Lakes, reservoirs and ponds, vol. 8(1): 18-27, 2014

FISH PASS INNOVATIONS FOR THE WEIR OF VELENTA BRIDGE FROM ORADEA CITY

Răzvan VOICU, Ecaterina LUCA
National Institute of Hydrology and Water Management
Bucharest, no. 97, Bucuresti-Ploiesti street, Romania, postal code 013686
phone +40-21-3181116. *Email: razvan.voicu@hidro.ro, ecaterina.luca@hidro.ro*

Abstract

This paper draw attention to the problems related to fish migration in the Crisul Repede River, from the Crisuri catchment's area and restoring the longitudinal connectivity of the river, in Oradea City. On this sector fish migration routs were interrupted by the presence of a large number of obstacles that strongly influence local lotic ecosystem. The purpose of the paper is to present two innovative technical solutions designed to facilitate the passage of migratory fish species (*Barbus barbus* and *Chondrostoma nasus*) upstream the weir, placed near the Velenta railway bridge from Oradea. The two migration systems presented in the paper are a good solution for fish migration and their implementing could be an important step in solving the problems regarding the hydromorphological pressures on water bodies and achieving a good ecological potential of heavy modified water bodies.

Keywords: fish pass, weir, Velenta Bridge, Crisul Repede

INTRODUCTION

Since ancient times people have tried to tame the rivers energy in order to use their potential in yours benefit by building all kinds of obstacles cross the river (rapids, dams, weirs, mills, power plants, ponds, reservoirs, etc.). In this process the main emphasis was on the economic side without taking into account the impacts of the constructions on aquatic ecosystems (interruption of aquatic species migration, changing the riverbed morphology and of the hydrological regime, destruction of riparian vegetation, etc.) (Diaconu, 1999).

Being tempted to believe that low weirs and sills are not a problem for fish, people overlook the fact that no the obstacle height is important but the effect that it has on local species that depend on free longitudinal movement in the river (Marmula, 2003).

Neglect the longitudinal connectivity importance of the analyzed water body (*Crisul Repede→Bonor – border [RW3.1.44_B7]*), designated as heavily modified from the hydro morphological point of view, due to a large number of works present in the riverbed led in time to devastating impact on migratory fish species by reducing population numbers or even the disappearance of some fish species, present in the study area before the weirs construction (Voicu&Luca, 2013; Voicu et all., 2013). It is well known that weirs, regardless of their height, block upstream and downstream fish migration (Marmula, 2003) if are not equipped with functional passage systems.

For this reason it is important to find solutions to longitudinal connectivity restoration of the Repede river affected by the cumulative effect of the 11 weirs present on the mentioned water body. The purpose of the paper is to present two innovative technical solutions designed to facilitate the passage of migratory fish species (barbus, nase and bream) and of the other aquatic animals upstream the weir, placed near the railway bridge from Oradea (Voicu&Luca, 2013; Voicu et all., 2013)..

Study area

The case study CFR Velenta Bridge weir (figure 1) is located on the Crişul Repede River in the east side of Oradea and represents a barrier for fish fauna migration upstream of the Crişul Repede River. This weir is placed on the *Crisul Repede→Bonor – border (RW3.1.44_B7)*, classified as one heavily modified and on where there are many obstacles (11 weirs).

In this area the Crişul Repede riverbed width is 70 m beside the weir, the flow rate is 23.1 m^3/s, and water velocity is 0.4 m/s. The average elevation of the terrain is 130.2 m beside the weir. The water temperature is 18°C, the pH – 8.11, and the turbidity is 3 (Studii hidrologice anuale la s.h. Oradea, 2012)

Study area is located in the on the *nase fishing zone* (Banarescu, 1964). The characteristic migratory fish species of this fish zone are: the nase (*Chondrostoma nasus*), barbel (*Barbus Barbus*) and zarte (*Vimba vimba*). In total in the study area were identified 12 fish species from which three migratory species: nase, barbel and bream, the most numerous being barbel and nase.

The general ecological status of the Crisul Repede river water, in the period 2006-2011 is a good one.

