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ABIOTIC TYPOLOGY OF SURFACE WATER BODIES IN THE HYDROGRAPHIC BASIN OF THE ARIEŞ RIVER

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ABSTRACT – Monitoring according to the Water Frame Directive (2000/60/E.C.) guidelines demands the identification of river water bodies, typology, and investigation of reference conditions within each river basin. The identification of **"water bodies"** based on geographical and hydromorphological determinants is to enable the status to be accurately described and compared to environmental objectives of the Directive. A surface water body has to be a discrete element of surface water, which is not to overlap with each other or to be composed of elements of surface water that are not contiguous. Heavily modified water bodies may be identified and designated where good ecological status is not achieved because of impacts on the hydromorphological characteristics of surface water resulting from physical alterations. By applying the methodology described in the guidance document related to the WFD – Water Framework Directive, identification and designation of abiotic typology water bodies has led to a number of 32 types of water bodies related to streams and 18 types of water bodies related to natural lakes. Due to its position and its morphometric features, the Arieş Basin includes around 12 water body types (eight related to streams and four related to lakes). A detailed overview regarding the spatial distribution of these types is also exposed for inside analysis.

Keywords: Water Frame Directive, abiotic typology, water bodies, streams, lakes

INTRODUCTION

Water quality protection activities at national level are done based on strict legislation, which has been adapted to the European standards since the last decade of last century. Initially, the most important water quality law was represented by state standard STAS 4706/1988, regarding the technical categories and conditions of water quality. Subsequently, a series of legislative acts have been added to this act (laws, regulations, ordinances, government decisions, etc.) in order to connect them to the European legislation.

The role of legislation is to create measures and means of coercion and persuasion, and offenses criminal penalties, civil liability and legal, financial penalties, the implementation of which is linked to limiting the contamination of surface water (Trufaş, Constanța, 2003). The action of protecting water quality is made through a series of legal authorities, from which the major role is played by the national water quality surveillance system, but also by National Administration "Romanian Waters - Apele Române", the national authority managing this resource.

Between 1990 and 1995, a series of concepts were used - criteria, objectives, standards, rules, classes of quality - without clearly defining their content. Moreover, the existence of differentiated conditions in terms of natural background in different river basins and the need to define both water quality and sediments in areas of natural or modified flow in rivers have expanded the complexity of these issues.

The most important action taken at national level is the implementation of the Water Framework Directive 2000/60/EC, which establishes a framework for water policy. This directive establishes a framework for the countries of the European Union regarding water policy, aimed at a jointly achieving a "good ecological and chemical status" of water by 2015 (Mihăiescu, 2009).

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METHODOLOGY

Under the new approach, assessing the ecological status of rivers is based on biological elements, hydro morphological and physico-chemical quality features. Biological elements became a first priority and concern specific composition and abundance of major biotic communities (benthic invertebrates, phytoplankton, periphiton, aquatic macrophytes, and fishes). Thus, a series of operational procedures were developed for macroinvertebrates, stating in detail aspects of harvesting, handling evidence, identifying bodies, quality assurance, and the formula for calculating the saprobe index.

Within the Water Framework Directive, a special chapter is dedicated to identifying and designation of surface water bodies.

Surface water body refers to a distinct and important element of surface water, such as a lake, river or channel, or part of a river or channel, transitory waterway or a coastal waterfront. The typology of surface water bodies consists of three categories:

a) Water bodies that have not been heavily modified;
b) Water bodies heavily modified;
c) Artificial water bodies.

The surface water bodies that have not been heavily modified are the natural and quasi-natural surface water bodies, or those that are modified just on the qualitative state.

The heavily modified water bodies are the surface water bodies, which have a substantial change character, due to physical degradations caused by human activities. By physical degradation, we mean changes of the hydro-morphological features of the water body, and by substantial changes, we mean significant changes, permanent and important on the initial regime flow, as well as those created by specific water uses.

The artificial water bodies are surface water bodies that are created by human activities (TR-4, Document Guidance…, 1995).

The surface water state is the general expression of the state of a surface water body, determined by the lowest state between ecological and chemical state. The environmental objective for the surface waters is the so-called *"good-state"*, which is the state achieved by a surface water body when its ecological and chemical state are at least *"good"*. The environmental objective of strongly modified and artificial water bodies is to achieve the so-called *"good ecological potential*" and not the *good state* like in the case of natural surface water bodies. Nevertheless, a modified or artificial water body can be fit into a natural water typology, if it achieves the same environmental objectives like a natural water body. The identification and designation of surface water bodies can be made on a complex procedure, which consists in several steps (Figure 1).

