Lakes, reservoirs and ponds, vol. 9(1): 43-55, 2015

SOLUTION FOR ICHTHYOFAUNA MIGRATION UPSTREAM- DOWNSTREAM OF THE TWO SPILLWAYS LOCATED NEAR MĂNĂŞTUR DAM ON THE SOMEŞUL MIC RIVER IN THE CLUJ NAPOCA CITY (ROMÂNIA)

Răzvan VOICU[1], Cosmin COSTESCU [2], Lliliana VOICU[1], Nicoleta LENGHER-BICA[3]

[1]National Institute of Hydrology and Water Management, Sos. Bucuresti-Ploiesti 97, Bucuresti, cod 013686, România, Tel.: +40-21-3181115, Fax.: +40-21-3181116, Email: rzvnvoicu@yahoo.com, biolili_80@yahoo.com
[2] Elco Construct S.R.L, construction company, Str. Nicolae Filimon 5 ,Bucuresti, cod 06301, România, Tel.: +40-37-2118901, Fax.: +40-372877017, Email: cos.costescu@yahoo.com
[3]Popp & Asociatii - Geotechnical Engineering Company, Str. Calea Grivitei 136, Bucuresti, cod 010737, România, Tel.: +40-21-3178828, Email: nicoletalengher@yahoo.com,

Abstract

Longitudinal connectivity represent the way in which organisms move the energy and material exchanges located throughout the water. Fragmentation the longitudinal connectivity of watercourses caused by dams or other hydrotechnical constructions represent a major impact on sediment transport, hydrological regime, downstream moving and biota migration. The hydromorphological elements (river continuity), as well as chemical, biological, physicochemical elements characterize the ecological status of rivers.Migratory fish species: nase (Chondrostoma nasus - protected by Bern Convention - Appendix III) and barbel (Barbus barbus - rare species, protected Habitats Directive (Annex V), annex 4A of Low nr.462 and Red List of RBDD) are blocked but the Hydrotechnical constructions (discharge sills, dams etc) located across the watercourse Somes Mic River. One of the important think of this system is the gravitational fall of water. This solution will lead to the restoration of the longitudinal connection of the Someşul Mic River in the Manastur neighborhood. România is part of the European Union and it has the obligation to implement the provisions of the Water Framework Directive 2000/60/EC, transposed into Romanian legislation by the Water Law 107/1996 as supplemented and amended (Act 310/2004). This engineering solution for fish fauna migration upstream – downstream of the spillways supports the Water Framework Directive 2000/60/EC, transposed into Romanian legislation by the Water Law 107/1996 as supplemented and amended (Act 310/2004).

Keywords: fish migration, Someşul Mic River, longitudinal connectivity, spillways, lotic ecosystem.

1.INTRODUCTION

To ensure the fish migration upstream and downstream the spillways and to the Mănăstur Dam restore in the local area the longitudinal connectivity of the of the Somesul Mic river.

"*Habitat diversity resulting directly from fluvial dynamics is increased through a combination of different types of hydrological connectivity. Three kinds of hydrological connectivity may be distinguished according to the water origin: (1) river water (permanent connections at both ends, permanent connection only downstream, and temporary connection occurring only during high river stages and floods); (2) groundwater from river infiltration (seepage within the alluvial aquifer); and (3) groundwater from hillslope aquifers*" (Amoros & Bornette 2002).

The issue of ecological restoration of water courses is a matter of public interest and has emerged as a result of the effects of human impact caused by the following factors: industrialization, urbanization, agricultural and zootechnical activities, and hydro-morphological pressures. Rivers restoration includes a large variety of methods, mainly aimed to restore the natural functions of rivers altered after anthropic interventions. (Voicu & Bretcan, 2014).

2.RESULTS AND DISCUSSIONS

The two spillways sills (fig.1) are located near Mănăştur dam (fig.2) downstream of the dam within 200 meters of it. Since migratory fish were found in the area (the barbel and the common nase) (Banarescu, 1964) some engineering solutions should be proposed to facilitate fish passage over the two spillway sills (Diaconu, 1999) (fig. 3). We have proposed a solution (Solution for Fish Migration on the Someşul Mic River upstream – downstream of in Cluj Napoca (Voicu & Bretcan, 2014) for helping fish cross over Mănăştur Dam and improving the existing fish scale (fig.1 and fig. 2).