The possible sources of the river pollution in the Oradea City reach are the pluvial discharges through the 11 discharge mouths (Sinteza calităţii apei din Spatiul Hidrografic Crisuri, 2012) and the companies that evacuates the waste waters in the river, from which predominates the industrial waters (33.3%) from the activities related to construction, chemical industry and transportation.

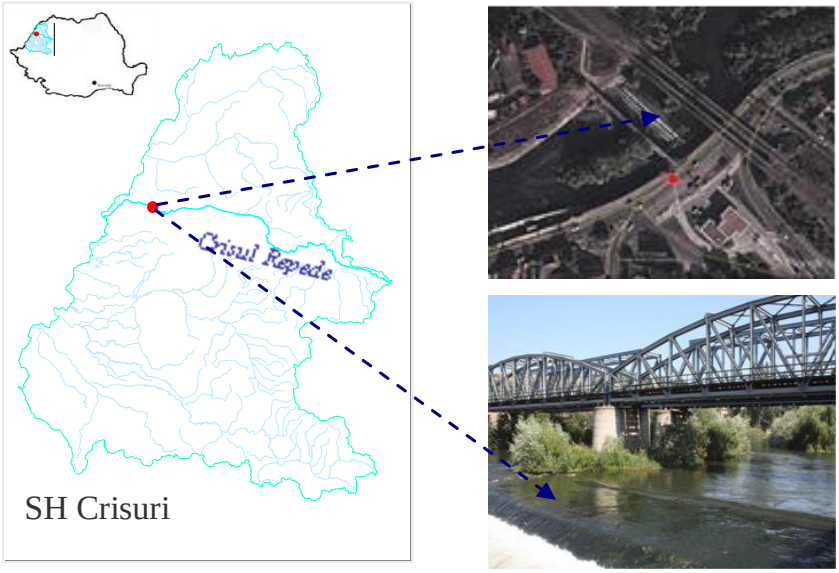


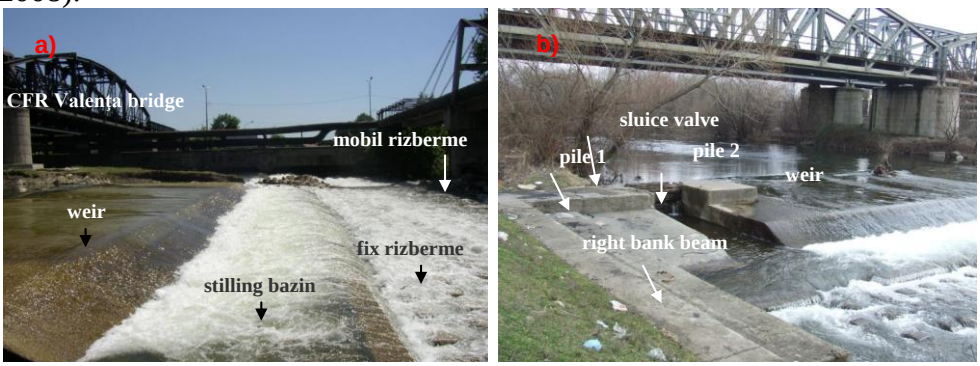
Figura 1. Study area

The main purpose of the weir is to stabilize the riverbed beside the railway bridge and water catchment by CFR water intake, now unused (figure 2).

Previous state (photo: M. Ghinea, 2003) *Current state(photo: E. Luca, 2013)*

Figure 2. The water intake from the CFR bridge weir

The analyzed weir comprises: crest weir, stilling basin, fixed and mobile resberme (figure 3) and is 3m high with a 2 m drop (Popovici, 2008).



View to the weir *View to the sluice gate valve*

Figure 3. Overview on the CFR Velenta Bridge weir from the right bank

METHODS

After a careful analyzes of the available information and data regarding the water quality and fish species from the study area, obtained from the Crisuri Water Basin Administration, and of the situation in situ to facilitate fish migration upstream the Velenta railway bridge weir two technical solutions based on the gravitational flow of water have been proposed.

First solution was developed during the elaboration of the research study *Bioengineering techniques of ecological restoration of water courses - support for environmental objectives set by the Water Framework Directive*, accomplished to National Institute of Hydrology and Water Management in 2013.

RESULTS AND DISCUSSIONS

Solution I

The first way to facilitate fish migration upstream the analyzed weir aims to implement a pass system rectangular channel-shaped, following the river slope.