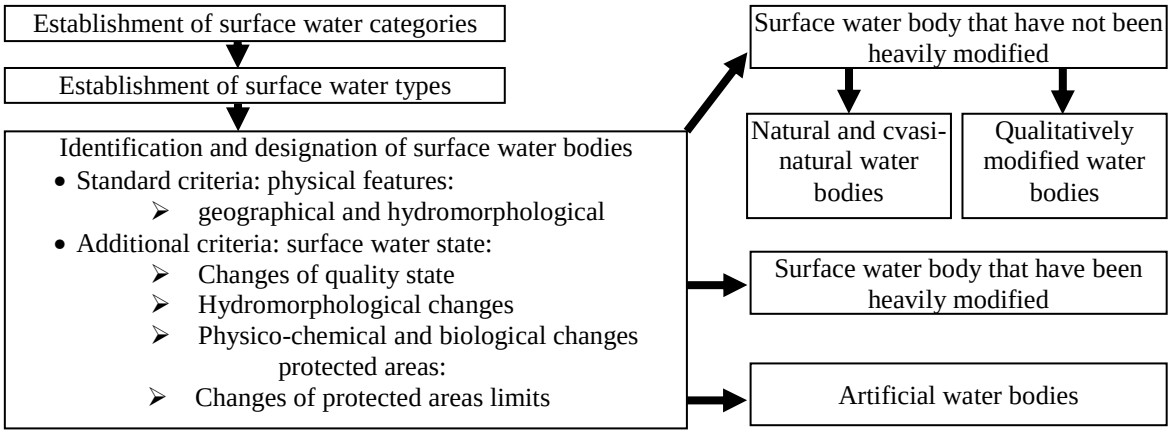

Figure 1. *Identification and designation of surface water bodies*
(according to the Methodological Guide for the Identification and designation of Water Bodies, 2005)

ABIOTIC TYPOLOGY OF SURFACE WATER BODIES IN THE HYDROGRAPHIC BASIN OF THE ARIEŞ RIVER

The abiotic typology of surface water bodies at national level has been made by taken into account a series of location criteria (geographical position and altitude), morphological criteria (catchment area and river slope), hydrological features (discharge value, retention/resilience time of water in lakes), geological and lithological features. The result of this was the establishment of 32 types of streams and 18 types of natural lakes.

THE ABIOTIC TYPOLOGY OF SURFACE WATER BODIES IN THE ARIEŞ BASIN

The hydrographic basin of the Arieş River is situated in the tenth Ecoregion – Carpathian Mountains, which also include the sub-ecoregion of the Transylvanian Plateau. As result of the applied methodology exposed above regarding the identification and designation of water bodies, we have identified 12 water body types (Table 3).

Table 1. *Abiotic typology of river surface water bodies applied in the Arieş Basin*

No.	Type	Features of aquatic unit
Watercourses		
1	RO 01a	Watercourse in mountain areas (silica)
2	RO 01b	Watercourse in mountain areas (limestone)
3	RO 02a	Watercourse located in piedmont or high hills areas
4	RO 04b	Watercourse sector located in hills and plateau areas
5	RO 05a	Watercourse located in intra-mountain depression
6	RO 16	Watercourse located in hills and plateau area with qualitative changes
7	RO 17	Watercourse sectors located in intra-mountain area with limestone substrata
8	RO 18	Watercourse located in hills with low plateau
9	RO 21	Watercourse located in low hills and in the plains
Natural lakes		
11	ROLN 16	Lake in the hill and plateau area, with very low depth, small surface and silica substrata
12	ROLN 18	Mountain lake, with low depth, very small surface and silica substrata
Man-made lakes		
13	ROLA 09	Lake in the hills, low depth, silica substrata
14	ROLA 10	Lake in depression area, with low surface, very low depth and silica substrata

The most frequent type is the *RO 01a*, specific to the catchment areas of the right-bank tributaries of the Arieşul Mare, called Arieş (downstream the town of Câmpeni): Valea Bistra, Valea Mare, Lupşa, and Poşaga. This type can also be found on the upper sectors of the Ocoliş and the Ocolişel valleys, respectively on the right tributaries of the Iara River, and on the Valea Ciorii, a right tributary of the Arieş (Figure 2). The above-mentioned basins are developed in the mountain area, belonging to the Bihor, the Muntele Mare and the Metaliferi Massifs. In the first type, RO 01, the subtype developed on limestone can also be mentioned, representative for the Arieş River sector between Albac and Mihoieşti, for the creeks draining the western side of the Trascău Mountains, respectively (Bătinaş, 2010).

