the collector basins, the pronounced drainage slope, the impermeable petrographic sublayer and the large quantity of rainfall decisively influence the discharge of Crisul Repede.

On the superior and middle course of Crişul Repede there are 4 important accumulations intended for the protection of the riverain space, by the attenuation of the high waters and securing the discharges for all uses (Pop Gr.,1992).

The dammings and the setup of the accumulation dams as well as the expansion of the localities and agroecosystems in prejudice of the forest steppe determined the pollution of the soil and water with fertilizers and pesticides. (Mălăcea,I.,1969, Papadopol M., 1978).

Concomitantly the biodiversity was also affected in respect of the biological cycle as well as the evolution of the size, frequency and dominance ratio of its vegetal and animal components (Brezeanu. Gh. & Simion-Gruița Al.2002)

MATERIAL AND METHODS

For the assessment of the ecological state of the water course we followed the evolution of the physical, chemical and biological indicators (Gâstescu P., Brețcan P., 2009), that are significant for the downstream uses in 5 sections, considered essential:

Section 1- upstream accumulation Leşu, Section 2 - Bulz, downstream accumulation Leşu, Section 3- downstream Şuncuiuş, Vadu Crişului, Section 4- Aleşd, upstream accumulation Lugaş, Section 5- downstream accumulation Tileagd

The determinations were performed in the interval 01.2009-09.2010, characterized by the manifestation of some extreme meteorological phenomena with reference to the periods when the loads are maximal for all uses.

One performed a number of 5 sets of determinations each year for each control section. The values of the determinations of the physical-chemical parameters (Mănescu S., 1994) are synthetically rendered in table no. 1

The work methods are stipulated in the 161/2006 standard - the quality of surface waters.

The biological analyses are performed over a short period, with reduced costs and they allow the assessment of the ecological state of the waterbody (Dalea A., 2003).

For the harvest of the biological samples one chose the section downstream dam Tileagd because it accumulates all the influences of the hydrotechnical setups from upstream(Varduca A., 2000) and is located a short distance away from the water supply intake of the city of Oradea

For the determination of the biological parameters one proceeded to microscopic examinations, followed by the statistical data processing according to the ecological methods H. Knopp and Pantle-Buck.

The results of the biological analyses are rendered in the table's no. 2 and 3.

RESULTS AND DISCUSSIONS

Table no.1

parameter	MU	value					
		section 1	section 2	section 3	section 4	section 5	NTPA-013
physical indicators							
temp.	°C	11,2	9,30	11,80	13,80	14,10	25
pH		8,20	8,10	8,30	8,30	8,20	6,5-8,5
MS	mg/l	6,80	9,70	7,30	8,00	9,80	25
Oxygen system							
OD	mgO/l	10,66	11,53	11,97	11,78	11,00	-
CBO5	mgO_2/l	2,44	2,17	4,03	2,68	2,71	<7
CCO-Cr	mgO/l	1,44	1,47	1,85	1,47	1,18	30
nutrients							
azotates	mgN/l	0,488	0,590	0,583	0,530	0,474	-
N-total	mgN/l	0,718	0,820	1,000	0,875	0,813	-
N Kjeldahl	mgN/l	0,225	0,226	0,421	0,380	0,332	3
$N\text{-}NH_4$	mgN/l	0,017	0,025	0,070	0,035	0,022	2
P-total	mgP/l	0,0238	0,0290	0,0332	0,0350	0,0338	-
$P\text{-}PO_4$	mgP/l	0,0053	0,0077	0,0130	0,0068	0,0136	0,4
Toxic pollutants							
Cu	µg/l	1,36	1,93	2,25	5,95	4,13	50
Fe total	mg/l	0,04	0,10	0,13	0,12	0,17	1,0
Mn total	mg/l	0,013	0,032	0,020	0,020	0,043	1,0
Zn	µg/l	5,00	8,50	6,33	8,00	5,67	500