This system is consisting of three modules attached to the weir in the water intake area on the right bank of the Crişul Repede river. The first module (Module M1) of the system implies the construction of a rectangular

channel , embedded at the top of the pile 2 located on the left side of the sluice gate valve (figure 4).

The Module M2 of migration system will be placed perpendicular to the top of the water intake piles (figure 4 a) being embedded in it, crossing the sluice and extending up to the support beam of the right bank of the river (figure 4 b).

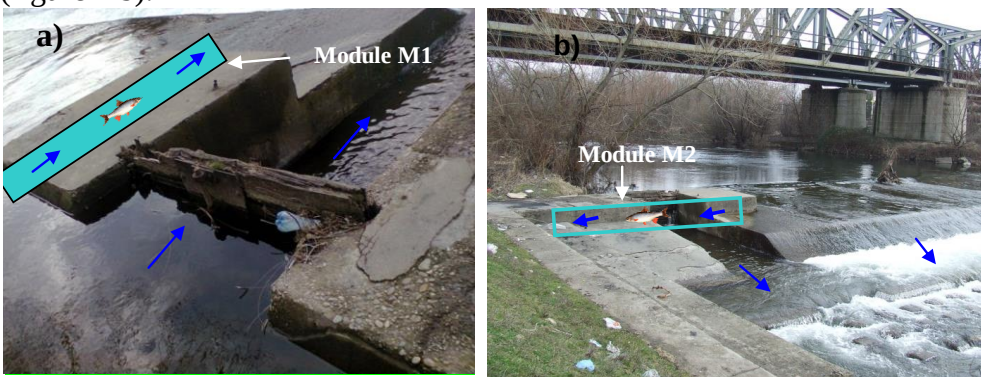


Figure 4. Location of the first two modules of the migration system

This module will be made of concrete and will be protected with a metal grille placed at the top. In front of the module M1 will be placed a 1.2 m long and 1m wide metal grille that aims to prevent the migration channel blockage with floating bodies. This metal grille will have a semicircle form and will have positioned at a distance of one meter from the upstream end of the rectangular channel (figure 5) so the fish can pass under or lateral of it.

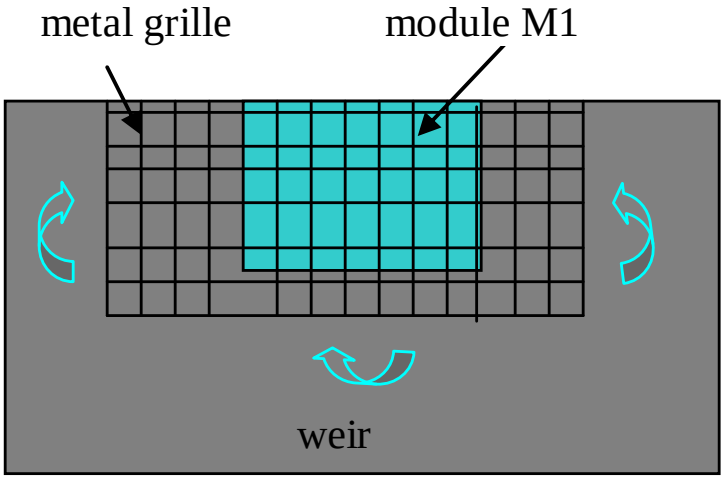


Figure 5. Scheme of the metal grille placement

Module M3 of the proposed fish pass system (figure 6) will be attached to the right bank abutment further of the module M2 and will be continued till the end of the abutment, its upper part being partially embedded in the pile 1.

