THE COMPARISON OF THE BELGIAN BIOTIC INDEX WITH PHYSICO-CHEMICAL ANALYSES FOR DANUBE WATER

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abstract: This paper compares the results of the biological and physico-chemical analyses of the Danube's waters upstream and downstream of Braila. The Belgian Biotic Index (BBI) was calculated using the existence of the macroinvertebrates in the Danube's water. The pollution of the Danube by the town Braila is minors, the quality of the waters being medium.

Introduction

International aid organizations fear that fresh water, a natural resource elementary for Man's existence, will have become so scarce in the 21st century that wars will be waged for it. The reserves of fresh water as well of surface water, as of ground water are indeed dwindling fast [1].

For Man, water is both an extended part of his natural environment in the form of precipitation, rivers and lakes and also an essential natural material resource for his domestic, agricultural and industrial uses. To satisfy his legitimate needs for water, man must inevitably interfere in the hydrologic cycle quantitatively by extraction, impoundment, flow regulation, water transfer etc, and qualitatively by the return of the used water as effluents. However he should be aware of the ecological consequences, many of which are directly detrimental to his interests [2].

Quality, as applied to water as a natural material resource, is more difficult to define subjectively and can only satisfactorily be defined objectively in terms of specific uses. Although different natural waters, e. g. soft and hard waters, may best serve different uses, any deterioration in the environmental quality of a water source results in a lowering of the quality of the water for most purposes. Quality assessment of surface waters is therefore a necessity, not in the first place out of purely environmental considerations but out of economic and sanitary ones. Due to the subjective nature of the concept of water quality, different approaches have been and are being used and a clear evolution in this field of research can be observed. Initially, in many countries the assessment of water quality for water management purposes was based mainly or exclusively on physico-chemical data.

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Subsequently biological assessment methods became fully accepted in the seventies as the focus of water quality problems shifted from the biotic load to its impact on aquatic life such as the eutrophication problem and toxic effects of polluting substances. The most recent development in biological assessment is the ecological or integrated approach in which the quality of the aquatic ecosystem as a whole is considered, i.e. including both the water zone or water body itself and the interlinked system of the aquatic, riparian and terrestrial zones and the animal and plant communities present there.

Many countries have developed and experimented biotic indices in defining the dynamics of ecological running complexes corresponding to the socio- economical development.

First biotic index was used in Great Britain and is known as the Trent Biotic Index (TBI), established by Woodiwiss, in 1964. Having this index as a starting point, there came into being a whole family of indices based on macroinvertebrates, used in many European countries [3].

In this work we realized the comparison of the Belgian Biotic Index (BBI) with physico-chemical analyses for Danube water.

Experimental part

The samples were collected from the Danube from March to November 2004 upstream (Chiscani) and downstream of Braila (Lippovan beach) to establish the role of the town in the pollution of the Danube.

The chemical indicators were analyzed with spectrophotometer UV-VIS CECIL 6100 (for NO_3^-, NH_4^+, PO_4^{3-}), spectrometer Spekol (NO_2^-, Cr, Fe) and colorimeter Duboscq for phenols.

The macroinvertebrates were sampled with a colonization sampler, preservation in the field by adding 70% denatured ethanol or 4% formaldehyde until the animals are completely immersed.

For identification we used a compound microscope and identification keys for macroinvertebrates [1,4,5].

The Belgian Biotic Index (BBI), in comparison with most other assessment methods, is the most organisms have only to be identified at family or genus level and not on species level [1]. (Table 1)

Evidently a lot of information on the qualitative characteristics of the invertebrate community studied get lost in this way but on the other hand does this approach allow us to study a much larger amount of samples since it is much less time consuming.

Table 1. Practical limits to identify taxa in the Belgian Biotic Index [1]

Taxonomic group	Identification level of taxonomic groups
Plathyhelminthes	Genus
Oligochaeta	Family
Hirudinea	Genus

Table 1. (*continued*)

Taxonomic group	Identification level of taxonomic groups
Mollusca	Genus
Crustacea	Family
Plecoptera	Genus
Ephemeroptera	Genus
Trichoptera	Family
Odonata	Genus
Megaloptera	Genus
Hemiptera	Genus
Coleoptera	Family
Diptera	Family except Chironomidae, divided in 2 groups: Chironomidae *thummi-plumosus* Chironomidae *non-thummi-plumosus*
Hydracarina	Presence

Table 2. Standard Table for Calculation of the Belgian Biotic Index [1]

Indicator group	Class frequency	Number of taxa				
		0-1	2-5	6-10	11-15	>16
Plecoptera, Heptagenidae	≥ 2	-	7	8	9	10
	1	5	6	7	8	9
Cased Trichoptera	≥ 2	-	6	7	8	9
	1	5	5	6	7	8
Ancylidae, Ephemeroptera (exc. Ecdyonuridae)	≥ 2	-	5	6	7	8
	1	3	4	5	6	7
Aphelocheirus, Odonata, Gammaridae, Mollusca (exc. *Sphaeriida*)	≥ 1	3	4	5	6	7
Asellidae, Hirudinea, Sphaeriidae, Hemiptera (exc. *Aphelocheirus*)	≥ 1	2	3	4	5	-
Tubificidae, *Chironomus thummi – plumosus*	≥ 1	1	2	3	-	-
Syrphidae – Eristalinae	≥ 1	0	1	1	-	-
		Biotic Index value				

