

Ecological Status Assessment of the Water Bodies Located in the Lower Sectors of the Jiu and the Motru Rivers (Oltenia, Romania)

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Abstract

By means of the Water Framework Directive methodology, the present study identifies the valid indicators used for evaluating the ecological status of two natural water bodies (the first located on the Jiu river between Bratovoiești and the Danube confluence, and the second on the Motru river between the Jirov and the Jiu confluence): hydromorphological indicators, physico-chemical indicators and biological indicators.

The quality parameters deviated from the norm are: Shannon-Wiener Diversity Index – 2.87 for the Motru WB and Functional groups index – 0.68 for the Jiu WB (biological Indicators); modified water-cross section coefficient (depth) (1.22) – the Motru WB, impoundment coefficient (0.91) – the Motru WB and Coefficient of major streambed reduction (1.24) – the Jiu WB (hydromorphological indicators).

The quality parameters (physico-chemical indicators) of the water drainage systems deviated from the norm are: Biochemical Oxygen demand BOD₅ (40.78 mg/l) and Ammonium Nitrogen N-NH₄⁺ (6.96 mg N/l) for Strehaia settlement; Biochemical Oxygen demand BOD₅ (33.70 mg/l), Ammonium Nitrogen N-NH₄⁺ (19.66 mg N/l) and Total Phosphorus P_T (8.96 mg/l) for Craiova settlement.

The target is to validate the ecological status for the two water bodies, respectively „moderate status” for the lower Jiu and „good status” for the lower Motru, related to the Class II and Class III of the European process of intercalibration, ensuring thus the compatibility at European level.

The relevance of the paper consists in the assessment of the ecological status of two natural water bodies located downstream with respect to a major punctiform polluting source (two major settlements, Craiova on the Jiu, respectively Strehaia on the Motru), impacting heavily the achievement of environmental objectives set by the Water Frame Directive.

Keywords: *WFD, water body, reference conditions, quality elements, urban settlements, ecological status*

Rezumat. Evaluarea stării ecologice a corpurilor de apă din cursurile inferioare ale râurilor Jiu și Motru (Oltenia, România)

Prin folosirea metodologiei propuse în DCA, prezentul studiu identifică indicatorii valabili pentru definirea stării ecologice (parametrii hidromorfologici, fizico-chimici și biologici) a două corpuri de apă naturale (pe râul Jiu corpul de apă: localitatea Bratovoiești - confluență Dunăre și pe râul Motru corpul de apă: confluență Jirov - confluență Jiu).

Valorile parametrilor de calitate înregistrate în secțiunile de monitorizare sunt: 2,87 pentru Indicele de diversitate Shannon-Wiener - corpul de apă Motru și 0,87 pentru Indicele grupe funcționale - corpul de apă Jiu (în cazul indicatorilor biologici); 1,22 pentru coeficientul de modificare a secțiunii transversale (adâncime) – corpul de apă Motru, 0,1 pentru coeficientul de îndiguire - corpul de apă Motru și 1,24 pentru coeficientul de reducere albie majoră - corpul de apă Jiu (în cazul indicatorilor hidromorfologici).

Parametrii de calitate (indicatorii fizico-chimici) ai apelor uzate evacuate sunt: consumul biochimic de oxigen (40,78 mg/l) și azotul amoniacal (6,96 mg N/l) – orașul Strehaia; consumul biochimic de oxigen (33,70 mg/l), azotul amoniacal (19,66 mg N/l) și fosforul total (8,96 mg/l) – orașul Craiova.

Obiectivul țintă îl constituie stabilirea stării ecologice pentru cele două corpuri de apă, respectiv „stare moderată” pentru cursul inferior al râului Jiu și „stare bună” pentru cursul inferior al râului Motru, stări ce corespund claselor a II-a și a III-a de calitate conform procesului european de intercalibrare, ceea ce le conferă compatibilitate la nivel european.

Importanța lucrării de față constă în determinarea stării ecologice a două corpuri de apă naturale amplasate aval de o sursă punctiformă de poluare majoră (așezările urbane Craiova pentru Jiu, respectiv Strehaia pentru Motru) cu impact în atingerea obiectivelor de mediu prevăzute de către Directiva Cadru Apă.

Cuvinte-cheie: *Directiva Cadru Apă, corp de apă, condiții de referință, elemente de calitate, aglomerări urbane, stare ecologică*

INTRODUCTION

The European Parliament and European Council Directive 2000/60/CE, generally known as the Water Framework Directive (WFD), defines in article 2 the ecological status as an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters, by using biological, hydromorphological and physical-chemical quality elements as support functions for the biological ones.

The same article of the WFD defines a water body as a discrete and significant element of surface water such as a lake, a reservoir, a stream, river or canal, part of a stream, river or canal, transitory water or a stretch of coastal water. Thus, at European level, it is introduced a new notion in hydrology – „water body as a basic unit in water management, in analysis of human pressure and human impact on water as well as in risk assessment of failing to achieve the environmental objectives” (Șerban and Gălie, 2006).

The new concept of ecological status evaluation promoted by the WFD differs fundamentally from the previous approaches in the field of water quality. In fact, this new approach is based on a principle stating that biological elements represent the integrator of all types of pressures and the general physical-chemical indicators are only elements of support in determining the ecological status.