Table no. 2

designation	saprobic category	fre-quency		saprobic index (s)			
		A	R	o	β	α	p
Cyanophycee							
Oscillatoria formosa	α	50	2	-	-	2	-
Oscillatoria limnetica	o- β	60	2	1	1	-	-
Diatomee							
Amphora ovalis	β-o	10	2	1	1	-	-
Cymbella lanceolata	β	5	1	-	1	-	-
Cymbella ventricosa	α	4	1	-	-	1	-
Melosira italica	o- β	25	2	1	1	-	-
Navicula cryptocephala	α	18	2	-	-	2	-
Navicula gracilis	o- β	12	2	1	1	-	-
Diatoma vulgare	o- β	14	2	1	1	-	-
Synedra acus	β	8	1	1	-	-	-
Pinnularia viridis	β	6	1	-	1	-	-
Chlorophyceae							
Cladophora glomerata	β	22	1	-	1	-	-
Ulothrix zonata	o	24	1	1	-	-	-
Scenedesmus quadricauda	β	12	1	-	1	-	-
Pediastrum sp.	o	10	1	1	-	-	-
Cosmarium turpini	o	9	1	1	-	-	-
Spirogyra porticalis	o- β	14	1	0,5	0,5	-	-
Closterium acerosum	α	8	1	-	-	1	-
Rhizopoda							
Actinosphaerium eichhornii	o- β	3	1	0,5	0,5	-	-
Amoeba proteus	β	2	1	-	1	-	-
Ciliata							
Dileptus anser	β-o	2	1	0,5	0,5	-	-
Coleps hirtus	β- α	2	1	-	0,5	0,5	-
Vorticella campanula	β	3	1	-	1	-	-
Vorticella alba	p- α	2	1	-	-	0,5	0,5
Rotatoria							
Embata comensalis	β- α	2	1	-	0,5	0,5	-
Rotaria citrina	o	2	1	1	-	-	-
Brachionus sp.	β	1	1	-	1	-	-
Kellichottia longispina	o	3	1	1	-	-	-
Mollusca							
Phisa acuta	β	3	1	-	1	-	-
Planorbis corneus	β	2	1	-	1	-	-
Unio pictorum	β	2	1	-	1	-	-
Cladocera							
Daphnia sp.	o- β	5	1	0,5	0,5	-	-
Bosmina longirostris	o- β	3	1	0,5	0,5	-	-
Copepoda							
Eucyclops serrulatus	o- β	3	1	0,5	0,5	-	-
Insecta							
Ephemera sp.	o- β	6	1	0,5	0,5	-	-
Perla sp.	β	3	1	-	1	-	-
Culex sp.	β- α	10	1	-	0,5	0,5	-
Chironomus plumosus	p	2	1	-	-	-	1
Cloeon sp.	o- α	2	1	0,5	-	0,5	-
Echyonurus sp.	o- β	2	1	0,5	0,5	-	-
Limnephilus sp.	o- β	2	1	0,5	0,5	-	-

The results of the biological analyses- from Book method

Table no. 3

designation	saprobic category	frequency A	h	s	sxh
Cyanophycee					
Oscillatoria formosa	α	50	1	3	3
Oscillatoria limnetica	o- β	60	1	1,5	1,5
Diatomee					
Amphora ovalis	β-o	10	1	1,5	1,5
Cymbella lanceolata	β	5	1	2	2
Cymbella ventricosa	α	4	1	3	3
Melosira italica	o- β	25	2	1,5	3
Navicula cryptocephala	α	18	1	3	3
Navicula gracilis	o- β	12	1	1,5	1,5
Diatoma vulgare	o- β	14	1	1,5	1,5
Synedra acus	β	8	1	2	2
Pinnularia viridis	β	6	1	2	2
Chlorophyceae					
Cladophora glomerata	β	22	1	2	2
Ulothrix zonata	o	24	1	1	1
Scenedesmus quadricauda	β	12	1	2	2
Pediastrum sp.	o	10	1	1	1
Cosmarium turpini	o	9	1	1	1
Spirogyra porticalis	o- β	14	1	1,5	1,5
Closterium acerosum	α	8	1	3	3
Rhizopoda					
Actinosphaerium eichhornii	o- β	3	1	1,5	1,5
Amoeba proteus	β	2	1	2	2
Ciliata					
Dileptus anser	β-o	2	1	1,5	1,5
Coleps hirtus	β- α	2	1	2,5	2,5
Vorticella campanula	β	3	1	2	2
Vorticella alba	p- α	2	1	3,5	3,5
Rotatoria					
Embata comensalis	β- α	2	1	2,5	2,5
Rotaria citrina	o	2	1	1	1
Brachionus sp.	β	1	1	2	2
Kellichottia longispina	o	3	1	1	1
Mollusca					
Phisa acuta	β	3	1	2	2
Planorbis corneus	β	2	1	2	2
Unio pictorum	β	2	1	2	2
Cladocera					
Daphnia sp.	o- β	5	1	1,5	1,5
Bosmina longirostris	o- β	3	1	1,5	1,5
Copepoda					
Eucyclops serrulatus	β	3	1	2	2
Insecta					
Ephemera sp.	o- β	6	1	1,5	1,5
Perla sp.	β	3	1	2	2
Culex sp.	β- α	10	1	2,5	2,5
Chironomus plumosus	p	2	1	4	4
Cloeon sp.	o- α	2	1	2	2
Echyonurus sp.	o- β	2	1	1,5	1,5
Limnephilus sp.	o- β	2	1	1,5	1,5