Results and Discussion

Physico-chemical assessments were initially preferred above biological assessments because the science of chemistry developed earlier than biology and yields far more accurate and reproducible results. Scientists therefore considered for a long time that physico-chemical assessment in legislation and standards (water quality objectives) is better than biological assessment mainly for several reasons:

– The direct relation with emissions of polluting substances;

– The relative to perform and standardize sampling and measurements of “common” chemicals in river water;
– The straight-forward manner in which water management objectives and quality standards can be expressed in terms of threshold concentrations;

All biological quality methods for running and standing waters are based upon the same simple principle: all the existing species, populations and communities of aquatic plants and animals do not react in the same way to stress induced by a certain type of pollution. The degree of difference in response is reflected in quantitative or qualitative changes, which can be measured and hence can be transformed into mathematical formula’s and value scales [1, 2].

The values of the chemical indicators shown in the next table are the average values got after the analyze of the water samples taken in 2004 – from two places of the Danube (upstream and downstream Braila).

Table 3. Physico-chemical analyses for Danube waters in 2004

		NO_3^-	NH_4^+	NO_2^-	PO_4^{3-}	Cr	Fe	Phenols
Upstream of Braila	Medium values	1,34	0,1503	0,0316	0,0329	0,0225	0,502	0,0024
	Maximum values	1,77	0,25	0,049	0,043	0,0317	0,82	0,0036
Downstream of Braila	Medium values	1,4211	0,26	0,0284	0,0457	0,0268	0,6706	0,0027
	Maximum values	1,8	0,4	0,041	0,07	0,045	1,04	0,0047
CMA(mg/L)		3	0,3	0,06	0,2	0,05	0,1	0,001

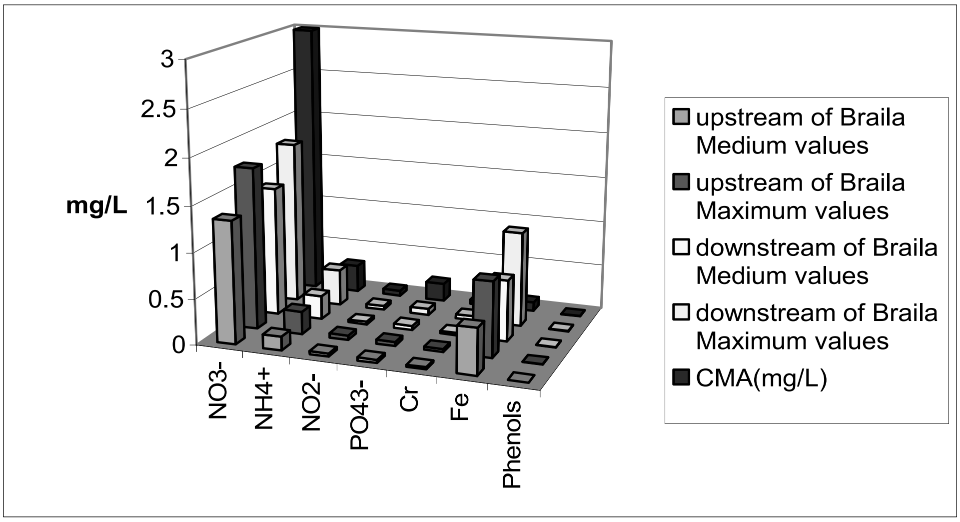

Fig. 1: *The medium and maximum values of chemical indicators*

Table 4. The Belgian Biotic Index of the Danube's waters in 2004

Groups macroinvertebrates	Upstream of Braila	Downstream of Braila
Plathyhelminthes	-	1
Oligochaeta	1	1
Hirudinea	2	1
Mollusca	3	2
Crustacea	2	2
Plecoptera	-	-
Ephemeroptera	1	1
Trichoptera	1	1
Odonata	2	1
Megaloptera	-	-
Hemiptera	2	2
Coleoptera	1	1
Diptera	2	2
Total number groups	10	10
Belgian Biotic Index	7	7
Water quality	Weak polluted	Weak polluted

Conclusions

As results from the two analyses – biological (Table 4) and physico-chemical (Table 3, Fig. 1) – Braila town don't make a significant pollution of the Danube's water, which are in second level of quality.

Results that assessments of water via a chemical analysis and via a biological analysis give as two different sets of information. Physico-chemical analysis yields information about the possible physico-chemical causes that may influence the quality status of the natural resource "water". Biological analyses yields information of the effects of physico-chemical, structural, biological and hydrodynamic causes that influence the quality of the ecosystem "water".

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