The characterization of water body types proposed by the directive is based on regionalization (Cohen et al., 1998). Ecological regionalization has been widely used in the context of river ecology to study biological communities (Van Sickle et al., 2006), to define quality goals (Prat and Munné, 2000) or to assign reference conditions (Dawson et al., 2002; Carballo et al., 2009).

In order to analyze hydromorphological conditions, the hydrological regime was considered. The hydrological regime is determined by natural flow regime, river continuity and WFD morphological conditions (Leopold and Maddock, 1953, Bizjak and Miko, 2004). The elements used as indicators for the morphological conditions were river depth and width variation, structure and substrate of the river bed and structure of the riparian zone (Munné et al., 2003, Wattage and Soussan, 2003). A number of authors (Hewitt, 1991, Rico et al., 1992, Birk and Hering, 2006, Ocampo-Duque et al., 2007) have used macro-invertebrates and fish fauna as bio-indicators to define the biological conditions of rivers.

Spatial variation of these indicators can be correlated with the human impact (from settlements)

on the aquatic ecosystem (Naiman and Decamps, 1990): concentration of heavy metals in the Topciderska river load (one of the most polluted urban flows in Serbia) (Dragicevic et al., 2010); transport and transformation of nutrients (nitrogen compounds and total phosphorous) along the most polluted reaches of the canal Becej-Bogojevo, Serbia (Grabic et al., 2011).

From the legal point of view, the WFD was enforced in the Romanian law by means of the Law 310/2004 which modifies and completes the Water Law 107/1996. In Romania, beginning with 2004, the quality assessment of surface waters (according to WFD) is made at the level of river basins. The River Basin Management Plan represents the means to implement the WFD, readjusted through Article 13 and Annex VII, having as main objective the achievement of “a good status” for the water bodies corresponding to a balanced management of water resources.

Study areas

This paper proposes valid indicators for defining the ecological status of two water bodies, located in the region of Oltenia, South-Western Romania, according to the methodology proposed by the WFD. The physical-geographical framework is the general support for the evolution of the two water bodies. Thus, the physical characterization of the valleys and the administrative-territorial units' surfaces drained by the two water bodies impose as the first step in our study.

The Jiu River has a length of 339 km and a basin surface of 10,080 square km; it is a first degree tributary of the Danube and flows into it at 692 km upstream from the Danube's mouth. The lower catchment of the Jiu river basin (situated downstream Craiova settlement) is a space with an exceptional natural heritage that has been seriously transformed by man, the natural-human opposition becoming the key-element of the region (Licurici et al., 2011).

The water body located between Bratovoiești and the confluence with the Danube is superposed to a sector of the lower Jiu (the Livadia stream – a right tributary, and the Gioroc stream – a left tributary), having a length of 57.3 km and a surface of the drained administrative-territorial units of 749.75 square km. The maximum altitude in this area is 59 m (on the right side) and the minimum altitude is 24.1 m at the confluence with the Danube.

Downstream Craiova, the valley of the Jiu River is asymmetrically developed having a width of 5–8 km, in which the floodplain has an average width of 4–5 km (Savin, 1990). Within this sector, the right slope remains steep and has a very active dynamics,

while the left slope generally occupies half of the valley's width (Fig. 1). On the left slope, in the Northern sector, five river terraces develop: 70–90 m (Cârcea terrace), 40–60 m (Șimnic terrace), 30–40 m (Bârza terrace), 15–22 m (Malu Mare terrace) and 5–12 m (Rojișteea terrace). These generally present a continuous development and fade into the Danube terraces downstream the alignment of Padea-Mârșani settlements (Coteș, 1957).

The current shape has a historical age, being the result of climatic variations influencing the hydrologic regimen of the river, associated with the influence of neo-tectonic movements (Curcan et al., 2009). Except for the sectors with old anastomotic branches or marshland areas and pluvial sand banks, the geomorphology of the floodplain is rather unvaried. Downstream Rojișteea, on the left side, it can easily be observed an old branch of the Jiu – the Jieț.

According to Corine Land Cover (2006), the significant diffuse sources of water pollution are shown in Figure 1, being represented by: non-irrigated arable lands (33.63%), pastures (8.09%), mainly agricultural lands (7.52%) and settlements (5.18%).

The Motru River (134 km length) forms the largest reception sub-basin (1,895 square km) of the Jiu hydrographic basin. The water body confined by the confluence of the Jirov and the Jiu river has a length of 45.1 km and a drained surface of the administrative-territorial units of 338.2 square km.

The main tributaries of the Motru river in this sector are on the right side (the Jirov, the Hușnița, the Slătinic and the Tălăpan streams) while on the left side there is only one tributary, the Stângăceaua stream. The maximum altitude in this area is 362 m on the left slope and the minimum altitude is 102 m at the river's mouth (Fig. 2).

