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FISHWAYS OPPORTUNITY IN ROMANIA

VICTORIA TATOLE, PETRU BĂNĂRESCU

Abstract. The utility level of fishways is estimated on the basis of an inventory of the upper Tisa River fish species. For each species, aside biological, chorological and origin (autochthonous, allochthonous) characteristics, the scientific, protective and economical importance are considered.

Résumé. On apprécie le niveau d'utilité des équipements de passage des poissons sur la base de l'analyse d'un échantillon piscicole provenant de la rivière Tisa supérieure. Pour chaque espèce on prend en considération en plus des caractéristiques biologiques, chorologiques, aussi celles concernant la nature de l'espèce (autochtone, allochtone), son importance scientifique, l'importance protective, l'importance économique.

Key words: fishway, Romania, Tisa River.

INTRODUCTION

In the strategy for implementing the Directive 2000/60/EC of the European Parliament and of the Council, establishing a framework for the Community action in the field of water policy, the Romanian central authority for environment – The Ministry of Environment and Sustainable Development – had also foreseen measures related to the complex issues of sustainable management and preservation of renewable water resources. In this context, related to the *Longitudinal and lateral connectivity of waters,* a series of aspects associated to the opportunity, methodology and efficiency potential of fishways were addressed.

This paper aims at presenting a point of view on the opportunity of fishways on Romanian rivers, and therefore we analyzed the fish fauna of one of the significant components of the Romanian hydrographic network: a section of Tisa River.

REFERRING TO THE NEED OF FISHWAYS FOR THE FISH SPECIES POTENTIALLY AFFECTED BY HYDRO-ENERGETIC ARRANGEMENTS

In order to maintain the fish population size at an optimal level in a river ecosystem is imperatively essential that the integrity of the reproduction, feeding, sheltering and moving areas is not affected.

Unfortunately, hydro-technical, and especially the hydro-energetic arrangements (due to the construction of the dam lakes), represent a source for habitat fragmentation, separating the downstream growth area from the upstream reproduction area. This leads to population breakup and isolation, and in time is conducting to the regression, and even to species extinction. In this situation, for managing and preserving the aquatic resources of the affected ecosystems, a series of remedies are to be taken, materialized mainly in the use of equipments and devices, adequate to the type of obstacle to be crossed.

The first fishways, were built in France at the beginning of the XVIIth century (Katopodis & Rajaratnam, 1983 – cited by Kamula, 2001). Since then, in different countries a constant concern was addressed to the improvement of this complex method, mainly in France, but also in UK, Belgium, Russia, Germany, Finland, and

last but not least USA and Canada. The study of fishways was important mainly for anodromous[1] migratory fish species, such as: the eel, the salmon, the sea trout, the herrings, some sturgeon species, etc.

In Romania, the issue of fishways necessity was raised for some sturgeon and herring species, for the first time during the construction of Iron Gates I and II hydro-electric power stations on the Danube. The problem was reopened 10 years ago, when, for the first time, the elaboration of a documentation concerning *the study of fishways need at Săpânța and Teceu hydro-energetic power plants, in order to allow fish migration through the arranged Tisa River section* was financed.

In Romania, the subject of fishways was less disputed then in the other countries and at all implemented. It has to be approached on an interdisciplinary basis, biologist-engineer, and the technical decision has to take into account the analysis of all the biological characteristics of the affected fish fund.

In achieving this, a sum of criteria for substantiating the different opportunity and efficiency variants of the chosen technical solutions are needed.

To enunciate and to form a hierarchy of these criteria we used the information given by the specialized literature: Bârcă (1948), Vibert & Lagler (1961), Larinier (1983, 1992 a, b), Porcher & Travade (1992), Kamula (2001).

We provide bellow a step-by-step plan that has to be followed to assure the correct implementation framework for such devices:

- evaluation of the ecological status of the aquatic ecosystem, in the given situation of the hydro-technical arrangement:
  - the structure of the fish fund;
  - identification of the fish species reproduction and growth areas "borders"[2];
  - estimation of fish production up- and downstream the obstacle;
  - estimation of the reproductive potential up- and downstream the obstacle;
- estimation of ecological loss due to obstacle construction;
- estimation of fishway placement and functioning costs;
- estimation of alternatives costs: breeding and repopulation;
- estimation of fishways efficiency.

