ECOLOGICAL STATUS OF LOTIC SYSTEMS ASSESSED BASED ON BIOTIC QUALITY COMPONENTS: ARGEŞ, VEDEA AND LITORAL RIVER BASINS

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The assessment of current status of aquatic systems and the analysis of spatial and temporal variability of uni- and multi-criterial indices currently used in the monitoring and evaluation of the ecological status of lotic systems, are essential conditions to guide further development and refinement of the existing methods. Based on the data sets generated by the national monitoring system for the period 2009–2010 biotic indices of benthic invertebrates, phytoplankton and phytobenthos communities were calculated. Subsequently, the values of these indices were used to calculate the multimetric indices in order to evaluate the ecological state of lotic systems in the river basins Argeş, Vedea and Litoral. In most cases, the multimetric indices of macro-zoobenthos established the biological final status of water bodies. This suggests a better efficiency of methods based on benthic invertebrates as compared to those based on phytobenthos and phytoplankton in assessing the ecological status of studied water bodies and early detection of changes in communities structure due to anthropogenic impacts and ecological reconstruction.

Key words: biological indices, ecological status, uni-criterial indices, multi-criteria indices.

INTRODUCTION

Since the 80s, the importance of biological quality components has been widely recognized by the scientific community, the collection, analysis and interpretation of such data being crucial in order to assist the decision makers (Barbour *et al*., 1999).

Currently, in all the EU Member States, the ecological status of lotic systems is assessed using biological, physico-chemical and hydromorphological components specific to each type of lotic system. Based on comparison with the reference status (undisturbed, natural or hypothetical) five quality classes, respectively high, good, moderate, poor and bad, are defined in accordance with the recommendations of the Water Framework Directive (WFD). In order to integrate the biotic quality components within the ecological status the following variables should be considered: composition, distribution and abundance of biotic components, the ratio of sensitive to tolerant taxa and the diversity within each compartment (Hering *et al*., 2004).

In order to achieve a European and national unitary assessment of lotic systems ecological status intercalibration exercises were developed with the aim to ensure the compliance with the WFD (WISE, 2008). Outcomes of the first inter-calibration exercise performed in 2004-2007 showed that many gaps in developing integrated assessment methods still exist (Moldoveanu & Rîşnoveanu, 2010; Commission Decision, 2008). For the first River Basin Management Plan (RBMP), completed after the first intercalibration exercise, a limited number of methods for biological quality components have been applied in Romania; at that moment only the assessment methods for phytoplankton, macroinvertebrates and fish were developed in compliance with the WFD. For macroinvertebrates and fish, the methods were further developed by the Romanian authorities after the 2nd phase of intercalibration (2008-2011). The development and refinement of the assessment methods for biological quality components has continued with some progress in terms of development of phytobenthos evaluation system (no yet validated at European level) (European Commission, 2012). The data collection is ongoing for aquatic macrophytes. In this case it is foreseen that the method to be completed during 2014. The authorities involved in the implementation of the WFD in Romania estimate that until the 2-nd RBMP assessment methods for all biological quality components will be developed and validated.

In this context, the analysis of the ecological status of water bodies based on the assessment methods used by the national authority responsible for the implementation of the WFD (National Administration "Apele Române" - ANAR) remain a research priority meant to support the scientific development and refinement of the National Integrated Monitoring System.

MATERIAL AND METHODS

The assessment of ecological status of lotic systems in Argeş, Vedea and Litoral river basins was done using the dataset generated by the National Monitoring System in 2009-2010. Eight water bodies were analyzed for each Argeş and Vedea river basins and nine water bodies for Litoral basin.

A total of eight typologies of water bodies out of the 20 typologies identified at national level (National Management Plan, 2009) are analyzed. Most of them belong to lowland typologies (RO06, RO08, RO10, RO19, and RO20) and few to hilly areas (RO05) and highlands (RO01, RO02). There is no reference monitoring section established for all these typologies in the studied water bodies. Of the total number of monitoring sections analyzed (25) only four were reference sites.