The RO 02a type is peculiar for the upper section of the Arieşul Mare (source area), Arieşul Mic, Albac River, the upper sector of Iara, between the abstractions from the high area to the Iara Depression.

The RO 03b is representative for the hydrographic basins of the Sohodol, Ciuruleasa, Cernița, Bucium, Valea Muşcanilor and Râmetea rivers, while type RO 04b is associated with the Abrud River.

Type RO 05a is specific to the lower sector of the Arieş River, between the mountain gate and up to the river mouth. The great majority of streams have a natural and quasi-natural state, few of them being influenced by human intervention. Thus, due to mining activities there are some streams situated in the central part of the basin that are heavily modified, especially from the qualitative point of view.

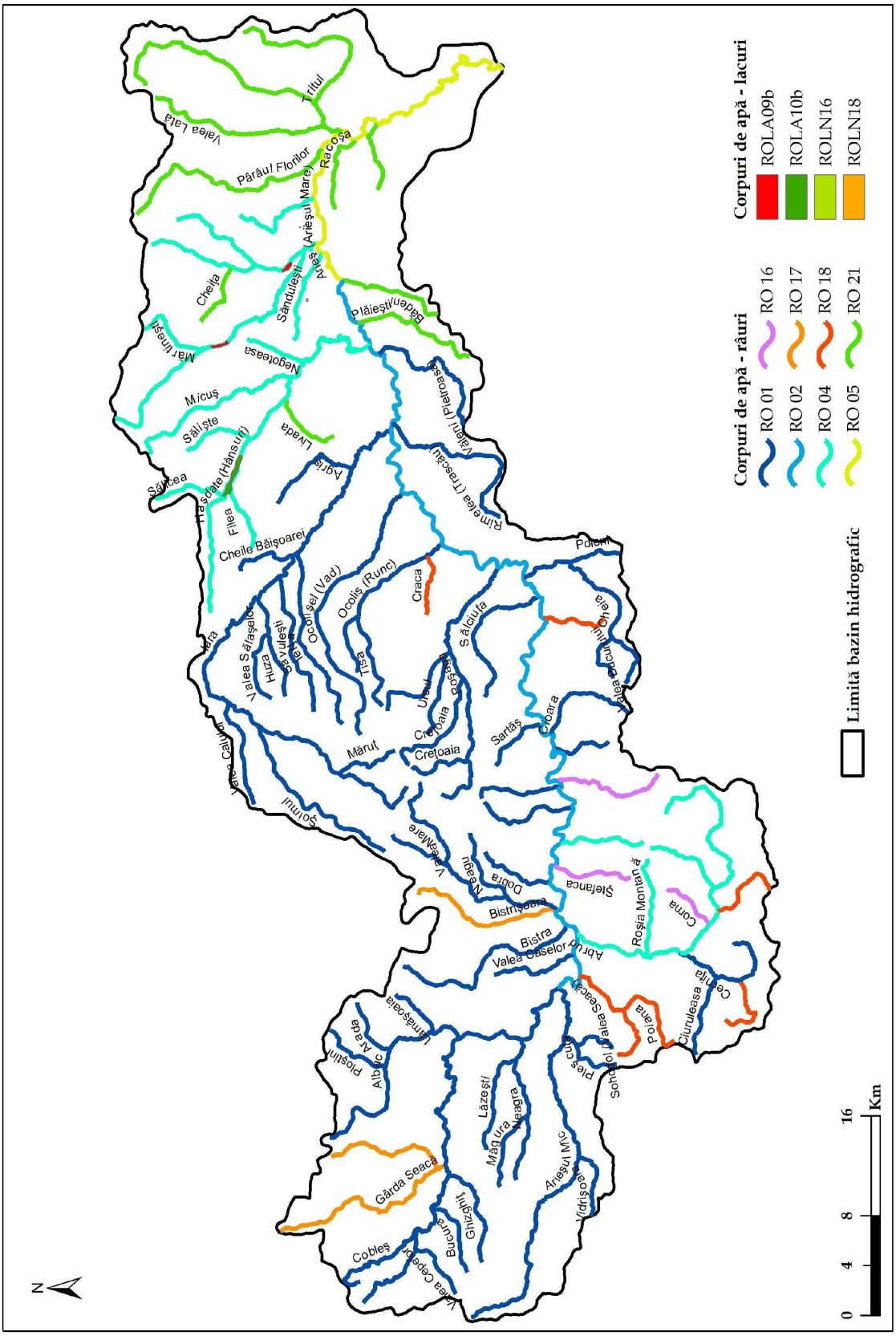

Figure 2. *Abiotic typology of surface water bodies applied in the Arieş Basin*

In the RO 16 type, we have included the following watercourses: Valea Ştefancei, Valea Muşcanilor, Valea Roşiei, Valea Şesii. In the lower part of the basin, the morphology of the catchment area is characterized by low altitudes, specific to the last type that has been identified, namely the RO 21 type. We have associated this one with most of the tributaries that are flowing from the southern side of the Feleac and Luduş Hills: Valea Racilor, Valea Hăşdate, Valea Fâneața Vacilor and Tritiul Creek.

In a synthesis of the water bodies inventory, we have identified a total number of 184 streams and stream sectors, from which more than 60% are related to the first type (RO 01), followed by the one very similar with the former, RO 02 (Fig. 3).

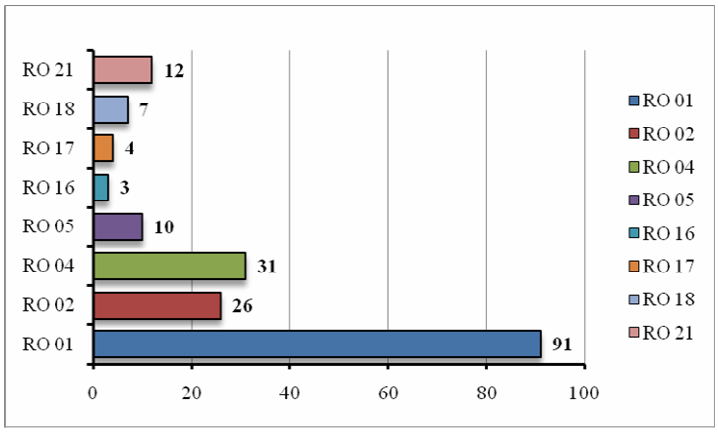

Figure 3. *The distribution of river water body types in the Arieş Basin – Number of streams belonging to a certain type*