The critical analysis of the information obtained following the above presented steps is determinant for establishing the adequate placement, type and number of fishways for a specific river.

At the same time, an efficiency monitoring of the installed fishways, in the context of hydro-technical objective functioning at foreseen parameters, has to be done.

Summing up, the efficacy level of a fishway is given in direct correlation with the pursued biological goals. It will be placed in correspondence with its positioning inside the basin, with its capacity for assuring fish migration, and its connection to other obstacles.

[1] Amphibiotic migratory species, which during their lifetime migrate over thousands of kilometers, passing from freshwaters to marine ones.

[2] The fish species from Romanian rivers have limited migratory needs, being preponderantly holobiotic.

At once, it is imperative that both those exploiting the fishway and those managing the fish populations concur in their decisions.

THE ANALYSIS OF FISH FUND OF TISA RIVER, IN THE CONTEXT OF FISHWAY PLACEMENT

The Tisa River (the Romanian section) was not aleatory chosen as a case study, but following the research undergone in this area by the authors, with the explicit goal of establishing the opportunity of fishways in the context of hydro-electric power plants construction.

The upper Tisa River basin has a Northern Ukrainian part and a Southern Romanian part.

To characterize the two upper Tisa River basin's components we considered both the data available in the specialized literature: Bănărescu (1954; 1964; 1969; 2002), Bănărescu & Bichiceanu (1959), Harka & Bănărescu (1999), and the observation and data collected in the field.

From all the available information, we assembled a list of fish species that occur in the Romanian section of Tisa River, species that are given in table 1.

The table comprises columns for species origins (autochthonous, allochthonous), their scientific importance, their protective status, their economical and/or industrial value. The last three columns are designated to the opportunity of fishways for each of the species: of use, useless, to be studied.

Table 1

Fish Species identified in Tisa River (upper Romanian sector).

Species	Common Name	Autochthonous	Allochthonous	Scientific importance	1198/2005	Natura 2000	Economical (*); Industrial (I) Value	Of use	Useless	To be studied
CLS. CYCLOSTOMI ORD. PETROMYZONES FAM. PETROMYZONITIDAE										
Eudontomyzon danfordi Regan, 1911	Carpathian lamprey	*			2	*		*		
CLS. OSTEICHTHYES ORD. ACIPENSERIFORMES FAM. ACIPENSERIDAE										
Acipenser ruthenus (Linné, 1758)	Sterlet	*			4A					*
ORD. SALMONIFORMES FAM. SALMONIDAE										
Salmo trutta fario Pall. 1811	Trout	*					*; I	*		
Oncorhynchus mykiss (Walbaum, 1792)	Rainbow trout		*						*	
Hucho hucho (Linné, 1758)	Huchen	*			2	*	*; I	*		
Thymallus thymallus (Linné, 1758)	Grayling	*			4A		*	*		

Table 1 (continued)