Figure 1 The two spillway sills photo (ABA Somes – Tisa)

Figure 2 Mănăştur Dam, Cluj Napoca (ABA Someş – Tisa)

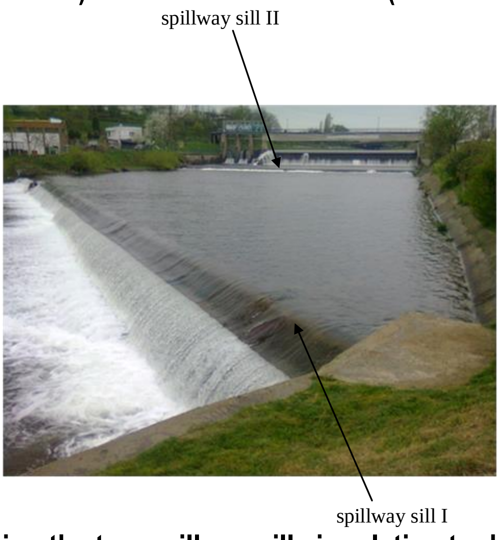

Figure 3 Positioning the two spillway sills in relation to dam Mănăştur Dam

A practical solution must be implemented on the left side, both within and outside the concrete (fig. 4). A rectangular canal with a slope of about 3.5 ‰, smaller than the slope of the river, whose slope is over 4.3 ‰, is drilled three meters upstream from the nearest spillway sill (spillway sill II) on Mănăştur dam. This canal drilled in the bank may be semicircular or rectangular and forms a semicircle with a 6 meters diameter (fig.5). The water speed downstream of Mănăştur dam is about 1m/s and river slope is 0.43 percent (%). The water flow is of about 5.5 m^3/s.

Figure 4 The second spillway sill and concrete left bank

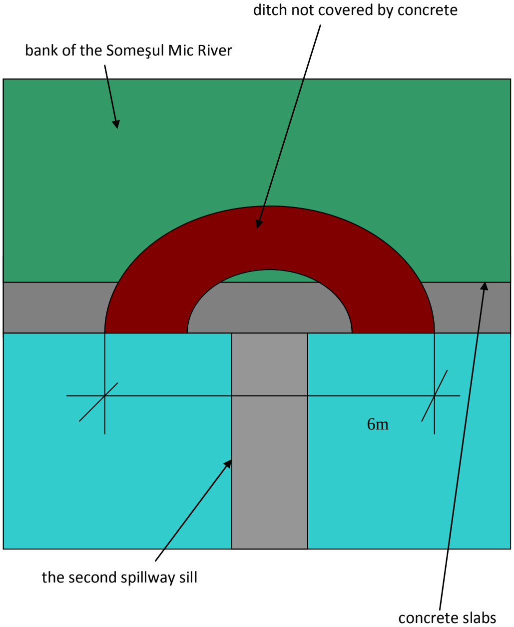

Figure 5 Drilling a canal (ditch) within the left bank– indicative scheme

After concreting the canal or the semicircular ditch, another rectangular canal for helping fish migration is fixed inside the ditch, which opens from the top. The canal will be made of concrete (high quality without roughness) and will have the same slope as the ditch forementioned, that is less than the slope of the river in that area (fig. 6).