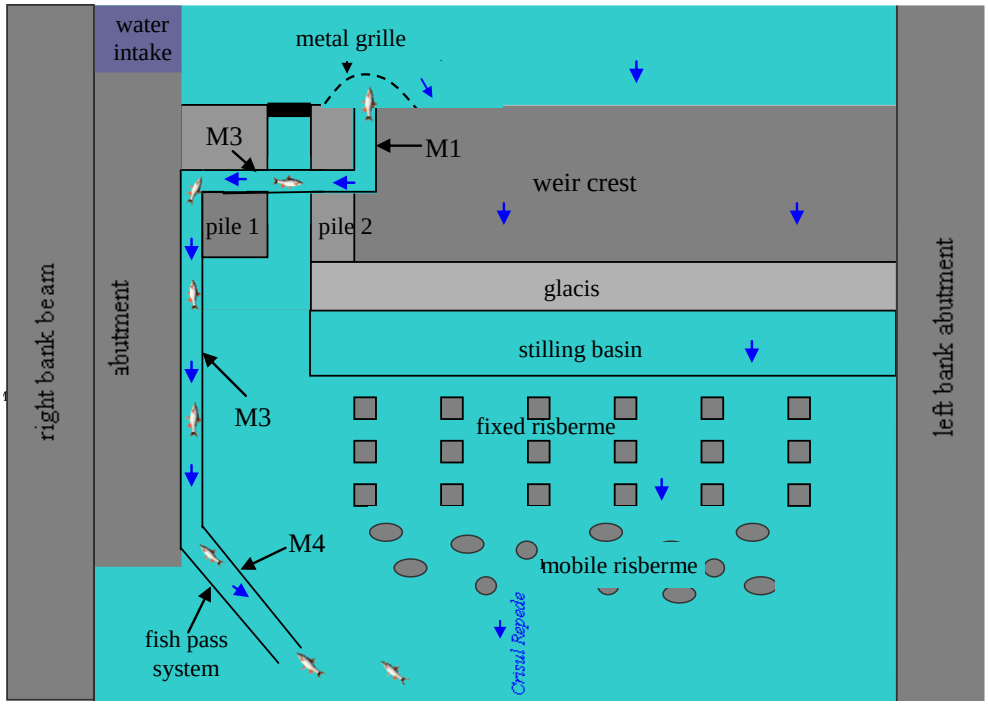


Figure 6. General scheme of the proposed fish migration system

At the end of M3 module will be attached at an angle of approx. 45 degrees module M4 that will descend into the riverbed (figure 6).

The presented solution is simple and can be easily applied without affecting the structure of the weir and of the water intake its modules being performed both of concrete and metal.

Solution II

The second proposed solution provides the realization of a rectangular channel made of concrete or metal that is also composed of four modules joined together (figure 7).

The first module (CI) of the second fish migration system will be placed at the middle of the weir being partially embedded in it (figure 8). This module will be covered with a concret slats.

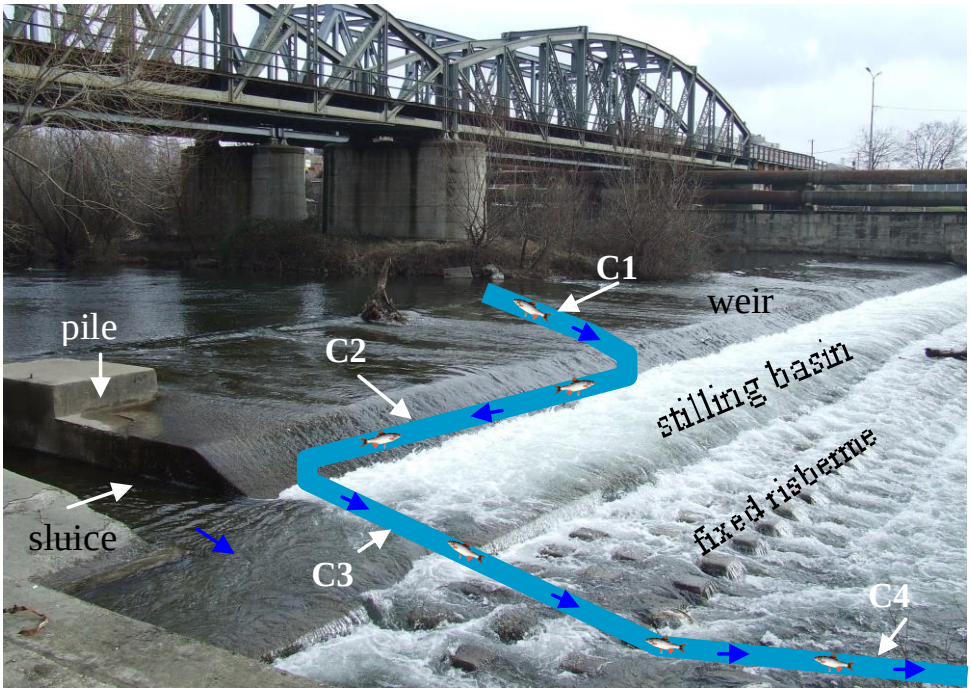


Figure 7. Positioning of the modules 1-3 of the fish migration system

Second module (CII) of the system will be drilled in the slope of the weir (glacis) and further of the first module (figure 8). Modules CI and CII will be lined with reinforced-concrete sheet-pile to prevent weir erosion.

