Water resources and wetlands, *Editors: Petre Gâştescu, William Lewis Jr., Petre Breţcan*
Conference Proceedings, 14-16 September 2012, Tulcea - Romania
ISBN: 978-606-605-038-8

ENSURING LONGITUDINAL CONNECTIVITY OF THE JIU RIVER NEAR ISALNITA DAM

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Abstract

This paper continues the series of research concerning the longitudinal connectivity of rivers elaborated by the National Institute of Hydrology and Water Management (NIHWM) and represents a part of a complex study on ensuring fish migration upstream Işalniţa Dam (H= 18 m), located on the Jiu River. The objective of this paper is based on the need to ensure longitudinal connectivity of the inland rivers in order to establish sustainable ways of solving present problems of fish migration generated by dam construction. The goal is to provide solutions for the central or local institutions in order to solve the problems they are facing, to restore the longitudinal connectivity of the Jiu River near Işalniţa Dam. The water body "Işalniţa reservoir" has been classified as heavily modified water body, due to the dam's presence. Therefore, the need to solve longitudinal connectivity and fish migration problems has led to technical frontal solutions in order to ensure fish migration upstream and downstream Işalniţa Dam. The proposed technical solutions will contribute to restore longitudinal connectivity of the Jiu River and aquatic habitats and also to improve the natural ecosystems and water quality. In this way, restoration of longitudinal connectivity of Jiu River near Işalniţa Dam would provide habitats reconnection on the area located at the confluence between the Jiu River and Turceni Dam and create optimal conditions for fish migration and aquatic fauna development.

Keywords: longitudinal connectivity, fish migration, dams, water course

INTRODUCTION

This paper continues the series of research concerning the longitudinal connectivity of rivers elaborated by the National Institute of Hydrology and Water Management (NIHWM) and represents a part of a complex study on ensuring fish migration upstream Işalnița Dam (H= 18 m), located on the Jiu River. The objective of this paper is based on the need to ensure longitudinal connectivity of the inland rivers in order to establish sustainable ways of solving present problems of fish migration generated by dam construction. The goal is to provide solutions for the central or local institutions in order to solve the problems they are facing, to restore the longitudinal connectivity of the Jiu River near Işalnița Dam.

1. STUDY AREA

The studied area is part of the basin of one of the major river systems in Romania - Jiu – having 3867 km length and covering a collection area of about 10,080 km2 [1]. Geographically, the study area - the Isalnita dam – is part of the Jiu piedmont sector in the Sub-Carpathians and Getic Piedmont, situated nearby the morphological contact with the Oltenia Plain. This area ranges within the Pontic Ecoregion characterized by a slightly wavy relief in the north, a predominantly siliceous geology, a chernozem soil, deciduous forests and agricultural areas.

The Isalnita water intake with diversion dam is located on the Jiu River at about 12 km upstream from the city of Craiova in Dolj County and at about 99.5 km from the mouth of the Jiu River. The diversion dam has 18 m height and was put in operation in 1964 [3], [6] (Figure 1). The storage lake, created due to construction of the water intake diversion dam on the Jiu River, in order to ensure drinking water supply for Craiova municipality and Isalnita industrial platform, has an area of 180 hectares and a volume of 1.65 million m^3, being located between both sides of the Jiu River.

The body of water "Isalnita reservoir" (ROLW7.1._B120) is located on the site of community importance ROSCI0045 - *Jiu Corridor*, along the middle and lower Jiu River watercourse which includes one of the rarest and most representative relict samples of less altered European meadow, and a major transbalkan corridor for bird migration (central European-Bulgarian corridor) followed by an impressive number of birds (33% of bird species reported in Romania), of which 84% are protected at national and European level [7].