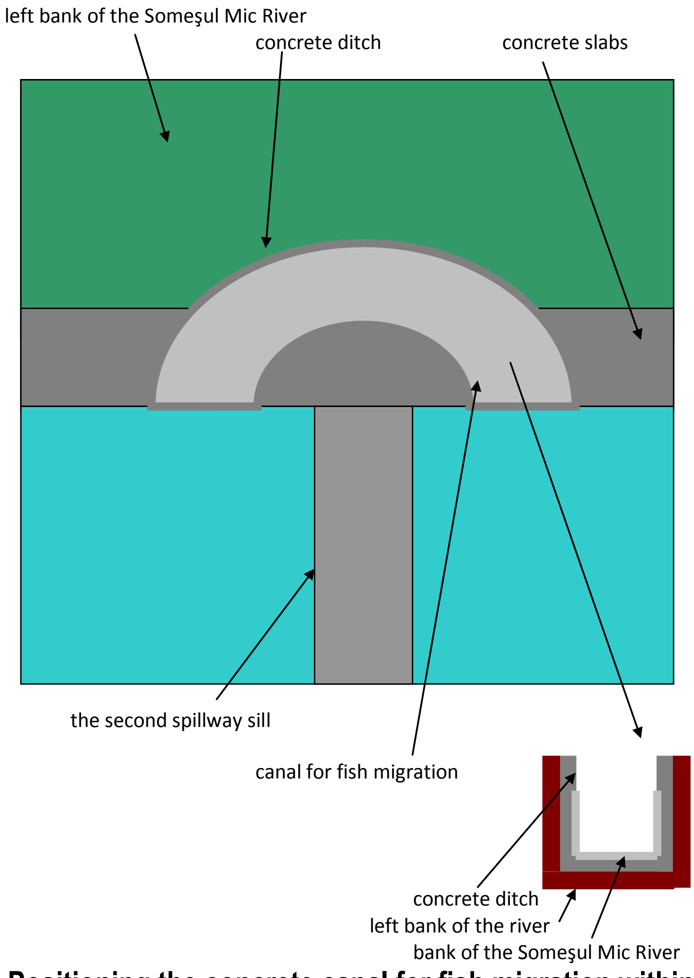

Figure 6 Positioning the concrete canal for fish migration within the concrete ditch– indicative scheme

The canal for fish migration is 43cm wide and 40cm high. At the beginning of the canal, above the water level, there is a semicircular metal bar redirecting the floating elements towards the spillway sill (fig.7). The canal (module M1) will raise up to approx. 30 cm above the water level. The canal will turn to the left in a semicircle (fig. 8 Positioning module M1).

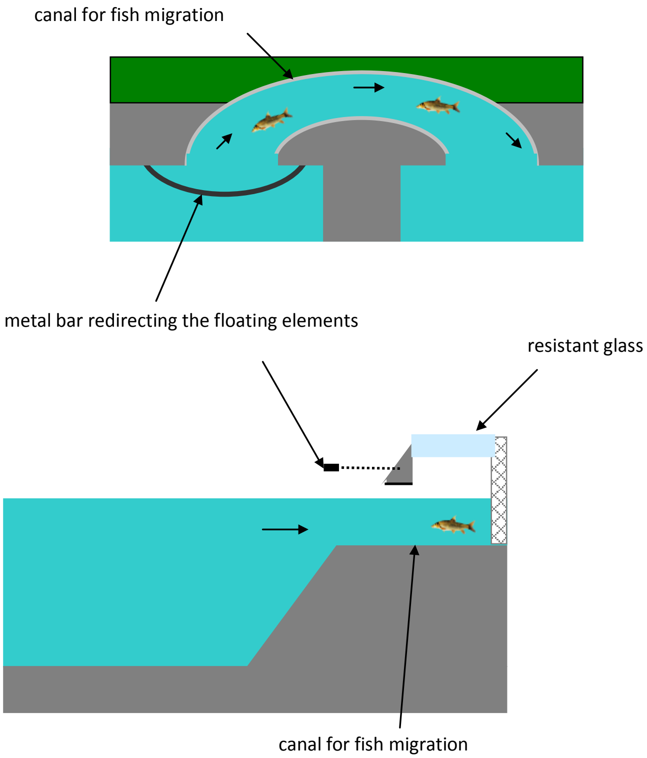

Figure 7 Positioning the metal bar redirecting the floating elements– indicative scheme

Thus, the canal for fish migration (module M2) will continue its journey over the water level up to 3 meters from the first spillway sill, where it penetrates the bank again. There it will have a different height (one meter) whereas the width remains the same (40cm). It preserves the same semicircle form (module M3), has a 6 m diameter, whereas the distance to the spillway sill is 3 meters (fig. 9).

Because it is two times deeper than the other modules of the canal (fig. 10) for fish migration, the last M3 semicircular module will raise directly from the bank into the Somesul Mic River. Filling the last M3 module will be also done by using a pipe that captures water from the Mănăstur storage lake (fig. 9).