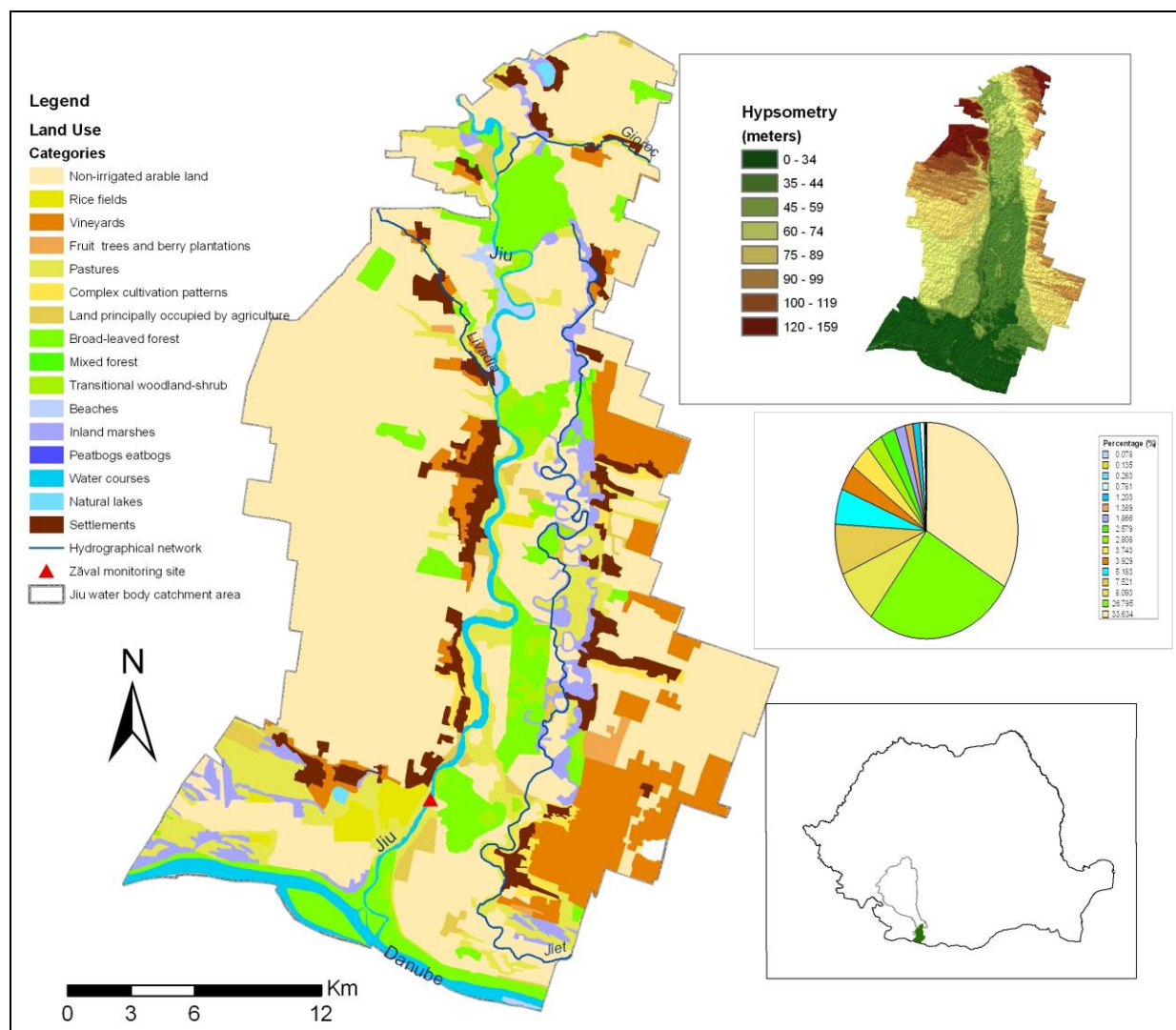


Fig. 1. Land use and hypsometric map of the drained surface of the water body corresponding to the lower sector of the Jiu river (Corine Land Cover, 2006 and SRTM elevation model)