The biotic quality components used to assess the ecological status of water bodies are benthic invertebrates, phytobenthos and phytoplankton. Based on quantitative numerical data provided by the ANAR (composition of benthic communities and numerical density of taxa) the following indices were calculated using the national methods: Number of taxa (NT), Number of families (NF),

Ephemeroptera - Plecoptera - Trichoptera (EPT), Oligochaeta - Chironomidae (OCH), rheophile (REO), limnophile (LIM), Saprobe Index (SI) and Functional groups (FG).

For each single index ecological quality ratio (EQR) was computed based on the reference status value corresponding to each typology. The ratio between the lower to higher value was computed so that EQR to be subunitary. Subsequently, the multi-metric index (Annex 6.1.1.B. of Synthesis Management Plans) was computed in order to assess and classify the water bodies' status in one of the five quality classes.

In 2009 the assessment of ecological status of water bodies considered also the phytoplankton and phytobenthos saprobe index and in 2010 the multi-metric indices for these biotic components. The "one-out all-out" principle was applied to establish the final ecological status of water bodies.

RESULTS AND DISCUSSION

The same monitoring section is framed in different quality classes by different indices calculated for benthic invertebrate community at each sampling moment (Tables 1, 2).

Based on saprobe index (SI) of invertebrates (the only index considered by national monitoring system in 2009), almost 80% of the cases (sections and sampling campaigns in 2009 and 2010) from Argeş river basin are classified in high and good quality status, except the monitoring sections Ciumeşti (September 2009, July and September, 2010) and Brezoaiele (March and September, 2009 and 2010) that belong to RO05 and RO10 typologies, respectively. In Vedea river basin the SI of invertebrates classify almost 60% of the total cases, in high and good quality status; in the other cases the SI has values that classify the respective water bodies in moderate and poor quality status. Thus, the monitoring sections located on river Vedea (downstream Roşiori de Vede - May and July 2009, May 2010; upstream Alexandria - July and September 2009, May 2010; upstream the confluence with river Teleorman - July to September 2009, July 2010), river Cotmeana (Ciobani - March 2009, downstream Poiana Lacului - July 2010) and river Teleorman (upstream the confluence with river Vedea, July 2009 and September 2010) are classified as having moderate quality status; the downstream Roşiori de Vede monitoring section (September 2009 and 2010, July 2010) has poor quality status. In Litoral river basin SI reveals a moderate ecological status for all sections belonging to RO05 typology in 2009, and over 80% in 2010; the monitoring sections belonging to RO06 typology are equally classified in good and moderate ecological status whereas the monitoring sections belonging to RO08 typology are divided proportionally between the very good, good and moderate ecological status in 2009 while in 2010, the good ecological status is dominant (66% of cases).

Table 1

Quality biotic components monitored in 2009/2010 and the quality classes of water bodies in Litoral and Argeş river basin