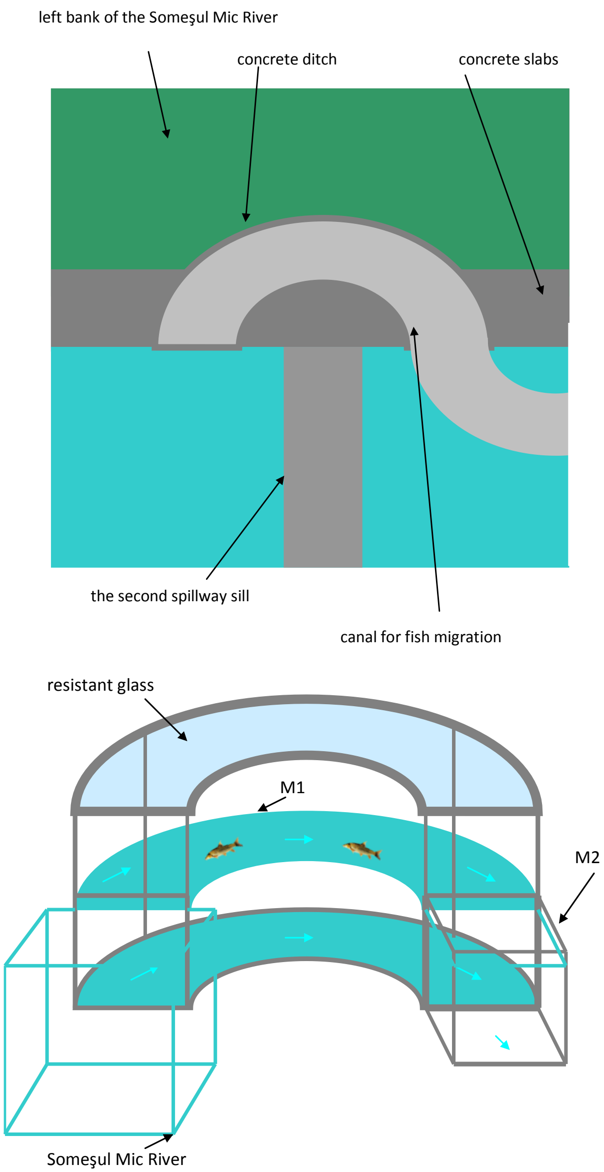

Figure 8 Positioning module M1– indicative scheme

In these circumstances the last module will be completely full and will discharge water directly into the Someșul Mic River, allowing fish to migrate upstream of the two spillway sills. In front of the pipe supplying the module M3 with water from Mănăştur Lake there is a metallic grating which prevents the fish from penetrating inside, and also dissipates the waterstream (fig.10). Both M1 and M3 modules are provided with very resistant protection glass on their tops (fig.11). In order to migrate within the canal, the fish must have light of the same intensity as the natural one. Waterproof and energy-saving lighting systems are the most common and used (LED lighting). For M1 and M3 modules, at both the entrance and exit of the concrete bank, inside the canal for fish migration, there are sensors that light the bulbs fixed to the concrete walls supporting the horizontal transparent glass (fig. 11).