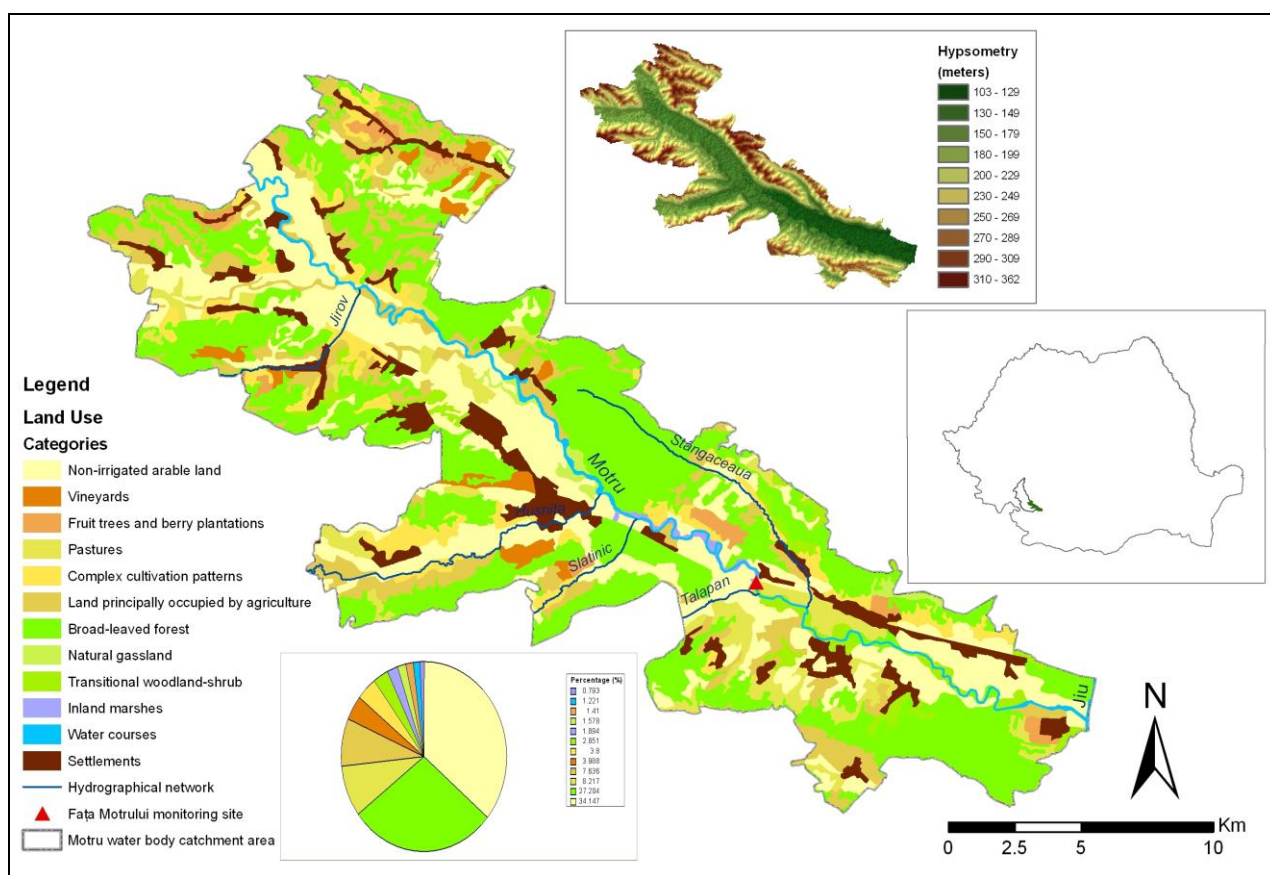


Fig. 2. Land use and hypsometric map of the drained surface of the water body corresponding to the lower sector of the Motru river (after Corine Land Cover, 2006 and SRTM elevation model)

The course of the Motru river, generally oriented on a North Western–South Eastern axis, closely follows the left slope downstream Fața Motrului settlement; after that, it occupies a median setting within the floodplain, until Eastern Buicești settlement. The course further flows under the right bank until the confluence with the Jiu river (Ionuș, 2009).

For the lower sector of the Motru, the influence of the positive neo-tectonic earth movements that took place in the Southern area of the valley led to a Northward „shift” of the river. The floodplain of the Motru river is 1.6–2 km wide between Strehaia and Buicești, and 2 km wide downstream Buicești (Stroe, 2003).

Upstream Strehaia, the sector delimited by the confluence with the Jirov and the confluence with the Hușnița, the Motru terraces on the right side (towards Coșușta Hills) are mostly fragmented and destroyed by numerous tributaries and torrents, this process being amplified by the low resistance to erosion of the predominant sand deposits existing in this area (Șchiopoiu, 1982).

In 1982, Al. Șchiopoiu identified three terraces downstream Strehaia, having the following extent: 30–40 m (the terrace bridge on the right side shows

a steep forefront), 50–60 m (presented as a step interrupted here and there by large torrent valleys, hundred meters wide) and 70–80 m (appearing as a rock erosion in shape of shoulders). The slopes are steeper on the left side, beginning with the entrance of the Motru in the piedmont and downstream the confluence with the Stângăceaua, where the river has gullies that are crossing the slope (Tomescu, 2004).

According to Corine Land Cover (2006), the significant diffuse sources of water pollution are shown in Figure 2 and are represented by non-irrigated arable land (34.15%), pastures (8.22%), mainly agricultural lands (7.64%) and settlements (5.26%).

DATA AND METHODS

In order to establish the ecological status of the analyzed water bodies, we took into consideration the typology and the reference conditions in conformity with the abiotic parameters of the B system in the WFD.

Hydromorphological elements for evaluating the ecological status are represented by the hydrological regimes and the morphological parameters.

The support physical-chemical elements used for the ecological status are represented by the nutrients

group (Ammonium Nitrogen $N-NH_4^+$, Nitrites Nitrogen $N-NO_2^-$, Nitrates Nitrogen $N-NO_3^-$, Phosphates Phosphorus $P-PO_4^{3-}$, Total Phosphorus), by the thermal and oxygenation conditions (water temperature, dissolved Oxygen, salinity, pH-acid status) and by the group of specific synthetic and non-synthetic (Copper-Cu, Zinc-Zn, Arsenic-As, Chromium-Cr) pollutants group.

In evaluating the ecological status of Romanian rivers, the biological elements that are taken into consideration are the phytoplankton, macro-zoobentos (composition and plenty of the benthic invertebrate fauna) and fish fauna (composition, plenty and age distribution).

Starting from a list of species recorded within a monitoring station, we have reckoned each of the seven indices proposed for evaluating the status of the water bodies based on the macro-invertebrate communities that enter the composition of the multimetric index for bentic macro-invertebrates: *Saprobic index* (SI), *Ephemeroptera, Plecoptera, Trichoptera insects index* (EPT_I), *Shannon-Wiener Diversity Index* (ISH), *Number of families index* (FAM), *Oligochaeta-Chironomidae index* OCH (OCH - IOCH/O), *Functional groups index* (IGF), *Preference index of flowing water* (REO/LIM).