Lotic system	Typology	Monitoring section	Code_ Sampling moment	Macrozoobenthos									Phytobenthos					Final status
				NF	SI	EPT	OCH	REO	LIM	FG	SW	MI	NT	SI	SW	DI	MI	Quality classes
Hamangia	RO05	H.P. Baia	1HB_SP	III/III	III/III	V/V	III/II	III/II	I/II	IV/III	I/I	**III/II**	*/III	IV/IV	*/III	*/II	*/II	**III/II**
			1HB_SU	III/II	III/III	V/V	I/II	V/II	I/I	V/IV	I/I	**I/III**	*/III	IV/IV	*/III	*/II	*/II	**I/III**
			1HB_AU	III/II	III/III	V/V	V/IV	IV/II	I/I	IV/IV	I/I	**III/III**	*/III	III/IV	*/II	*/II	*/II	**III/III**
	RO05	Hm 256	2HH_SP	III/I	III/III	V/V	V/IV	IV/IV	I/III	V/II	I/I	**III/II**	*/II	III/IV	*/I	*/	*/I	**III/II**
			2HH_SU	II/II	III/III	V/V	III/II	III/III	I/II	IV/II	I/I	**III/II**	*/III	III/IV	*/III	*/II	*/II	**III/II**
			2HH_AU	II/II	III/III	V/V	III/III	IV/III	I/II	III/II	I/I	**III/II**	*/III	III/IV	*/II	*/II	*/II	**III/II**
Teliţa	RO05	H.P. Poştă	1TP_SP	III/II	III/III	V/V	I/II	IV/II	I/II	V/IV	II/I	**III/II**	*/III	III/IV	*/III	*/II	*/II	**III/II**
			1TP_SU	II/III	III/III	V/V	I/II	IV/II	I/II	III/IV	I/I	**III/II**	*/III	III/IV	*/II	*/II	*/I	**III/II**
			1TP_AU	II/III	III/III	V/V	I/IV	III/III	I/IV	III/IV	I/I	**II/II**	*/III	II/IV	*/II	*/II	*/II	**II/II**
	RO05	Downstream the airport M. Kogălniceanu	2TK_SP	III/III	III/II	V/V	V/II	IV/III	I/II	IV/V	I/I	**III/III**	*/III	**/IV	*/III	*/II	*/III	**III/III**
			2TK_SU	III/III	III/II	V/V	V/III	II/II	I/I	V/IV	I/I	**III/II**	*/III	III/IV	*/III	*/II	*/II	**III/II**
			2TK_AU	III/II	III/III	V/V	II/III	IV/IV	I/III	III/II	I/I	**III/II**	*/III	II/IV	*/II	*/II	*/II	**III/II**
Ciucurova	RO06	Upstream Slava Rusă village	1CS_SP	II/III	III/II	V/V	III/II	II/I	III/V	II/III	I/I	**I/III**	*/III	*/IV	*/I	*/II	*/I	**I/III**
			1CS_SU	II/II	III/II	I/V	III/III	I/II	IV/III	I/II	I/I	**II/III**	*/III	*/IV	*/II	*/II	*/II	**II/III**
			1CS_AU	*/II	*/III	*/V	*/IV	*/III	*/II	*/IV	*/I	***/III**	*/III	*/II	*/I	*/II	*/II	***/III**
Casimcea	RO06	Upstream the bridge**	1CA_SP	III/II	II/II	V/V	III/II	I/I	IV/V	V/IV	II/I	**IV/III**	*/II	*/III	*/I	*/II	*/I	**IV/III**
			1CA_SU	III/II	II/III	V/V	III/III	I/II	IV/IV	III/II	I/I	**II/III**	*/III	*/IV	*/II	*/II	*/II	**II/III**
	RO08	H.P. Cheia	2CC2_SP	I/I	II/II	III/IV	II/II	I/II	V/III	I/I	I/I	**II/II**	*/I	II/III	*/I	*/III	*/I	**II/II**
			2CC2_SU	I/II	II/II	IV/V	I/III	I/IV	IV/I	I/I	I/I	**II/II**	*/I	II/II	*/I	*/III	*/I	**II/II**
			2CC2_AU	I/I	II/II	III/IV	I/III	I/III	V/II	II/I	I/I	**II/II**	*/I	II/I	*/I	*/III	*/I	**II/II**
Tăiţa	RO08	H.P. Satu Nou	1TS_SP	III/II	IV/IV	V/II	IV/III	V/V	I/I	III/I	II/I	**III/I**	*/III	*/IV	*/I	*/II	*/II	**III/II**
			1TS_SU	II/II	III/III	V/III	IV/III	V/V	I/I	III/I	II/II	**III/II**	*/III	III/IV	*/II	*/II	*/II	**III/II**
			1TS_AU	III/II	II/II	V/III	III/III	I/III	IV/II	V/I	I/I	**III/II**	*/III	III/III	*/II	*/II	*/II	**III/II**
	RO08	Upstream Horia reservoir	1TH_SP	III/II	II/II	V/IV	III/III	I/III	V/II	V/I	II/I	**III/II**	*/III	*/III	*/III	*/I	*/II	**III/II**
			1TH_SU	II/II	III/II	V/IV	III/III	II/V	IV/I	V/I	I/I	**III/II**	*/III	III/IV	*/II	*/I	*/II	**III/II**
			1TH_AU	II/III	III/III	V/V	III/IV	III/III	II/II	II/IV	I/I	**II/III**	*/III	III/III	*/II	*/II	*/II	**II/III**
Vâlsan	RO02	Brădet**	2VB_SU	III/IV	I/I	I/I	I/I	I/I	I/I	IV/II	I/III	**II/II**	*/I	III/II	*/I	*/II	*/I	**II/II**
	RO05	V. Mărului	3VV_SU	III/III	I/I	I/I	I/I	I/I	I/I	III/I	I/III	**II/II**	*/I	III/I	*/I	*/II	*/I	**II/II**
			3VV_AU	*/II	*/II	*/I	*/I	*/I	*/I	*/I	*/I	***/I**	*/I	*/I	*/I	*/II	*/I	***/I**