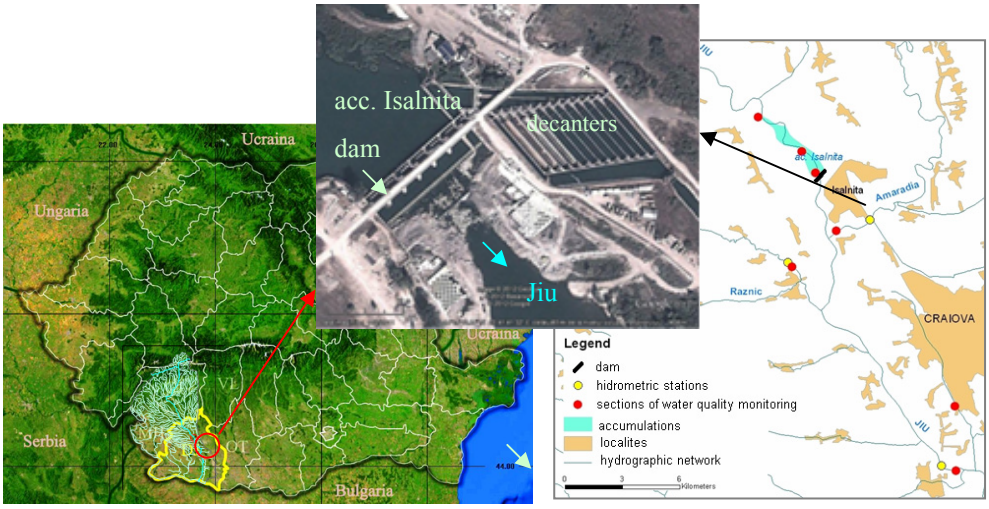

Figure 1. Location of study area

In terms of the Romanian fish species zoning, the area of study belongs to *barbel fish zone* with the migratory fish species as: the barbel (*Barbus Barbus*), the burbot (*Lota Lota*) and the sterlet (*Acipenser ruthenus*), plus migratory species from the neighboring fish zones: the gudgeon (*Gobio uranoscopus*), the carp (*Cyprinus carpio*), the ide (*Leuciscus idus*) and the asp (*Aspius aspius*) [2].

3. SOLUTION FOR ENSURING THE FISH MIGRATION

3.1. The Işalnița water intake with the diversion dam

The *Işalnița* water intake with the diversion dam operate like a system for raising the Jiu River water level in order to gravitationally lead the water flow towards a battery of 12 decanters (Figure 1), the decanted water serving mainly as cooling water for Isalnita thermal power station (Q_i = 33.33 m^3/s) and Şimnic (Q_i = 0.67 m^3/s) and water for water treatment station Craiova (Q_i = 1.15 m^3/s) [3]. The secondary function is to attenuate the effect of tributary floods into the dammed section through the volume available between NNR and NMR. The dam situated at the Isalnita water intake is composed of 6 current openings and a cleaning opening having a dam crest of 129.10 m length and is ranked as "B-category of importance"(dam of high importance). Given the designation of water body "Isalnita reservoir" (ROLW7.1._B120) as heavily modified water body and the presence of migratory fish species in the area, the proposed environmental aim in PMB - *good ecological potential* - provides identification and application of the necessary measures in order to restore the longitudinal connectivity. Therefore the need to solve issues related to longitudinal connectivity restoration of the Jiu River and ensuring fish migration has led to some technical solutions (frontal system) in order to ensure migrating of fish fauna upstream and downstream of Isalnita Dam.

3.2 Prezentation of the proposed solution

The proposed technical solution to ensure the fish migration upstream-downstream of Isalnita Dam provides creating a system composed of several components (metal gate (window), rectangular and trapezoidal channels (modules), metal supporting pillars, fastening systems, etc.). For this purpose, a part of the fish migration system upstream of the dam is to be placed on the weir in the first current opening (Figure 2 a).

On the top, the weir dam is provided with a left opening window which can be fixed by using three hinges (Figure 2 b). To seal the window/gate mentioned, it will be equipped with rubber gaskets. After opening, the window can be fixed on the weir dam by the means of two metal bars. Also, the window located on the top of the weir dam can be mounted on a vertical slide system, operated via a circular handle located inside the weir dam in order to enable input flow control on migration channel.

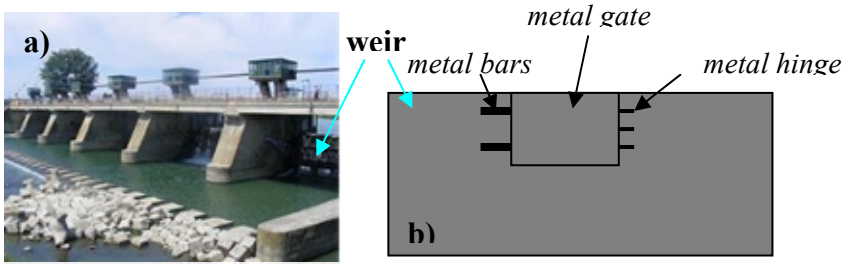

Figure 2. The weir in the first current opening (a) and the metal gate scheme (b)

Furthermore, a metallic rectangular channel having the same width as the metal gate (about 40-45 cm) will be fixed by welding or riveting right in line with the metal window shown in Figure 2. The metal channel is composed of modules that will be fixed on both the weir (in the bottom of the metal gate) and the central metal bar on the weir (Figure 3).