The evaluation of the ecological status is based on a five-stage classification system (Fig. 3):

- **Class I – very good status** is characterized by values of the biological, hydromorphological, and physical-chemical elements associated to untouched water ecosystems (taken as reference) or areas with minor anthropic modifications;
- **Class II – good status** is characterized by minor deviations of the biological, hydromorphological and physical-chemical elements associated to untouched water ecosystems (taken as reference) or areas with minor anthropic modifications;
- **Class III – moderate status** is characterized by values that differ in a moderate measure from values of the biological, hydromorphological and physical-chemical elements associated to untouched water ecosystems (taken as reference) or areas with minor anthropic modifications;
- **Class IV – poor status** is characterized by major alteration of values of the biological, hydromorphological and physical-chemical elements associated to untouched water ecosystems (taken as reference) or areas with minor anthropic modifications;
- **Class V – bad status** is characterized by severe alteration of values of the biological, hydromorphological and physical-chemical elements associated to untouched water ecosystems (taken as reference). It is established when a large

number of relevant biologic communities are absent compared to those present in untouched areas or areas with minor anthropic modifications.

The transposition of the WFD requirements, concerning the ecological status and the establishment of the 5 classes above, is based on a national study which is related to the European process of intercalibration, ensuring thus the compatibility at European level (ICIM, 2008).

The determination of the ecological status is achieved based on the values of the biological, hydromorphological and physical-chemical parameters recorded on two monitoring sites of the studied water bodies:

- Zăval monitoring site (Fig.1) for the water body Bratovoiești – the Danube confluence;
- Fața Motrului monitoring site (Fig. 2) for the water body the Jirov – the Jiu confluence.

RESULTS AND DISCUSSIONS

For the definition of the ecological status of the lower sectors of the Jiu and the Motru Rivers and assessment of the quality elements, the WFD provides assessment tables that classify each quality element through qualitative assessment (*high, good, moderate, poor and bad*).

Characterization of Water Body Types

In order to characterize water body types using system B, as described in Annex V of the WFD, the variables defined in the system that was adapted to the conditions of the Romanian territory were used. The proposed variables were determined based on data collected along the complete rivers, according to data collected during the study – the Jiu River Basin Management Plan, the study areas falls within the following categories.

Water body: Bratovoiești – the Danube confluence (on the Jiu river) Type: water sector with wet areas flowing through a field area; Symbol: RO18; Surface (sq. km): > 5000; Geology: silicon, limestone, organic; Lithological structure: sand, ooze, clay; Altitude: < 200 m; Potential biocoenosis type: barbel and carp.

Water body: the Jirov confluence – the Jiu confluence (on the Motru river). Type: water sector with flowing through hilly and piedmont area; Symbol: RO14; Surface (sq. km): 1000–10000; Geology: silicon, limestone, organic; Lithological structure: sand, gravel; Altitude: 200 – 500 m; Potential biocoenoses type: barbel, *Chondrostoma nasus*.

Establishment of Specific Reference Conditions

The reference conditions were established in conformity with the WFD for each type of water body and represent values of biological, hydromorphological and physical-chemical

elements untouched or with minor anthropic influences.

Table 1, 2 and 3 present the limits of the values for the quality parameters detailed with respect to the typology of the two water bodies (RO14–the Motru and RO18–the Jiu).