The natural lakes from the Arieş Basin are associated with the following types: ROLN 16 (Cheia and Sănduleşti lakes), ROLN 18 (Tăul Mare). The anthropic lakes are associated with the following types: ROLA 09b (the lakes from the lacustrian fishing system along the Racilor Valley and the Valea Caldă) and ROLA 10b (lakes in Ciurila, along the Hăşdate River).

CONCLUSIONS

The surface water quality is the result of a complex interaction between the natural and human factors. Data acquiring, administration and interpretation regarding surface water quality is an activity with great importance in the integrated process of environmental management. The initial data are obtained based on a very severe surveillance program of qualitative indicators, determined in representative monitoring sections, with the help of different methods and techniques, depending on the followed purpose. The processing and interpretation of the results is made through some mathematical operations, followed by their integration with the limits of quality standards. The exceedance of maximum concentrations will lead to a decrease in the use of the respective resource.

The abiotic typology used for designation of surface water bodies is just the first phase of the new methodology used for water quality evaluation, both in Romania and in every other country of the European Union, which has adopted the Water Framework Directive. In our case, the Arieş Basin, the watercourses with low human intervention, the so-called *"not heavily modified"* are dominant in the river network.

Unfortunately, the basin is well-known for its past and still present pollution phenomena, due to the mining activities in the northern part of the famous *"Patrulaterul Aurifer – Golden Rectangle"* with open and underground works in Baia de Arieş, Roşia Poieni and Roşia Montană. The streams that are draining these areas are strongly polluted and are suffering major changes, especially regarding the qualitative status. The lakes are not very numerous in this area, most of them are small and do not have significant changes related to their natural status.

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