ASPECTS OF THE ANTHROPIC IMPACT AND POLLUTION FROM THE SUPERIOR CATCHMENT AREA OF BISTRIŢA RIVER

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Abstract. The literature mentions that the construction of a dam and the aparition of the dam Lake Izvoru Muntelui - Bicaz in the middle catchment area of Bistriţa River and its regime of exploitation influenced the aparition of a microclimate with moist in excces in the soil and the modification of the landscape. The removal of some villages in this purpose and the economical developpment in the area increased the pressure on the environment. The present study aims to describe some of the problems affecting the superior catchment area of Bistriţa River, by the values of water physical and chemical analyses made in July and September 2005, the modification of the natural associations of plants and their slow replace with ruderal plants in inhabited areas, and some pictures of chaotic forest cutting, stone extract directly from the waterbed, storage of domestic wastes in the riverbed shore. The water analyses results showed organic pollution in the superior catchment area of Bistriţa River. The water quality decreased from upstream to downstream. On the main course of Bistriţa River the water was of 1st class on Bistriţa Aurie upstream Cârlibaba, 2nd at Ciocăneşti and Broşteni, 3rd at Ortoaia downstream Vatra Dornei city and 4th at Săvineşti village, the limit of the middle catchment area. On its main tributaries, Neagra Broşteni River and Dorna River is of 2nd class.

Keywords: anthropic impact, organic pollution, water quality classes, ruderal flora.

Rezumat. Aspecte ale impactului antropic şi poluării din bazinul superior al Bistriţei. Datele din literatură arată cum construcţia barajului şi apariţia Lacului de acumulare Izvoru Muntelui - Bicaz pe cursul mijlociu al Bistriţei şi regimul său de exploatare au determinat apariţia unui microclimat cu exces de umiditate în sol şi modificarea peisajului. Pe lângă acestea, strămutarea unor localităţi şi dezvoltarea economică au crescut presiunea asupra mediului. Lucrarea de faţă îşi propune să surprindă unele din problemele ce afectează bazinul superior al Bistriţei, redând prin rezultatele analizelor fizico-chimice din iulie şi septembrie 2005, modificările asociaţiilor naturale şi înlocuirea lor treptată cu plante ruderale şi segetale în perimetrul zonelor locuite, unele fotografii cu tăierile masive de pădure, amenjările şi lucrările în albie, depozitarea deşeurilor menajere direct pe malul apei. Rezultatele analizelor chimice semnalează prezenţa poluării organice în bazinul superior al Bistriţei, calitatea apei sub aspectul folosinţei scăzând din amonte în aval. Bistriţa Aurie, amonte de Cârlibaba are clasa I de calitate ca apoi, la Ciocăneşti şi la Broşteni, a III[a] la Ortoaia, aval de Vatra Dornei, iar la Săvineşti, să fie puternic poluată – clasa a IVa. Pe Neagra Broşteni şi Dorna are clasa a II[a].

Cuvinte cheie: impact antropic, poluare organică, clase de calitate a apei, flora ruderală.

Introduction

There is well known that any human action has impact on the environment. A lot of modern methods try to evaluate the anthropogenic influence. Most of that methods compare the natural, unaffected areas with the modified ones. Chemical or biological analyses of water assesments compare the results upstream and downstream of the suspected source of pollution. The same principle is used in the case of vegetation studies.

The main course of the Bistriţa River was traditionally used as a transportation way for the exploited wood for the last three centuries until the construction of the dams in its middle and inferior catchment area. I was finished in 1961 begun to fill from 1960. The catchment surface of the lake is 4025 km^2. Downstream all the natural conditions pre-existent for Bistriţa River course have changed (Ujvàry, 1971). The construction of a dam and the apparition of the Lake Izvoru Muntelui – Bicaz influenced the apparition of a microclimate with the increased of the fogg frequency and the excess of the moist from

the soil by direct infiltration (Mihăilescu, 2001). Other human actions are: the reorganising activities of the land, the extension and the apparition on the versants of some new localities by the removing of population from the actual area of the lake, the construction of the infrastructure etc. Today the degree of the hydro technical arrangements is high (Gheorghieş, 1998) and present even at the Ştiol Lake named also "Bistriţa Source Lake" (Fig. 1), in Rona Mountains that is a touristic destination.

Medium density of population per km^2, compared within the areas of Bistriţa River catchment is in Maramureş 82.33, in Suceava 82.49, in Neamţ 97.05, in Bacău 106.72. The exploitation of the wood continued (Table 1), being the main tendency for the local economy followed by tourism (Table 2).