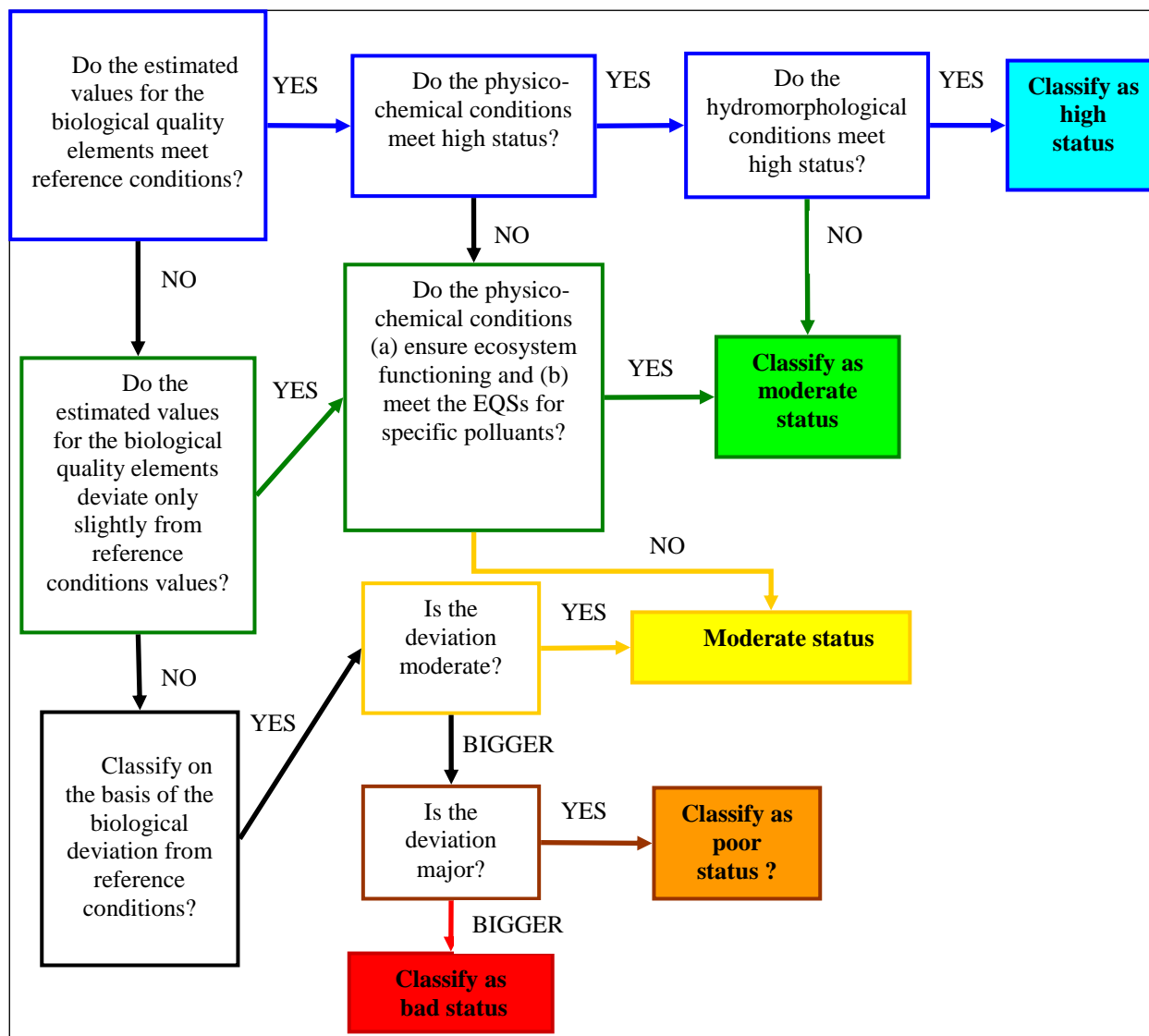


Fig. 3. Diagram of biological, hydromorphological and physicochemical quality elements in ecological status classification according the normative definitions in Annex V: 1.2. (WFD)

Types Ecological Status Indicators

Biological Indicators

Evaluation of the ecological status from the point of view of fish fauna was made only for the water body on the Motru river: the Jirov confluence – the Jiu confluence. For the water body on the Jiu river: Bratovoiești – the Danube confluence the fish fauna was not analyzed due to the relatively high flow of the river in Zăval section (87.7 cubic meter/second – mean multi-year flow).

The initial analysis method started with the determination of the biological coefficients presented in the framework Specific Reference Conditions. Part of these coefficients recorded positive deviations from the reference values (Shannon-Wiener Diversity Index – 2.87 for the Motru WB and Functional groups index – 0.68 for the Jiu WB (Table 1).

After reckoning the multimetric index based on invertebrates, the ecological status of the two water bodies was evaluated as *good*.

Table 1. Results for the reference conditions and biological parameters assessed (2007)

Biological coefficients	Reference conditions R014/RO18 type	Fața Motrului monitoring site (Motru WB)	Zăval monitoring site (Jiu WB)
European Fish Index (EFI+)	>0,912 (for Salmonicol waters) >0,94 (for Cyprinicol waters)	0,79	**
Saprobic index 30%	0,921/0,738	2,2	2,05
Ephemeroptera, Plecoptera, Trichoptera insects index10%	1,55/1,6	0,43	0,34
Shannon-Wiener Diversity Index 20%	0,3/0,3	2,87	1,44
Number of families index10%	1,9/1,9	13,33	5
Oligochaeta-Chironomidae index 10%	14/14	0,31	0,2
Functional groups index 10%	0,25/0,25	0,34	0,68
Preference index of flowing water 10%	0,3/0,3	0,97	1,00
Multimetric index for benthic macroinvertebrates	0,9/0,9	0,929	0,721
Ecological Status	-	Good	Good
** for large rivers sample acquisition is still poor, reason for which on the Jiu river in Zăval section, no samples were available to determine the fish fauna coefficients.			

Source: Scientific study concerning the elaboration of classification systems and global evaluation of surface water bodies (rivers, lakes, transitory waters, coast waters) in conformity with the requirements of the WFD 2000/60/CE based on biological, hydromorphological, and physical-chemical elements - National Research and Development Institute for Environment Protection, Bucharest

Physico-chemical Indicators

The ecological status evaluated only via general physical-chemical elements and specific pollutants is determined by the worst-case scenario.

As seen in Table 2, the ecological status of the water body on the Motru river: the Jirov confluence – the Jiu confluence is evaluated as **good**, while the status of the water body on the Jiu river: Bratovoiești – the Danube confluence is evaluated as **moderate**, the main cause being the lack of a treatment process for the waste waters of Craiova.

The interpretation of values corresponding to the Water Quality Index on the Motru river, on the basis of the scheme proposed by House and Ellis (1987) allows for the establishment of the usage domain for the river water as natural resource. During the years when values above 90 percent were registered, the water of the Motru river was good for all recreation activities and convenient for all fish species and aquatic fauna, while in the case of the values comprised between 74 and 90 percent, the water situation was uncertain for aquatic sports that imply the direct contact with the water and for fishing, only supporting the population with sweet water fish species (Ionuș, 2010).

In what concerns the water body on the Jiu: Bratovoiești – the Danube confluence the drained surface corresponds to the following administrative-territorial units: Bratovoiești, Drănic, Valea

Stanciului, Dobrești, Gângiova, Sadova, Gighera și Ostroveni. For the water body on the Motru: the Jirov confluence – the Jiu confluence the drained surface corresponds to the following administrative-territorial units: Văgiulești, Corcova, Strehaia, Butoiești and Stângăceaua.