ORD. GADIFORMES FAM. GADIDAE										
Lota lota (Linné, 1758)	Burbot	*			3B	*			*	
FAM.UMBRIDAE										
Umbra krameri Walbaum, 1792	Mudminnow	*			2	*			*	
ESOCIFORMES FAM. ESOCIDAE										
Esox lucius Linné, 1758	Pike	*					*			*
ORD. CYPRINIFORMES FAM. CYPRINIDAE										
Rutilus rutilus (Linné, 1758)	Roach	*					*		*	
Rutilus pigus (Lacepede, 1804)[3]	Danubian roach	*			2;4A	*			*	
Pseudorasbora parva Schlegel, 1844	Topmouth gudgeon		*						*	
Barbus barbus (Linné, 1758)	Barbel	*			4A		*	*		
*Barbusc.*cf. *petenyi* Heckel, 1847[4]	Danubian rheophilic barb	*			2;4A	*			*	
Gobio gobio obtusirostris Valenciennes, 1844	Danubian gudgeon	*								*
Gobio uranoscopus frici Vladykov, 1925	Danubian longbarbel gudgeon	*			2	*			*	
Gobio albipinnatus vladykovi Fang, 1943	White-finned gudgeon	*			2	*			*	
Gobio kessleri Dybowski, 1862	Kessler's gudgeon	*			2,4A	*			*	
Abramis brama danubii Pavlov, 1956	Danubian bream	*					*		*	
Abramis sapa (Pallas, 1811)	White-eyed bream	*								*
Abramis ballerus (Linné, 1758)	Blue bream	*							*	
Vimba vimba carinata (Pallas, 1811)	Zarte	*					*	*		
Pelecus cultratus (Linné, 1758)	Sabrefish	*			2	*			*	
Rhodeus sericeus amarus (Linné, 1758)	Chinese bitterling	*			2	*			*	
Chondrostoma nasus (Linné, 1758)	Nase	*					*	*		
Alburnus alburnus (Linné, 1758)	Bleak	*					*			*
Alburnoides bipunctatus (Bloch, 1782)	Spirlin	*							*	
Blicca bjoerkna (Linné, 1758)	Silver bream	*					*		*	
Aspius aspius (Linné, 1758)	Asp	*			2	*		*		

[3] The presence of species is possible, but not yet conformed.
[4] The species is splited (Iftime, 2004).

Table 1 (continued)

Leucaspius delineatus (Heckel, 1843)	Sunbleak	*								*
Phoxinus phoxinus (Linné, 1758)	Eurasian minnow	*							*	
Tinca tinca (Linné, 1758)	Tench	*							*	
Scardinius erythrophthalmus (Linné, 1758)	Rudd	*							*	
Leuciscus cephalus (Linné, 1758)	Chub	*					*		*	
Leuciscus leuciscus (Linné, 1758)	Dace	*							*	
Leuciscus idus (Linné, 1758)	Ide	*		*						*
Telestes souffia agassizi (Risso, 1826)	Blageon	*			2	*			*	
Cyprinus carpio (Linné, 1758)	Carp	*					*; I			*
Carassius carassius (Linné, 1758)	Crucian carp	*			3B				*	
Carassius auratus gibelio (Linné, 1758)	Prussian carp		*						*	
Ctenopharyngodon idella Valenciennes, 1844	Grass carp		*				*;I		*	
Hypophthalmichthys molitrix Valenciennes, 1844	Silver carp		*				*;I		*	
Aristichthys nobilis Richardson, 1859	Bighead carp		*				*;I		*	
FAM. COBITIDAE										
Cobitis taenia (Linné, 1758)	Spined loach	*			2	*			*	
Sabanejewia aurata balcanica Karaman, 1922	Golden loach	*			2	*			*	
Orthrias barbatulus (Linné, 1758)	Stone loach	*							*	
FAM. SILURIDAE										
Silurus glanis (Linné, 1758)	Wels catfish	*					*		*	
FAM. ICTALURIDAE										
Ictalurus nebulosus (Le Seur, 1819)	Brown bullhead		*						*	
ORD. PERCIFORMES FAM.PERCIDAE										
Perca fluviatilis (Linné, 1758)	Redfin perch	*					*		*	
Stizostedion lucioperca (Linné, 1758)	Pikeperch	*					*			*
Stizostedion volgense (Gmelin,1788)	Volga pikeperch	*			3B				*	
Zingel streber (Siebold, 1863)	Danube streber	*			2	*			*	
Zingel zingel (Linné, 1766)	Zingel	*			2;3A; 4A	*			*	
Gymnocephalus cernuus (Linné, 1758)	Eurasian ruffe	*							*	

Table 1 (continued)

Gymnocephalus schraetser (Linné, 1758)	Schraetser	*			2	*		*		
Gymnocephalus baloni Holcik et Hensel, 1974	Balon's ruffe	*			2;3A	*				*
FAM. CENTRARCHIDAE										
Lepomis gibbosus (Linné, 1758)	Pumpkinseed		*						*	
ORD. SCORPAENIFORMES FAM. COTTIDAE										
Cottus gobio Linné, 1758	Bullhead	*			2	*			*	
Cottus poecilopus Heckel 1836	Alpine bullhead	*		*	3B				*	

The fish inventory comprises 59 species. Many of them are migrating upstream for reproduction, afterwards coming back downstream (*Chondrostoma nasus, Vimba vimba carinata, Barbus barbus, Aspius aspius,* etc.). However, even in the case of territorial and strictly sedentary species, a series of individuals may venture in small "raids" when the food becomes scarce. These trips are part of the species survival strategy: individuals exchange between neighboring populations allows the populations affected, from various reasons, by size decrement to recover. Furthermore, as a rule, the fish and invertebrate species are moving not only along a river, but also from the river to its tributaries, and back.