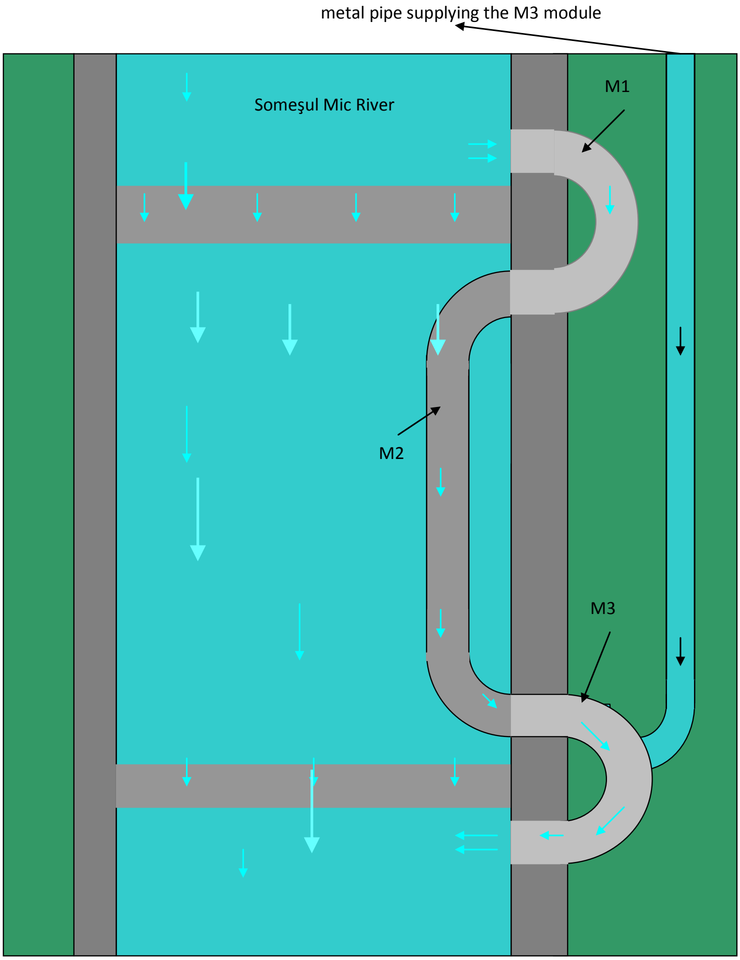

Figure 9 Positioning M2 module – indicative scheme

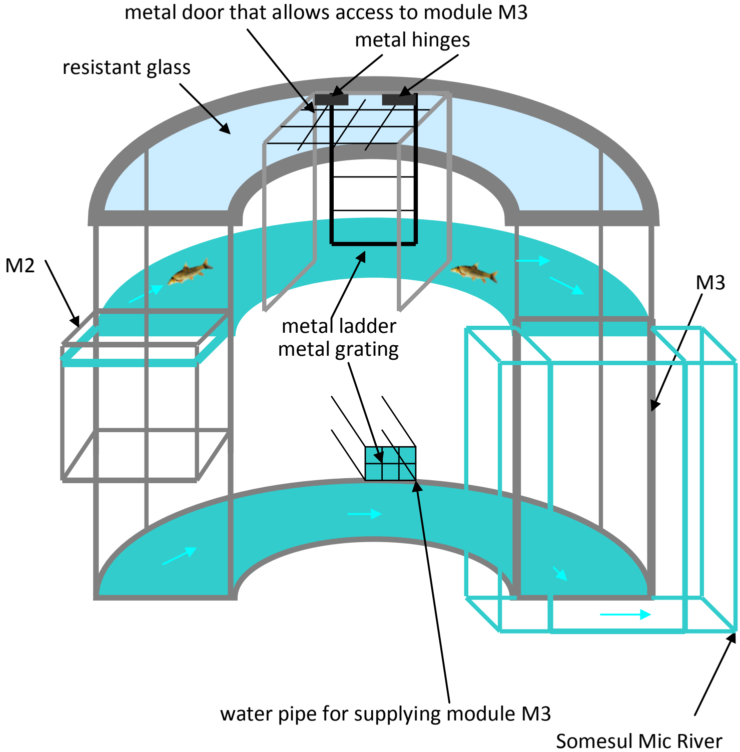

Figure 10 Direct connection between module M3 and the Somesul Mic River – indicative scheme

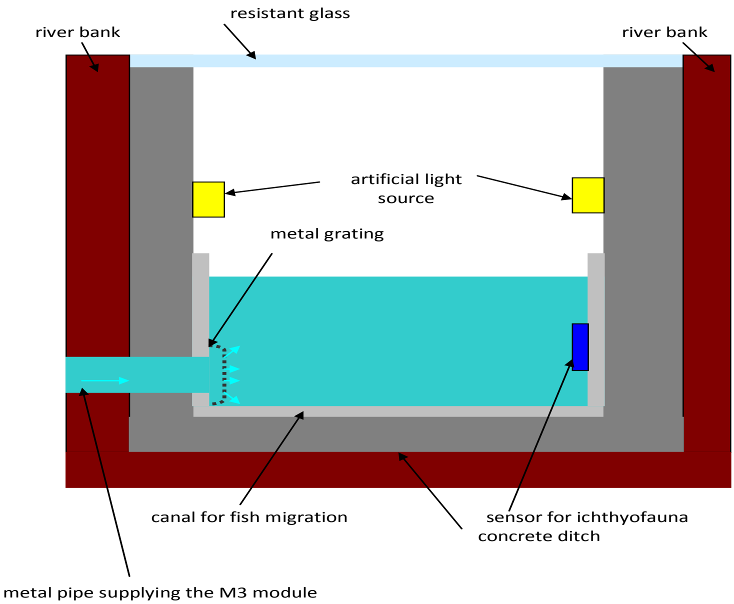

Figure 11 Positioning the glass in the upper part of the modules M1 and M3– indicative scheme

Module 2 is made of rectangular parallelepiped rest areas (fig. 12) 14 cm depth.