From the point of view of anthropic pressure on the two water bodies, although the administrative units are characterized by a majority of rural settlements, the urban population (Strehaia and Craiova settlements) through their water distribution and water drainage systems are the main punctiform polluting sources. Therefore, choosing the two water bodies as being representative is justified by the fact that the two urban settlements do not yet have waste water treatment plants, being thus heavy pollution sources for the two water systems.

The water drainage system of the city of Strehaia takes the waste waters of a population of 14098 equivalent inhabitants. The average evacuated flow is 4.5 litres/second, and the quality parameters deviated from the norm are: Biochemical Oxygen demand BOD₅ (40.78 mg/l) and Ammonium Nitrogen N-NH₄⁺ (6.96 mg N/l), thus influencing the water body analyzed. The evacuation of the waste waters is carried out in the Hușnița stream, with no treatment, and then again in the Motru river (the distance between the evacuation in the city and the confluence of the Hușnița and the Motru being of 0.9 km).

Table 2. Results for the reference conditions and the physico-chemical parameters and specific pollutants assessed (2007)

Physico-chemical and specific pollutants	Reference conditions R014/RO18 type	Fața Motrului monitoring site (Motru WB)	Zăval monitoring site (Jiu WB)
Temperature (°C)	21,5 °C (for Salmonicol waters) 28 °C (for Cyprinicol waters)	13,5	19,8
pH	6,5-8,5	8	7,9
Dissolved Oxygen (mg/l)	8/10	9,9	8,8
Ammonium nitrogen N-NH ₄ ⁺ (mg N/l)	0,66/0,09	0,172	0,33
Nitrites nitrogen N-NO ₂ ⁻ (mg N/l)	0,08/0,011	0,015	0,04
Nitrates nitrogen N-NO ₃ ⁻ (mg N/l)	2,6/0,7	0,708	2,37
Phosphates phosphorus P-PO ₄ ³⁻ (mg P/l)	0,09/0,035	0,0368	0,08
Total Phosphorus (mg P/l)	0,23/0,11	0,0694	0,14
Copper (μg/l)	0,75/2/6	3,9	5,92
Zinc (μg/l)	7/35/50	5,5	7,55
Arsen (μg/l)	49	0,96	1,47
Crom (μg/l)	8,8	1,7	1,068
Ecological Status	-	Good	Moderate

Source: Scientific study concerning the elaboration of classification systems and global evaluation of surface water bodies (rivers, lakes, transitory waters, coast waters) in conformity with the requirements of the WFD 2000/60/CE based on biological, hydromorphological, and physical-chemical elements - National Research and Development Institute for Environment Protection, Bucharest

The main punctiform polluting source for the water body corresponding to the lower Jiu river is the city of Craiova and its waste waters. The city of Craiova still does not have a waste water treatment plant. The Craiova water drainage system serves a population of 385000 equivalent inhabitants, evacuating a mean flow of waste water of 1320.96 litres/second. The quality parameters that are deviated from the norm are: Biochemical Oxygen demand BOD₅ (33.70 mg/l), Ammonium Nitrogen N-NH₄⁺ (19.66 mg N/l) and Total Phosphorus P_T (8.96 mg/l) (Fig. 4).

Hydromorphological Indicators

The ecological status evaluated by means of hydromorphological elements is considered relevant if

only the ecological status is *very good*, both for the biological and the physical-chemical elements and also for the specific pollutants.

The hydromorphological parameters used to support the analysis of the ecological status and which record deviations from the reference values are (Tab. 3): Modified water-cross section coefficient (depth) (1.22)–the Motru WB, Impoundment coefficient (0.91)–the Motru WB and Coefficient of major streambed reduction (1.24)–the Jiu WB. This is due to the local physical-geographical conditions, to the influence of the basic level, to the shape of the valleys, to the evolution of the waterbeds, and implicitly to the floodplain dynamics of the two rivers.

Table 3. Results for the reference conditions and for hydromorphological parameters assessed (2007)

Hydrological regime and Morphological parameters	Reference conditions R014/RO18 type	Fața Motrului monitoring site (Motru WB)	Zăval monitoring site (Jiu WB)
Coefficient of Average flow variation	0,96-1,04	1,08	1,02
Level variations coefficient (m)	0,90 – 1,10	0,85	1,10
Modified water-cross section coefficient (depth)	0,95 – 1,05	1,22	1,00
Modified water-cross section coefficient (width)	0,95 – 1,05	1,00	1,00
Coefficient of major streambed reduction	1	0,91	1,24
Impoundment coefficient	0	0,91	0,532
River bank consolidation coefficient	0	0,009	0
Ecological Status	-	Moderate	Moderate

Source: Scientific study concerning the elaboration of classification systems and global evaluation of surface water bodies (rivers, lakes, transitory waters, coast waters) in conformity with the requirements of the WFD 2000/60/CE based on biological, hydromorphological, and physical-chemical elements - National Research and Development Institute for Environment Protection, Bucharest