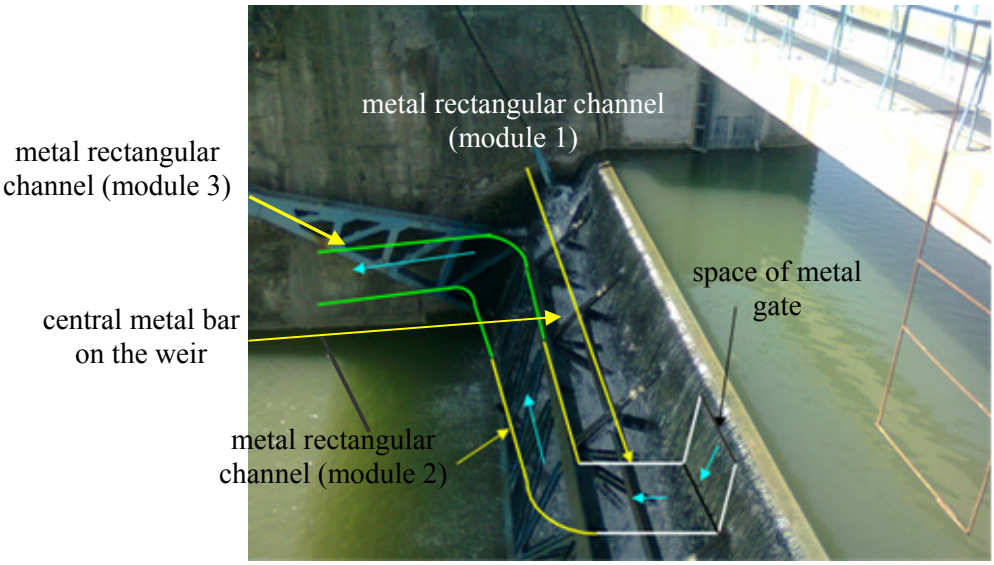

Figure 3. Fixing the system modules for fish migration or rectangular and trapezoidal channels fixing - indicative scheme

The rectangular channel modules for fish migration will be conjoined; the module 2 of the channel mentioned will be attached by the first rectangular channel; it will be fixed (welded) on the central metal bar on slope, so that the slope of module 2 to follow the average slope of the Jiu River in the area of Isalnita Dam. (Figure 3). Module 3 is similar to module 2 shown in Figure 4. The first three modules can be made of sheet aluminum or iron, with a thickness of ≈ 10 mm, and the others can be made of iron. The three modules are welded together resulting in a single module fixed on the weir and being lifted at the same time with it, because the weir lifting mechanism can face additional weights of about 150 kg of those three modules. Module 4 of the channel will be attached on the module 3 by means of some screws, which can be unscrewed when lifting the weir. This module will be provided with an oblique side for lateral fixing on the support pillar of the dam (Figure 4).

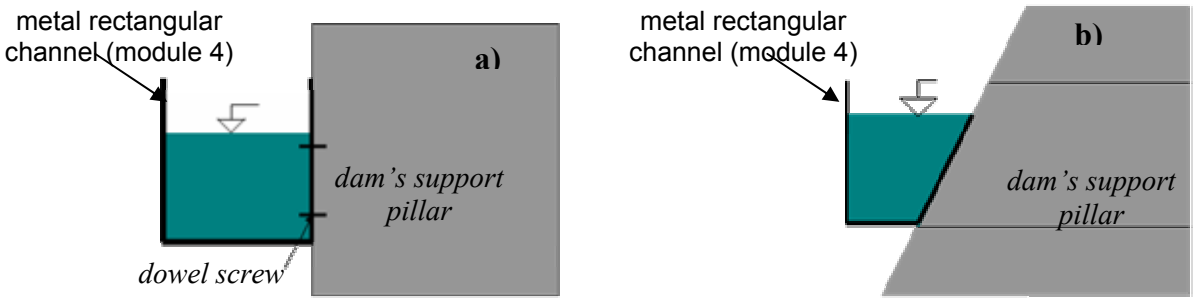

Figure 4. Positioning scheme of module 4 on the Isalnita dam's pillar (side cross section (a), frontal cross section (b))

At a distance of about one meter from the place where modules 3 and 4 are conjoined, module 4 is provided with a mobile metal seal (bellow-type), in order to allow it to be lifted when the level of water is high (in case of floods) (Figure 5). Starting from the mid-front of the support pillar 2 of Isalnita Dam and up to the support pillar 6, the following four identical modules (modules 5, 6, 7 and 8) will be set on their frontal side, according to the diagram in Figure 5.