Table 1 (continued)

Doamnei	RO05	Ciumeşti	3DC_SU	III/IV	II/III	III/V	I/III	I/III	I/III	V/I	II/II	**II/III**	*/II	II/I	*/I	*/II	*/I	**II/III**
			3DC_AU	III/III	III/III	IV/II	I/I	I/IV	I/III	V/II	II/I	**II/II**	*/I	II/I	*/I	*/II	*/I	**II/II**
Dâmbovicioara	RO01	Gorges exit**	1DI1_SP	IV/*	I/*	II/*	II/*	I/*	I/*	II/*	II/*	**II/***	*/*	III/*	*/*	*/*	*/*	**II/***
			1DI1_SU	III/II	II/II	I/I	I/I	I/I	I/I	II/I	I/I	**II/I**	*/I	III/III	*/I	*/II	*/I	**II/I**
			1DI1_AU	*/II	*/II	*/II	*/I	*/I	*/I	*/II	/I	****/II**	*/I	*/III	*/I	*/III	*/II	***/II**
Valea Cheii	RO01	Gorges exit**	1DI2_SP	IV/*	II/*	II/*	I/*	I/*	I/*	III/*	II/*	**II/***	*/*	III/*	*/*	*/*	*/*	**II/***
			1DI2_SU	IV/II	II/II	I/I	I/I	I/I	I/I	II/I	I/I	**II/I**	*/I	III/III	*/I	*/II	*/II	**II/II**
			1DI2_AU	*/II	*/I	*/I	*/I	*/I	*/I	*/I	*/I	**/I**	*/I	*/III	*/I	*/II	*/I	**/I**
Dâmboviţa	RO05	Downstream Cetăţuia village	2DV_SP	III/*	II/*	II/*	I/*	I/*	I/*	V/*	III/*	**I/***	*/*	I/*	*/*	*/*	*/*	**I/***
			2DV_SU	II/III	II/II	I/III	I/I	I/II	I/I	IV/III	I/I	**II/II**	*/I	I/II	*/I	*/II	*/II	**II/II**
			2DV_AU	*/III	*/II	*/I	*/I	*/I	*/I	*/I	*/I	**/I**	*/I	*/II	*/I	*/II	*/II	**/II**
	RO10	Malu cu Flori	3DM_SP	III/*	II/*	I/*	I/*	I/*	IV/*	I/*	II/*	**II/***	*/*	II/*	*/*	*/*	*/*	**II/***
			3DM_SU	II/II	I/II	I/I	I/I	I/I	V/I	II/I	I/I	**II/I**	*/I	I/III	*/I	*/III	*/II	**II/II**
			3DM_AU	*/II	*/I	*/I	*/I	*/I	*/I	*/II	*/I	**/I**	*/II	*/I	*/I	*/III	*/I	**/I**
	RO10	Brezoaiele	4DB_SP	III/II	IV/III	V/IV	V/V	V/V	I/I	V/II	I/II	**III/I**	*/*	*/*	*/*	*/*	*/*	**III/I**
			4DB_SU	*/II	*/II	*/III	*/I	*/V	*/I	*/I	*/II	****/II**	*/*	*/*	*/*	*/*	*/*	***/II**
			4DB_AU	**II/II**	**IV/II**	**V/I**	**V/II**	**V/V**	**I/I**	**V/I**	**I/I**	**III/II**	*/*	*/*	*/*	*/*	*/*	**III/II**

Abbreviations: TND - total numerical density; NT - number of taxa; NF - number of families; SI - saprobe index; EPT – Ephemeroptera - Plecoptera-Trichoptera index; OCH – Oligochaeta - Chironomidae index; REO - rheophilic index; LIM - limnophilic index ; FG - functional group index; SW - Shannon Wiener diversity; MI - multimetric index; NAD - numerical abundance of diatoms; DI - diatoms index; SD - Shannon diversity; NAB - numerical abundance of Bacillariophyceae; SP = spring; SU = summer; AU = autumn; *Not monitored / computed; **References sites.