This mountain area has always been a destination for tourism. The dimensions of the tourism activity and constructions increased considerably in the last years (Table 2) and the pressure on the environment also.

Some of the tourism destinations are also a few natural protected areas of flora: Lala-Bila (west side of Cârlibaba village) contains *Pinus cembra*, *Taxus baccata*, *Rhododendron kotskhyi*, *Leontopodium alpinum*, *Cypripedium calceolus* etc.; Poiana Stampei (at the confluence of Dorna River and Dornişoara Stream, at 17 km Vatra Dornei) contains *Pinus sylvestris f. turfosa*, *Sphagnum wulfianum*, *Andromeda polifolia*, *Eriophorum vaginatum*, *Drosera rotundifolia*, *Orchis* sp., *Eunotia parallela*, *E. septentrionalis*, *Pinnularia streptoraphe* and endemic *Batrachospermum dornense*, *Dinacharis intermedia*, *Elosa vorali*, *Lecane carpatica*, *L. sphagnophila* (Rotifera) (Mohan, 1990).

Human impact increased by chaotic forest cutting (Fig. 1.a), stone extraction directly from the riverbed (Fig. 2.c), storage of domestic wastes (Fig. 2.b) upon the running waters shores. Even some of our samples were taken nearby garbage and wastes (Figs. 1.c, 2.b).

Table 1. Volum of exploited wood in the catchment area of Bistriţa River (thousands of m^3) in 2003 (Anuarul statistic al României, 2004).

Region/ County	Total	Coniferous	Fagus	Oak	Various hard species	Various soft species
Total	166915	7139.0	4797.7	1531.6	18230.0	1450.2
Nord-Est	5545.6	3883.5	857.4	120.5	358.6	325.6
Suceava	3279.6	30519.3	167.7	6.2	36.7	9.7
Neamţ	933.7	583.6	239.0	14.9	48.5	47.7
Bacău	752.9	232.9	370.5	24.0	68.2	57.3

Table 2. Intern brute product (PIBR) in milliards of lei, current prices in 2004 in the catchment area of Bistriţa River (Anuarul statistic al României, 2004).

PIBR (in milliards of lei, current prices)	2001		2002	
	Total	North-East	Total	Nord-Est
Agriculture, hunting	156128.6	26810.7	17312.2	34965.5
Fishing, Fish farming	50.6	9.2	63.8	12.3
Energetic industry	32346.8	40939.3	426098.2	48702.6
Constructions	62333.7	7048.5	87888.8	9549.5
Trading	106640.7	11324.8	130334.0	13778.8
Hotels, restaurants	24590.0	2338.7	32337.6	2467.6

Material and Methods

In July and September 2005 we made chemical analysis for the water quality assessment with the compact laboratory for water testing Merck. We calculated the oxygen saturation index after Oehme and Shuler for the main course of Bistriţa River in its superior catchment area, from upstream Cârlibaba to Săvineşti and its main tributaries,

Dorna River and Neagra Broşteni River. The classes of water quality provided are presented below (Table 3).

Table 3. Orientational values for grading the quality of water bodies (Compact laboratory for water testing, Merck).

Quality class		I	II	III	IV
Organic load		Unpolluted to very slightly polluted	Moderately polluted	Strongly polluted	Extremely polluted
CBO_5 (mg/l)		1 - 2	2 - 8	8 - 20	> 20
O_2 minimum (mg/l)		> 8	> 6	> 2	< 2
Oxygen saturation in %		86 – 100	50 – 85	20 – 40	< 10
		100 – 110	110 – 150	150 – 200	> 230
pH	Acidic	6.5 – 7.0	6.0 – 6.5	5.0 – 5.5	< 5.0
	Alkaline	7.0 – 7.5	8.0 – 8.5	9.0 – 9.5	10.0
Ammonium (mg/l)		< 0.1	0.1 – 1	> 2	> 5
Nitrate (mg/l)		< 1.0	1 – 5	> 5	
Nitrite (mg/l)		< 0.1	0.2 – 0.5	4.0 – 6.0	8.0
Orthophosphate (mg/l)		< 0.03	< 0.5	> 0.5	
Total hardness (mmol/l)		Ca 3.6	Ca 5.3	Ca 7.1	
Acid-binding capacity (mmol/l)		0.5 – 1.0	0.25 – 0.5	0.03 – 0.1	0.05
Orthophosphate (mg/l)		< 0.03	< 0.5	> 0.5	

Results and Discussion

Upstream Cârlibaba village, the results of water analysis from Bistriţa Aurie shows that the water is without organic load (1st class of quality). At the next station, Ciocăneşti village, also on Bistriţa Aurie, O_2 value and the index of oxygen saturation are good (Tables 6, 7), but CBO_5 and ammonium values indicate the 2nd category (moderately polluted but well oxygenated) (Tables 4, 5).