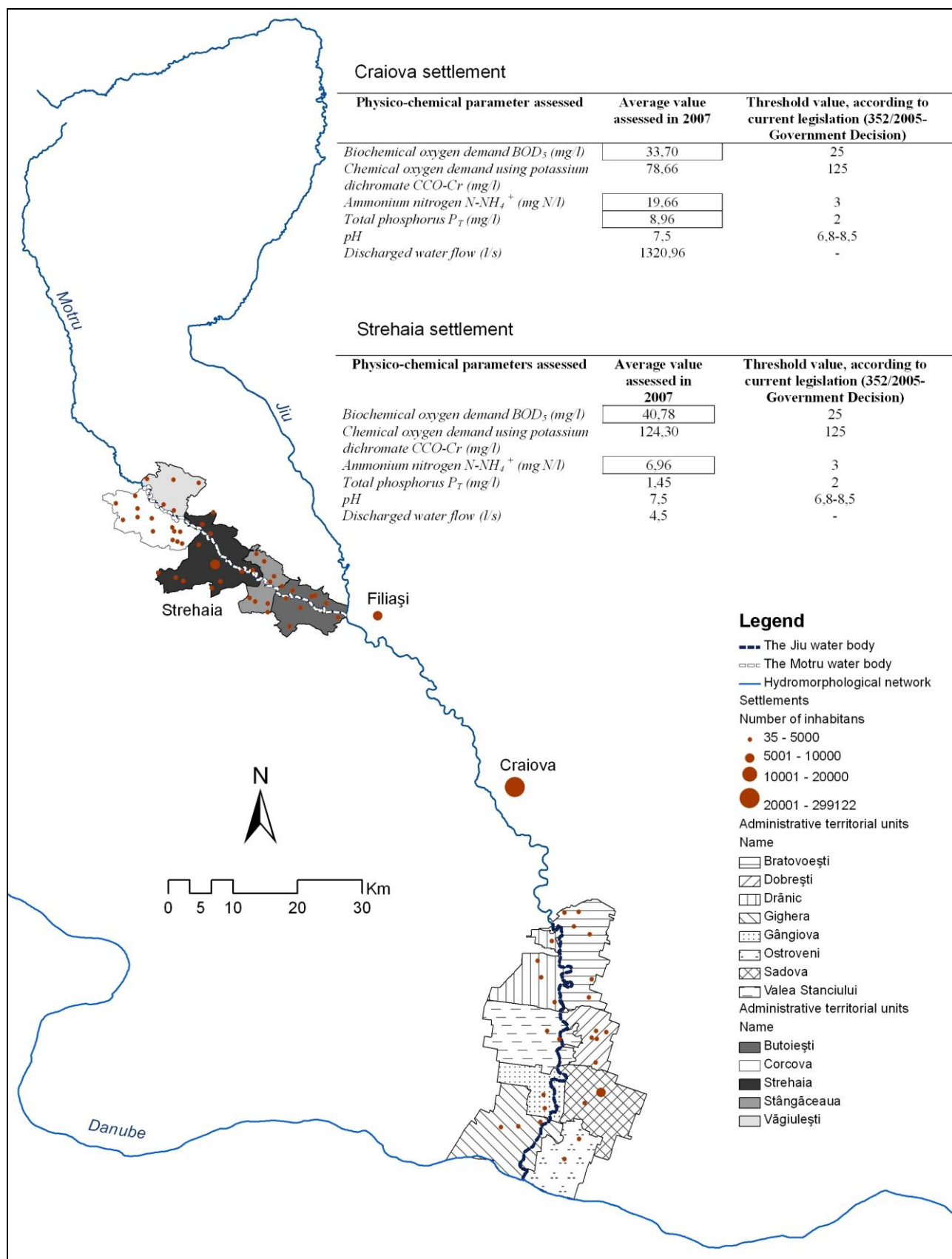


Fig. 4. The human pressure on the Jiu and the Motru water bodies (physical-chemical parameters assessed in waste waters discharged from urban Craiova and Strehaia settlements in 2007)

When the ecological status evaluated only through biological elements is superior to the status given by the physical-chemical elements, then it will prevail the status given by the physical-chemical elements. This rule is applied in the assessment of the ecological status of the water body on the Jiu river between Bratovoiești and the confluence with the Danube.

CONCLUSION

The ecological status evaluation of the two water bodies corresponding to the lower parts of the Jiu and the Motru rivers was made by integrating all quality elements of flowing waters (biological, hydromorphological and physical-chemical), by

applying the worst-case principle, except for the hydromorphological elements.

Therefore, if the evaluated ecological status in conformity with the hydromorphological elements is *moderate*, and the evaluated ecological status in conformity with the biological elements is *good*, then it will prevail the status given by the biological elements (the pressure of hydromorphological elements on the water body has no impact). This case is also met in evaluating the ecological status of the two water bodies in Table 4.

At the end of this study, the ecological status of the water body on the Motru river: the Jirov confluence–the Jiu confluence is evaluated as *good*, meaning that in conformity with the WFD, the ecological status of this sector must be maintained (Vannote et al., 1980).

Table 4. Assessment of the ecological status of the Jiu and the Motru water bodies

Water body	Assessed quality elements			Ecological status
	Biological	Hydro-morphological	Physico-chemical	
Motru Jirov confluence – Jiu confluence	Good	Moderate	Good	Good
Jiu Bratovoiești – Danube confluence	Good	Moderate	Moderate	Moderate

The *moderate* ecological status of the water body on the lower sector of the Jiu river: Bratovoiești – the Danube confluence reflects an average degree of pollution, for which immediate actions must be taken to improve its quality in order to meet the objectives of the Water Frame Directive.

Taking into consideration the available set of analysis, the ecological status can be assessed with different levels of confidence (Șerban Adina, 2009).

The ecological status of the two water bodies was established with a medium confidence level, because less than twelve analysis per site were analysed.

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