Table 2

Quality biotic components monitored in 2009/2010 and the quality classes of water bodies in Vedea river basin

Lotic system	Typology	Monitoring section	Code_ Sampling moment	Macrozoobenthos									Phytoplankton					Final status
				NF	SI	EPT	OCH	REO	LIM	FG	SW	MI	IS	SD	NT	NAB	MI	Quality classes
Vedea	RO10a	Văleni	2VV_SP	III/II	II/I	II/I	I/I	I/I	V/V	II/I	II/I	**III/II**	III/III	*/I	*/I	*/II	*/II	**III/II**
			2VV_SU	II/I	I/I	I/I	I/I	I/I	IV/IV	I/I	I/I	**I/I**	III/	*/II	*/I	*/I	*/I	**I/I**
			2VV_AU	II/III	II/I	I/II	I/I	I/II	IV/II	I/I	I/I	**II/I**	II/II	*/I	*/I	*/I	*/I	**II/I**
	RO10a	Downstream Roşiori de Vede	3VR_SP	I/I	II/III	II/III	I/I	II/V	II/I	I/I	I/I	**I/II**	III/	*/*	*/*	*/*	*/*	**I/II**
			3VR_SU	I/I	III/IV	II/II	I/I	III/IV	I/I	I/I	I/I	**I/II**	III/III	*/IV	*/I	*/I	*/III	**I/III**
			3VR_AU	I/I	III/IV	II/III	I/I	V/V	I/I	I/III	I/I	**I/II**	III/II	*/I	*/I	*/II	*/I	**I/II**
	RO10a	Upstream Alexandria	4VA_SP	I/I	II/III	II/III	I/I	II/V	II/I	I/I	I/I	**I/II**	III/*	*/*	*/*	*/*	*/*	**I/II**
			4VA_SU	I/I	III/II	II/II	I/I	III/II	I/IV	I/I	I/I	**I/I**	III/III	*/V	*/I	*/I	*/III	**I/III**
			4VA_AU	I/I	III/II	II/II	I/I	V/II	I/I	I/I	I/I	**I/II**	III/III	*/I	*/I	*/I	*/II	**I/II**
	RO10a	Upstream R. Teleorman confluence	5VT_SP	I/I	II/II	II/II	I/I	V/II	I/II	I/I	I/I	**I/II**	III/*	*/*	*/*	*/*	*/*	**I/II**
			5VT_SU	I/I	III/III	II/II	I/I	V/IV	I/I	I/I	I/I	**I/I**	III/III	*/V	*/I	*/I	*/II	**I/II**
			5VT_AU	I/I	III/II	II/III	I/I	V/V	I/I	I/I	I/I	**II/II**	III/	*/IV	*/I	*/I	*/I	**II/II**
Cotmeana	RO10a	Ciobani	2CC_SP	III/III	III/II	II/I	III/I	I/I	IV/III	V/V	III/I	**III/II**	III/II	*/I	*/I	*/I	*/II	**III/II**
			2CC_SU	II/II	II/II	I/I	I/I	I/I	V/V	I/I	I/I	**II/I**	II/III	*/I	*/I	*/I	*/I	**II/I**
			2CC_AU	II/II	II/II	I/III	I/I	III/V	I/I	I/II	I/I	**I/II**	III/II	*/I	*/I	*/I	*/I	**I/II**
	RO19a	Poiana Lacului	1CP_SP	III/II	II/II	IV/III	I/I	I/II	I/I	III/II	I/I	**I/II**	*/*	*/*	*/*	*/*	*/*	**I/II**
			1CP_SU	II/III	II/III	I/II	I/I	I/I	I/I	II/II	I/I	**II/I**	*/*	*/*	*/*	*/*	*/*	**II/I**
Teleorman	RO10a	Upstream river Vedea confluence	3TV_SP	I/I	II/II	II/II	II/I	III/I	I/III	I/I	I/I	**II/I**	II/*	*/*	*/*	*/*	*/*	**II/I**
			3TV_SU	I/I	III/II	III/II	II/I	V/II	I/II	I/I	I/I	**II/II**	III/III	*/II	*/I	*/I	*/II	**II/II**
			3TV_AU	I/I	II/III	II/II	I/I	III/III	I/I	I/I	I/I	**II/II**	III/III	*/I	*/I	*/II	*/II	**II/II**
Pârâul Câinelui	RO20a	Upstream river Vedea	1CV_SP	I/I	II/III	II/I	I/I	II/I	II/I	I/I	I/I	**II/II**	*/*	*/*	*/*	*/*	*/*	**II/**
			1CV_SU	I/I	II/II	IV/II	I/I	II/II	III/I	I/I	I/I	**I/II**	*/*	*/*	*/*	*/*	*/*	**I/II**