Table 4. The results of the water analysis in July 2005.

Station	O_2 (mg/l)	CBO_5	Nitrate	Nitrite	Ammo-nium	Orthophosphate (mg/l)
Cârlibaba	9.2	6.1	0	0. 05	0	0
Ciocăneşti	8.3	6.1	0.2	0. 05	0	0
Ortoaia	9.2	8.5	2	0. 05	0	0
Broşteni	8.3	6.1	0.2	0. 05	0	0
Negrişoara	9.2	9.2	0	0.025	0	0.25
Dorna	9.2	8.3	0	0. 25	0. 4	0

Table 5. The results of the water analysis in September 2005.

Station	O_2(mg/l)	CBO_5	Nitrite	Nitrate	Ammonium	Orthophosphate(mg/l)
Cârlibaba	9.2	6.1	0	0.05	0	0
Ciocăneşti	8.3	6.1	0.2	0.05	0	0
Ortoaia	9.2	8.5	2	0.05	0	0
Broşteni	8.3	6.1	0.2	0.05	0	0
Negrişoara	9.2	9.2	0	0.025	0	0.25
Dorna	9.2	8.3	0	0. 25	0.4	0

The Negrişoara Stream, tributary to Dorna River had normal oxygen values in July and the oxygen saturation index showed moderately polluted water; an unusual high concentration of organic matter appeared in September CBO_5 of 9.2 mg/l) (Table 5).

Downstream Vatra Dornei, at Ortoaia village, in the main course of Bistriţa River the water was strongly polluted (3rd cathegory) prouved by CBO_5 (Table 4, 5) and the saturation index - under 35 in July and September (Table 6, 7). The same analisys shwoed that at Broşteni the water is moderated polluted with organic matter (2nd category).

In its main tributaries of Bistrița River Neagra Broşteni and Dorna the water is also moderated polluted (2nd category).

Dorna River has well oxygenated but moderate polluted water (2nd category, but well oxygenated) by CBO_5, oxygen saturation index and the remains of nitrites and nitrates values in July (Table 4, 6).

Some more sever phenomena of organic pollution was signalled in July in Bistrița River at Săvineşti village, the concentration of ammonium being high, as well as the smaller but important concentrations of nitrite and nitrate (Table 4) including the water in the 4th category, meaning extremely polluted.

Table 6. Oxygen saturation index as a function of water temperature and atmospheric pressure in July 2005.

Station	Altitude	°C	CBO_5	Atmospheric pressure	In theory	O_2 (mg/l)	Oxygen saturation %	Correction factor	Oxygen saturation index (%)
Exploa-Tare	950	19	6.1	905	9.26	6.9	74.51	1.12	83.45
Ciocă-Neşti	850	19	6.1	916	9.26	8.3	89.63	1.11	99.49
Ortoaia	780	19	0.7	916	9.26	3	32.39	1.11	35.96
Broşteni	620	19	6.1	928	9.26	8.3	89.63	1.09	97.69
Săvineşti	530	20	5.4	952	9.08	6.8	74.88	1.06	79.38
Negişoa-Ra	820	20	9.2	916	9.08	9.2	101.32	1.11	112.46
Dorna	813	20	8.3	916	9.08	9.2	101.2	1.11	112.46
Neagra Broşteni	660	19	7.0	928	9.26	8.0	86.39	1.09	94.16