From the 59 identified species:

- 51 are autochthonous and 8 allochthonous (introduced).
- Two species are of high scientific value, from a zoogeographic point of view: *Telestes souffia agassizi* and *Cottus poecilopus*.
- 26 species are of protective interest at national level, being cited in the annexes to the G.O. 1198/2005, and 20 of them are also listed as requiring special protective measures at European level, being „Natura 2000" elements.

Another category is represented by the species of economical or even industrial value. Of these, the most frequent species in the analyzed area are: the trout, the grayling, the huchen, the chub, the nase, the barbel, the zarte, and rarer are the carp, the Danubian bream, the pike, the Wels catfish, the burbot, the pikeperch, the asp.

For most of the components of the middle and the inferior Danube's hydrographic basin the fish zoning is applicable, the following succession imposing on, from upstream to downstream: the trout's zone, the grayling and the Danube reophilic barb zone, the nase zone, the barbell zone and the carp zone. Tisa's upper hydrographic basin does not comply with this rule: in the rapid portions of the river the species characteristic for the nase zone and even some species of the grayling and the trout zone are dominant, while in the slow portions, are the species characteristic for plain areas. These areas alternate without a specific order, Tisa's zoning consisting of a mosaic of faunistic association.

As regarding the opportunity of fishways for the fish fund of the analyzed area, the facts indicate that they are:

A. – useful: for nine species, *Eudontomyzon danfordi*, *Salmo trutta fario, Hucho hucho, Thymallus thymallus, Barbus barbus, Vimba vimba carinata, Chondrostoma nasus, Aspius aspius* and *Gymnocephalus*

schraetser, whose lifecycle is conditioned by certain migrating processes occurrence. As noticed in table 1, seven of the nine species are of protective interest at a national level and four at the European level, being "Natura 2000" elements. Six of them are of economic importance, and two of them even of industrial importance. As following, we will emphasize the importance of certain features for which the fishways represent a proper solution.

- The *Eudontomyzon danfordi, Gymnocephalus schraetser* populations undertake reproduction migrations and are strictly reophilous. For maintaining the population size it is necessary to ensure the access of the populations along a section long enough, and which maintains all the characteristics of the river ecosystem
- The salmons. *Hucho hucho* (huchen), with a high economical importance aside the protective one, undertake migrations in March-April, the time of its reproduction. For maintaining this species in the Tisa River it is absolutely necessary to provide the exchange of individuals between the upstream and the downstream populations. We would like to emphasize that in certain dam lakes, for example Tarnița (the Someș basin) the hutchen acclimatized itself and is reaching big sizes. If it will be possible as well to ensure a continuous spread from the upper course, from Ukraine to Săpânța, as to communicate with the populations from Vișeu, in order to refresh the populational gene-fund, then the obstacle, represented by the hydro-energetic arrangement will not lead to this species extinction. Though *Thymallus thymallus* (grayling) has a wider distribution in Romania, as well as in the Euro-Asian region, this species is more endangered because its reproduction in captivity is harder to achieve, and therefore securing the biological material needed for repopulation is practically more diminished. Consequently, particularly for this species, a fishway should keep the link between the upstream and the downstream, ensuring its survival in the upper Tisa basin. *Salmo trutta fario* (trout) is the most frequent salmon species in the upper Tisa basin. It can accommodate to the high placed dam lakes (for example lakes from the Someşul Mic River, Drăgan Valley) with the condition that the reproductive fund necessary for its survival will be ensured.
- As for the *Barbus barbus, Vimba vimba carinata* and *Chondrostoma nasus* populations, on whom we have been informed that have diminished their populational size in dammed rivers till extinction, the fishway solution could be a necessity. An argument in this direction should be a demonstrated behavioral particularity of these species: the formation of the spring shoals, in which the representatives of hilly areas populations, as well as submontaneous populations, aside to those of this river's more inferior sections proved to gather.
- The populations of the *Aspius aspius* species may passively profit by the placement of such fishways.