Abbreviations: TND - total numerical density; NT - number of taxa; NF - number of families; SI - saprobe index; EPT – Ephemeroptera – Plecoptera - Trichoptera index; OCH – Oligochaeta - Chironomidae index; REO - reophilic index; LIM - limnophilic index ; FG - functional group index; SW - Shannon Wiener diversity; MI - multimetric index; NAD - numerical abundance of diatoms; DI - diatoms index; SD - Shannon diversity; NAB - numerical abundance of Bacillariophyceae; SP = spring; SU = summer; AU = autumn; * Not monitored / computed.

EPT index highlights the following aspects:

- In Argeş river basin, the monitoring sections belonging to RO02 and RO01 typology fall into water quality classes I and II (high and good ecological status); all sections belonging to RO05 and RO10 typology in 2009 and 30% of them in 2010, fall into quality classes III, IV and V (moderate, poor and bad ecological status) (Table 1);
- In Vedea river basin the monitoring stations belonging to RO10 typology are classified in high and good ecological status, excepting the sections on river Teleorman: upstream the confluence with river Vedea – (July, 2009); downstream Roşiori de Vede (May and September 2010); Ciobani and downstream Poiana Lacului (July and May 2010, respectively) that were classified in the IIIrd quality class (moderate ecological status) (Table 2);
- In Litoral river basin all the monitoring sections belonging to RO05 and RO06 typology at all sampling moments (excepting that on downstream Slava Rusă - Ciucurova river, July 2009) and 67% of those belonging to RO08 typology in 2009, were classified by the values of EPT index as having bad ecological status (Table 1). In this basin, as well as in the others, besides the EPT index, one to three other biotic indices (e.g. OCH, LIM, REO, FG) have values specific to the bad ecological status (water quality class V) as follows: in 60% of the total cases in 2009 and 23% in 2010 in Litoral water bodies; in 40% and 25% cases, respectively in river Argeş basin; and in 35% of cases for both 2009 and 2010 in river Vedea basin.

Nevertheless, a contrast between the EPT values in the three river basins was noticed. If in Litoral river basin EPT index classify the most sections (85% in 2009 and 70% in 2010) in bad ecological status (quality class V), in river Argeş basin this is the case for only three cases (Brezoaiele - May and September 2009 and Ciumeşti - July 2010). In river Vedea basin in all cases the values of EPT index classify the sections in other quality classes than the bad one. This can be explained by the fact that Litoral river basin has special patterns with respect to the river size (small size rivers) that frequently exhibit the drainage phenomenon. Besides, in this river basin it was noticed that the freshwater benthic communities have a specific structure as compared to the other two basins. Thus, in the most cases in Litoral river basin species belonging to Oligochaeta, Chironomidae and Planorbidae groups are dominating while the insects (Ephemeroptera, Plecoptera and Thricoptera) have low density or are even absent (in approximately 80% of cases in 2009 and 50% in 2010). Low flows of the Litoral rivers that in some cases (PH Mail, PH Baia, PH Cheia in 2010) are below the multi-annual monthly means can explain these structural features of benthic communities (Biggs, 2000; Jowett, 2000). Low flow represents a limitative factor in EPT species development, which, according to some researchers (Jowett & Duncan, 1990), are common in streams with higher flows than the multi-annual monthly mean, while snails, worms and chironomids reach high densities and frequency in streams with low flow.