Figure 5. Positioning of modules 5-8 on the support pillars of Isalnita Dam - indicative scheme

Module 9 is fixed on the pillar 6 when conjoining with module 8; the conjoining end of the module 10 is a circular curve which will be fixed to the support wall of the dam located on the right bank of the river (Figure 5).

Next, modules 10 and 11 of the channel for fish migration (Figure 6) will be fixed on the support wall of the dam located on the right bank of the river. Module 10 will be identical to modules 5-8 and will have a length of about 5 meters. Module 11 will consist in an S-shaped trapezoidal channel which, in the area of the second (dyke-type) concrete sill, will be mounted on a concrete support pillar at a distance of about 20 m from the right bank of the Jiu River (Figure 7). The fixing system of modules 9, 10 and 11 is similar to that shown in Figure 4 (a) for module 4.

Figure 6. Positioning modules 10, 11 and 12 of the channel for fish migration

The end of the module 12, the last module for fish migration arrangement, will descend directly into the stilling basin settled in Jiu riverbed, thus providing the necessary attraction current at the entrance of the channel for fish migration.

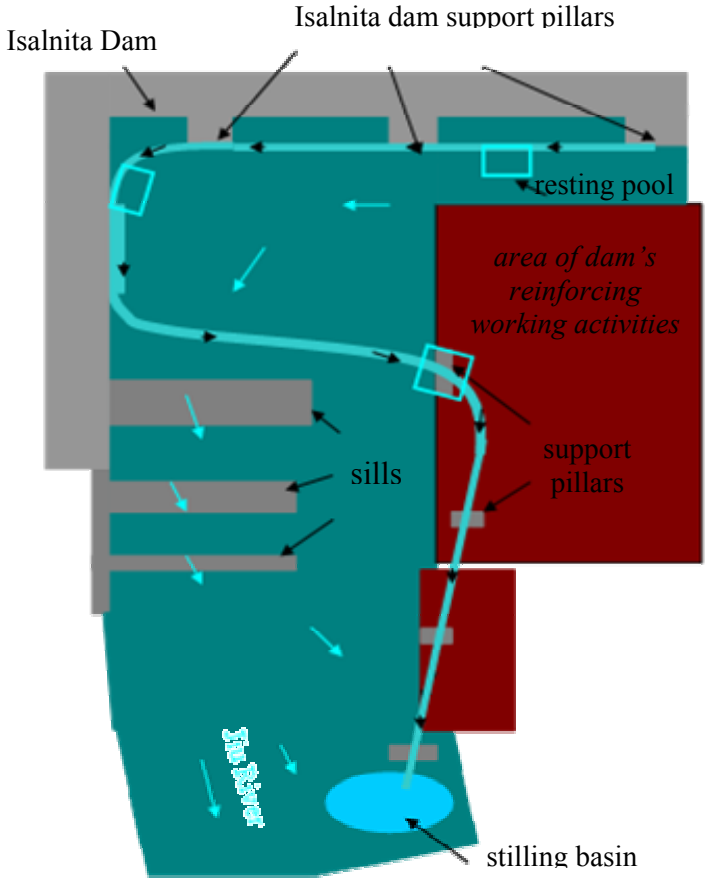

Figure 7. General indicative scheme of proposed solutions to ensure fish migration upstream of Isalnita Dam

To protect fish and prevent illegal fishing activities, all channel modules to ensure the migration of fish fauna can be fitted with a metal mesh grill. During maintenance the grills will be attached to the front side of the dam's support pillars by the means of a metal fixing system.

In order to ensure rest areas for fish on their way to the breeding habitats where the modules 5-6, 8-9 and 11-12 are conjoining, the third stilling basin for fish will be mounted directly on the support pillar of the channel. (Figure 7).

CONCLUSIONS

The proposed technical solutions will contribute to restore longitudinal connectivity of the Jiu River and aquatic habitats and also to improve the natural ecosystems and water quality. In this way, restoration of longitudinal connectivity of Jiu River near Işalnița Dam would provide habitats reconnection on the area located at the confluence between the Jiu River and Turceni Dam and create optimal conditions for fish migration and aquatic fauna development.

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