B. – useless for a number of 40 from a total of 59 analyzed species. We have taken this decision in the frame of the following evidence:

- some are species characteristic for still waters, living in the Tisa River's pounds and channels network and who do not migrate: *Umbra krameri,*

Rutillus rutillus, Rutillus pigus, Carassius carassius, Tinca tinca, Rhodeus sericeus amarus;

- some are species characteristic for mountain rivers, who do not arrive in the nearby of the foreseen placement area of the hydro-technical arrangement, *Telestes souffia agassizi*, *Cottus gobio, Cottus poecilopus*;
- some are species living in the downstream area, never arriving upstream of the hydro-technical arrangement: *Gobio albipinnatus vladykovi, Pelecus cultratus, Leuciscus leuciscus, Abramis brama danubii, Blicca bjoerkna, Scardinius erythrophthalmus, Stizostedion volgense, Gymnocephalus cernuus, Perca fluviatilis* and probably *Silurus glanis;*
- some are species with a high adaptation potential. On the basis of the gained experience one could notice that certain fish species, even among those strictly reophilous, may be able to accommodate and to survive the new conditions created by building the hydro-technical arrangement: *Phoxinus phoxinus, Barbus petenyi, Sabanejewia aurata balcanica, Orthrias barbatulus;*
- some are species for whom the hydro-technical arrangements have proved beneficial, i.e. inducing important growths of the *Abramis ballerus* populational size;
- some are species for whom the existent methodology is not able to meet certain ethological characteristics, *Lota lota, Gobio uranoscopus frici, Gobio kessleri, Zingel zingel, Zingel streber,*
- some are species which do not migrate: *Alburnoides bipunctatus*, *Leuciscus cephalus, Cobitis taenia;*
- some are introduced species, *Oncorhynchus mykiss, Pseudorasbora parva, Carassius auratus gibelio, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Aristichthys nobilis, Ictalurus nebulosus, Lepomis gibosus.*

C. – to be studied. In this class we have enclosed 10 species, as follows: *Acipenser ruthenus, Esox lucius, Gobio gobio obtusirostris, Abramis sapa, Alburnus alburnus*, *Leucaspius delineatus, Leuciscus idus, Cyprinus carpio, Stizostedion lucioperca, Gymnocephalus baloni*, on whom is still uncertain if they migrate or not. Because we don't have all these information, we can't decide on the opportunity of placing or not such devices.

To be more suggestive we have drawn figure 1, which shows the utility level of fishways, as for the case of the upper Tisa River.

As shown, fishways in the analyzed section of Tisa River are useful for 22% of the fish species, are useless for 64%, and for 14% there is the need to carry out more studies.

As results from the figure 2 fishways justify their usefulness for a number of species which represent 15.25% autochthonous species, 10.17% species of national protective interest, 7.8% species of European protective interest – "Natura 2000", and 10.17% economically important, from which 3.39% have an industrial importance.

We consider them useless for 54.24% autochthonous species and 13.56% allochthonous, 1.7% species of scientific importance, 30.51% species of national protective interest and 25.42% species of European protective interest – "Natura 2000", for 15.25% economical important species and 5.08% adaptable to industrial breeding.