For all water bodies and cases, Shannon-Wiener diversity index (SWmzb) of macrozoobenthos has values characteristic to class I and II, being in many cases contradictory to the EPT index that frame the same sections in the class V, especially in the Litoral water basin (Table 1).

In most cases (about 70% in 2009 and 60% in 2010), SI of phytoplankton (SIfp) classify the monitoring sections in the IIIrd quality class (moderate state), in all other cases having specific values for the Ist and IInd quality classes (Table 2).

For an integrated assessment of ecological status, the macrozoobenthos multimetric index (MImzb) was considered (Tables 1 and 2). Its values highlight the following aspects:

- In Argeş river basin, in 2009, the majority of the monitoring sections (about 60%) are classified in quality class III, except Ciumeşti stations (March and July) that fall in the quality class II and Cetățuia (at a single sampling moment, in March) that has high quality status. In 2010, the MImzb classified the most sections in quality classes I and II except for Ciumeşti section (July) where MImzb value is specific to class III;
- In Vedea river basin, monitoring sections are placed at all sampling dates in high and good status, excepting Văleni and Ciobani sections in March 2009 that are classified as having moderate status;
- In Litoral river basin in 2009 the majority of the monitoring sections (60%) are classified in the quality class III excepting P.H. Baia (Hamangia water body) and upstream Slava Rusă (Ciucurova water body) that has high status in June and March, respectively; the monitoring section PH Postă (Telița water body, in September), Upstream Slava Rusă (Ciucurova water body, in June), upstream Casimcea bridge (Casimcea 1, in June), upstream Horia reservoir (Taița 2 water body, in September) and PH Cheia (at all sampling campaigns) are classified in quality class II whereas the section upstream bridge Casimcea (Casimcea 1, April) falls in quality class IV (poor status). In 2010 macrozoobenthos MI classified the majority of monitoring stations (64%) in quality class II (good status). The other monitoring sections, except P.H. Satul Nou section in March (high ecological status) are classified in quality class III.

In 2010 values of the phytobenthos Shannon-Wiener index (SWIfb), biological diatom index (BDIfb) and multimetric index (MIfb) were analyzed in addition to those from 2009 (Table 1). In most cases (over 80%), in the Argeş river basin, BDIfb has values that classify the monitoring sections in good status. SWIfb has values between 2.34 and 2.90 characteristic to high status at all sampling moments for all sections. MIfb values classify the sections in high and good quality status at all sampling moments. Although the phytobenthos saprobe index usually classifies sections in a lower quality class than saprobe index of zoobenthos, the situation changes when the phytobenthos multimetric index is considered. MIfb classifies the majority of the sections in a better class than MImzb. This suggests the need for further refinement of the threshold values of biotic monitoring indices used to separate the five classes of water quality.

Regarding the phytoplankton, in 2010 other indices such as Simpson diversity (DS), number of taxa (NT), numerical abundance of Bacillariophyceae (NAB) and multimetric index (MIphy) were analyzed in addition to those monitored in 2009 (Table 2). In all cases NAB index classifies the monitoring sections in high and good quality status whereas DS index classifies them in good status, in approximately 70% of cases. The IMphy index has also values specific to good quality status except for the sections located downstream Roşiori de Vede and upstream Alexandria, in July 2010.

CONCLUSIONS

The analysis of the biotic quality components data generated by the national monitoring system has allowed highlighting the synergies and contrasts in terms of discrimination power of the different indices used for the assessment of water bodies' ecological status in different river basins and typologies.

It was emphasized the correlation between geomorphologic and biological structural peculiarities of the water bodies belonging to different catchments or typologies and the values of the biotic quality indices. Therefore, our results highlight the need of using packages of indexes that include both uni- and multi-criteria indices specific to each typology.

The results of this paper show that in order to achieve an integrated assessment of quality/ecological status of the aquatic systems according to the WFD, it still need to better define the threshold values between the five classes of water quality for each index and typology. Further development of the existing monitoring methods is required to guide in a judicious way the aquatic ecosystems management.

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