The results of the biological analyses- from Pantle-Book method

From a meteo-climatic point of view the 2 years encompassed in the present study are different, the year 2009 being droughty, characterized by high temperatures and little rainfall and the first 8 months of 2010 were rich in above average rainfall, with great temperature variations.

1. Analysing the values of the physical-chemical indicators, according to Order 161/2006, in the mentioned section, the ecological state of the Crişul Repede waters allows the bordering of the waterbody in the quality category I.
2. By calculating the values of the synthetic indexes according to the Knoop method one determined the relative cleanness coefficient C= 79,2% relative impurification, I= 20,8%, so the ecological state of the waterbody is good, allowing the bordering in the quality category I-II.
3. The calculation of the saprobic index according to the Pantle-Book method led to the value I_S= 2, so the ecological state of the waterbody is good, allowing the bordering in the quality category II.
4. The differences registered by using the 2 ecological methods are owed to the fact that the Knoop method utilizes a frequency scale from 1 to 7, which allows the nuancing of the results, while the Pantle-Book method borders the indicators on a scale from 1 to 3.

CONCLUSIONS

1. The longitudinal and dam works influence the flora and fauna biodiversity of the area, especially the rheophile hydrobionts.
2. The bottom drainings which attenuate the high waters and secure the downstream discharges modify the thermal system by the significant uptake of waters with the temperature of 4°C, which influences the biological cycle and the trophic system of the hydrobionts.
3. The stagnation of the water in accumulations determines the concentration of the nutrients, which leads to the intensification of the water eutrophycation process and may influence the downstream uses.
4. The macrophytes from the meadow zones are influenced by the elimination of those that do not tolerate the submerged system, the vegetation facies from downstream of dams being that of park with shrub.
5. The accumulation of matter in suspension modifies the water transparency and favors the development of certain aphotic organisms, which in the moment of drainage qualitatively influence the downstream ecosystem.

The supply of the accumulations with cold mountain waters, the thermal stratification and the bottom drainage draw forms that are typical for the middle-upper course and determine the increased dominance of the hydrobionts specific to the waters from the oligosaprobic category downstream of the dams.

The presence of the dams stops the migration of the fish population in anadrom direction, determining an increased specificity of the ichtyofauna on each portion of the course, delimited by the existent accumulations.

The correlative interpretation of the physical, chemical and biological indicators confirm the beneficial influence of the hydrotechnical works on the uses from downstream, including the bordering in the ecological state of the waterbody, compatible with the potabilisation norms (NTPA/2002- 013).

With a view to a complete monitoring of the waterbodies the periodic determination of the physical-chemical indicators and the analysis of the benthic hydrobionts from the 4 accumulations is useful.

For the efficientization of the monitoring of the waterbody quality, consisting of the reduction of the analyses volume, of the work time and costs, we recommend that the biological analyses should precede the physical-chemical ones.

Likewise the qualitative biological analyses allow an assessment of the quality state of the waterbody, so that afterwards only certain representative physical-chemical parameters may be recommended for analysis.

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