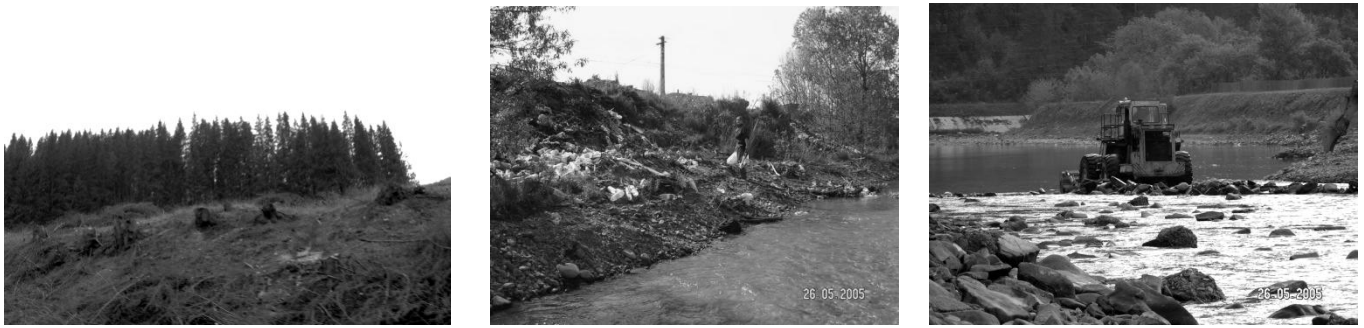
Among the various modalities to evaluate the anthropogenic impact is the analysis of the vegetation. Especially in inhabited surroundings among the garbage deposited, unfortunately, directly in the channel (e.g. Fig. 2.b) it can be found ruderal associations of plants that indicate us a big N_2 concentration in the soil.

Table 7. Oxygen saturation index as a function of water temperature and atmospheric pressure in September 2005.

Station	Altitude	°C	CBO_5	Atmospheric pressure	In theory	O_2 mg/l	Oxygen saturation %	Correction factor	Oxygen saturation index (%)
Cârlibaba	950	17	6.1	905	9.64	9.2	95.43	1.12	106.88
Ciocăneşti	850	16	6.1	916	9.85	8.3	84.26	1.11	93.52
Ortoaia	780	17	8.5	916	9.64	9.2	95.43	1.11	93.52
Broşteni	620	16	6.1	928	9.85	8.3	84.26	1.09	91.84
Negrişoara	820	16	9.2	916	9.85	9.2	93.40	1.11	103.67
Dorna	813	17	8.3	916	9.64	9.2	95.43	1.11	93.52

a **b** **c**

Figure 1. Small artificial dams (details at a, b) at Ştiol Lake named also Izvoru Bistriţei (c), in Rodna Mountains.



a **b** **c**

Figure 2. Pictures of the effects of anthropic impact on the environment from the superior catchment area of Bistriţa River: **a.** Forest distruction and slip of the soil in Prislop passage; **b.** Domestic garbage „stored" on the shore of the Calimănel at Panaci (the riverbed is already influenced by the sulf exploitation from Călimani mountains); **c.** Extraction of rocks and pebbles from the riverbed for constructions (Bistriţa River).

Plants well known as indicators for these conditions are (Ştefan, 2005; Chifu, 2006): *Urtica dioica, Chenopodium vulvaria, Chenopodium botrys, Amaranthus albus, A. retroflexus, Lepidium ruderale, Atriplex tatarica, Chaerophyllum temullum, Chaerophyllum aromaticum, Aegopodium podagraria, Petasites hybridus, Rorippa austriaca, Calystegia sepium,* etc. The characteristic associations of local vegetation are invaded by these species with a very large ecological preferences and replaced with ruderal associations (Ştefan, 2005; Chifu, 2006): *Tanaceto – Artemisietum vulgaris* Sissingh 1950, *Ivetum xanthifoliae* Fijalkowschi 1967, *Atriplicetum tataricae* Ubrizsy 1949, *Arctio – Ballotetum nigrae* (Felföldy 1942) Morariu 1943, *Polygonetum avicularis* (Gams. 1927) Soó 1940, *Sambucetum ebuli* Felföldy 1942.

Conclusions

The water analysis results, made in July and September 2005, showed organic pollution in the superior catchment area of Bistrița River. On the main course of Bistrița River the water was of 1st class on Bistrița Aurie upstream Cârlibaba, 2nd at Ciocăneşti and Broşteni, 3rd at Ortoaia downstream Vatra Dornei city and 4th at Săvineşti village, the limit of the middle catchment area. On its main tributaries: Neagra Broşteni River and Dorna River is of 2nd class.

Human impact is increased by chaotic forest cutting, stone extraction directly from the waterbed and storage of domestic wastes in the riverbed shore.

We found ruderal associations of plants that indicate a big N_2 concentration in the soil. The characteristic associations of local vegetation are invaded by these species with very large ecological preferences and replaced with ruderal associations.

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