CII module will be connected at an angle of 90 degrees near the water intake to the module CIII module that will pass over the fixed rizberme, where will be connect with module CIV. The front part of the module CII will be made from a durable glass provided with access windows to maintenance.

Module CIV will be attached further of the CIII module at the end of the fixed risberme and will facilitate fish to pass the mobile risberme, coming down in riverbed.

In order to protect the proposed fish pass system and migratory fish species, CI. CIII and CIV modules will be covered by a grille made from metal or concrete.

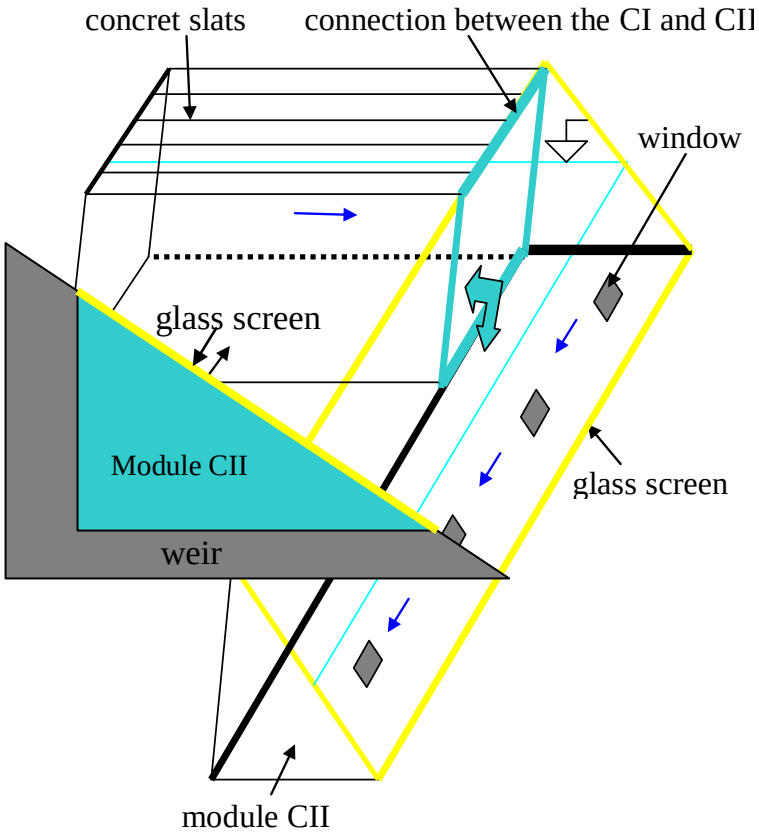


Figure 8. Scheme of the second module positioning

CONCLUSIONS

The proposed technical solutions to facilitate fish migration upstream the weir, placed downstream the railway bridge, is a technically feasible measure for longitudinal connectivity restoration and comes in supporting and completing the concerns of central and local authorities related to reconstruction of Crisul Repede River, biodiversity conservation of the local aquatic ecosystems and increase the tourist attractiveness of the study area.