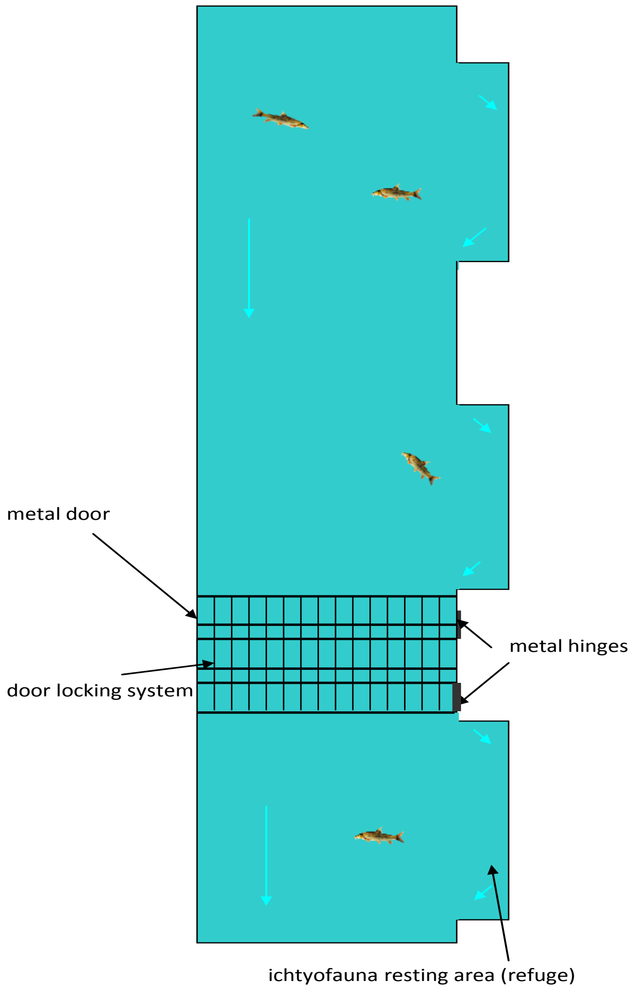

Figure 12 Positioning the refuge areas in the module M2 – indicative scheme

Given that Module 2 is about 40 meters, (all the computation will be done after receiving the final acceptance on the project) three ichthyofauna resting areas are required. Every resting area is about 14 cm deep, 4 m long and approximately 1m wide. The thickness of the modules and resting places for fish fauna is 3cm. Module 2 is fixed both in the river bed and the banks by the means of some metal bars (fig.13).