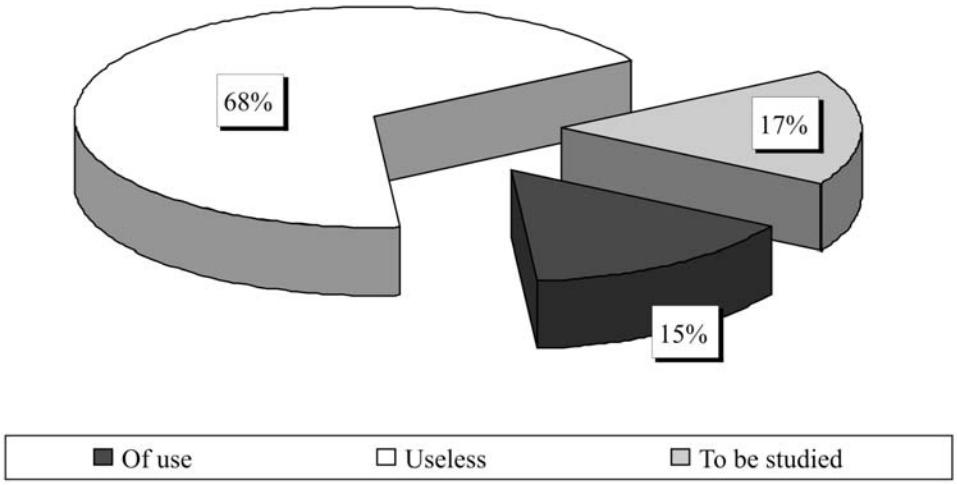

Fig. 1 – The usefulness level of fishways for the upper Tisa River.

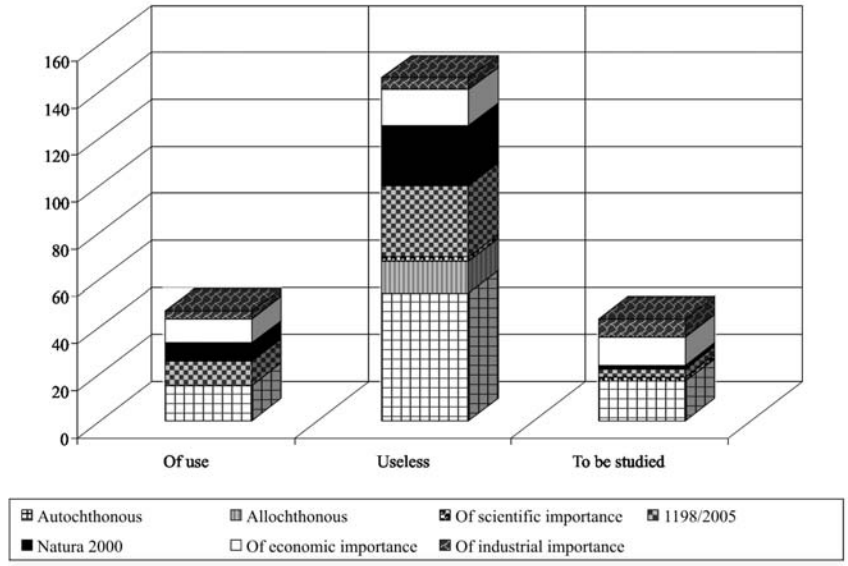

Fig. 2 – The characteristics of fish species, by the opportunity of the fishways for each of the species.

Finally, those who need further studies are: 16.95% autochthonous species, 1.7% species with a zoogeographical scientific importance, 3.39% species with a protective importance at national level and 1.7% at Community level – "Natura 2000", 11.86% economically important and 7.8% important at industrial level.

As a conclusion, we can resume that only the attentive analysis of the biological characteristics, chorology data, biotope requirements for each fish component, in correlation with the placement of the hydro-technical objective, can generate the fundamental information needed to define the decision, that will allow the maintenance of fish population size, in conditions as unaltered as possible.

OPORTUNITATEA DISPOZITIVELOR DE TRECERE PENTRU PEȘTI ÎN ROMÂNIA

REZUMAT

Este apreciat nivelul de utilitate al echipamentelor de trecere de peşti pe baza analizei unui eşantion piscicol provenit din Tisa superioară. Pentru fiecare species se iau in considerare pe lângă caracteristicile biologice, corologice şi cele privind natura speciei (autohtone, alohtone), importanța ştiințifică, importanța protectivă, importanța economică.

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Victoria Tatole
Muzeul Național de Istorie Naturală „Grigore Antipa"
Șos. Kiseleff nr. 1, 011341 București 2, România
e-mail: tatolev@antipa.ro

Petru Bănărescu
Academia Română
Calea Victoriei nr. 125, sector 1, 010071 București, România