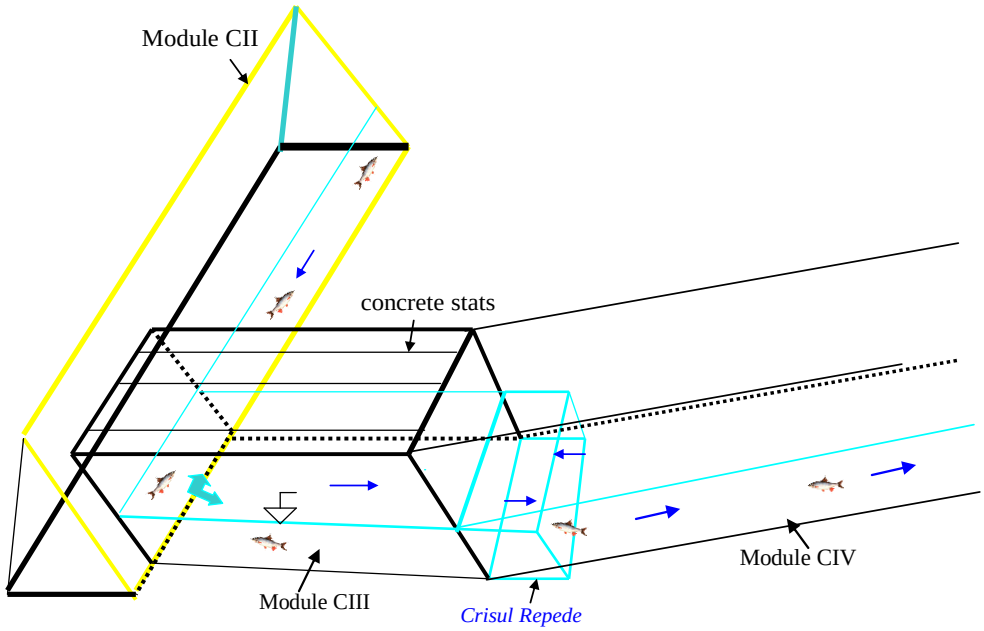


Figure 9. Positioning of modules CIII and CIV

REFERENCES

Banarescu, P. 1964, *Fauna R.P.R.* [*Fauna of P.R.R.*], Edit. Academiei Române, Bucuresti, 915 p. [in Romanian]

Diaconu S. 1999, *Cursuri de apa. Amenajare, impact, reabilitare* [*Water cources. Planning, impact, rehabilitation*], Edit. *H*G*A, Bucuresti, 189 p. [in Romanian]

Marmula G. 2003,, Fishery Resources Officer Inland Water Resources and Aquaculture Service, *FAO Fisheries Circular No. 942, Rev.1 (FIRI/C942 (Rev.1)*, Rome, available at www.fao.org

Popovici I.A. (2008), Studiu de caz Crişul Repede, Consultarea participării publicului [*Case study Crisul Repede. Consultation with the public participation*], Oradea, 28.10.2008, http://www.rowater.ro/dacrisuri

Voicu R. & Luca E. 2013, Solution to facilitate fish migration upstream of the weir located on the Crişul Repede River, near the Dacia Bridge, *Scientific Conference of the National Institute of Hydrology and Water Management,* Bucharest, September 23-26.

Voicu R., Luca E. & Voicu L. (2013), Facilitation of fish migration upstream the Centre Bridge on the Crişul Repede River, *"Ovidius" University Annals of Constanta, Series CIVIL ENGINEERING*, Year XV–Issue 15 (2013), Section VI, pp 281-286.

***(2007), Anexa 6.2. Justificarea desemnării corpurilor de apa puternic modificate si artificiale din Spaţiul Hidrografic Crişuri, [*Annex 6.2. Justification for designation of heavily modified and asrtificial water bodies in Crisuri hydrographis space*], PMB Crisuri. www.rowater.ro/dacrisuri

***(2012), *Sinteza calităţii apei din spaţiul Hidrografic Crişuri* [*Summary of water quality in the Crişuri catchment*], ABA Crisuri Oradea.

***(1966), *Monografia hidrologică a bazinului hidrografic Crisuri* [*Hydrological monography of Cris basin*], Edit. Institutul de Studii si Cercetari Hidrotehnice, 234p.

***(2012), *Studii Hidrologice Anuale la s.h. Oradea,* [*Annual Hydrological Studies*], 2011-2012, Arhiva INHGA, Bucureşti.

***(2013), *Tehnici bioinginereşti de restaurare ecologică a cursurilor de apă, suport pentru realizarea obiectivelor de mediu prevăzute de Directiva Cadru a Apei. Studiu de caz* [*Bioengineering techniques of ecological restoration of water courses - support for environmental objectives set by the Water Framework Directive*], Studiu arhiva INHGA, Bucuresti. [in Romanian]