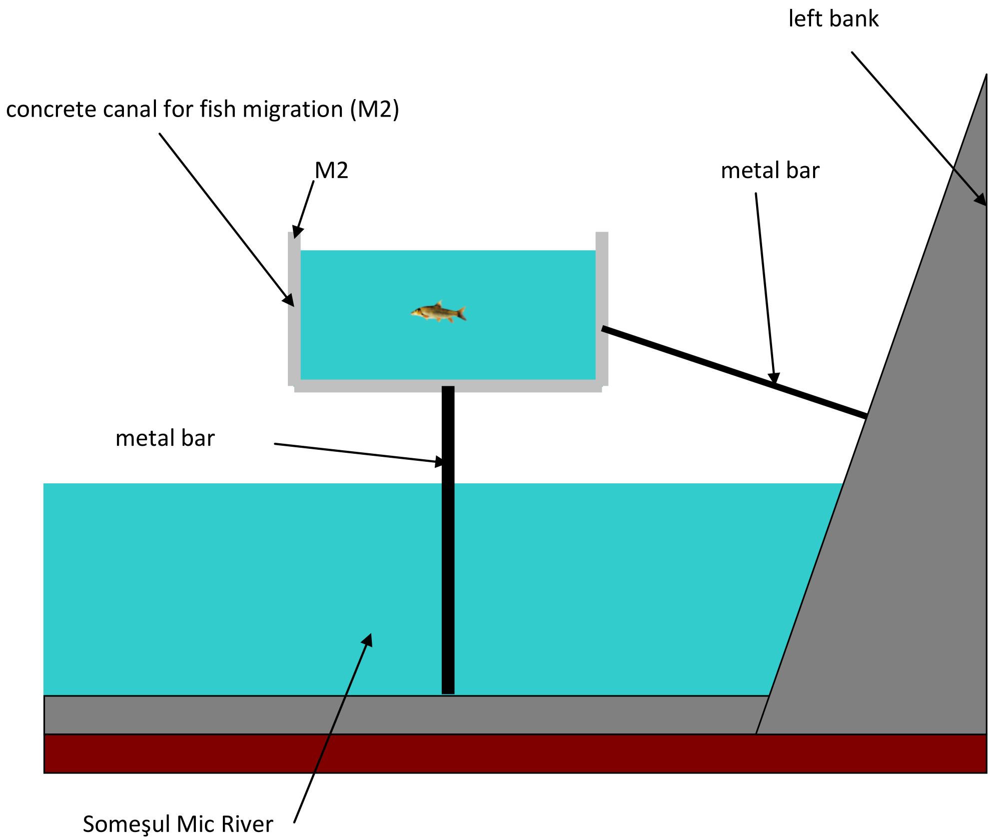

Figure 13 Positioning Module 2 for ichthyofauna migration, – indicative scheme

Above, Module M2 is provided with a metal grille having two doors, which are fixed on metal hinges for solving various technical problems (fig. 14). Circular visiting doors provided with protective metal grille can also be found in the circular ditches. The access to the modules M1 and M3 is done directly by some vertical concrete ditches equipped with metal stairs (fig10).

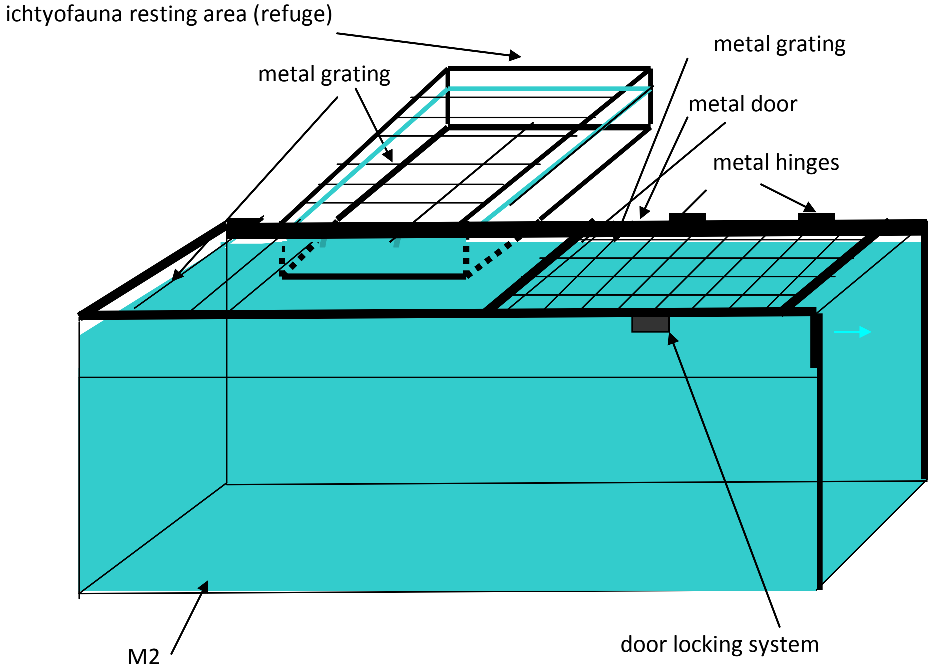

Figure 14 Positioning the metal door within the Module M2 – indicative scheme

CONCLUSIONS

The biggest advantage of this solution is that it can adjust (calculate) the slope of the canal for fish migration as much as needed because the module M2 is suspended and it can be positioned so that the slope of the canal to be smaller than that of the Someşul Mic River. The surfaces of the three modules (M1, M2 and M3) are not ribbed and so, they cannot hurt fish because they are perfectly smooth. Another advantage of this solution is that the Module M3 penetrates directly into the river bed, therefore it is not necessary to create another module to take water flow from the module M3 and thus hinder the fish passage over the two spillway sills. Water circulation through all three modules and also through the pipe that supplies the module M3 is performed gravitationally, thus saves energy except from the sources of indoor lighting. In case of large floods which discharge over Mănăştur dam large amounts of water, they can only damage, in the worst case, the module M2 that can be replaced quickly. Both execution and maintenance costs are average, which gives the advantage to be applied anywhere in the world.

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