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Captive fishes population from Vida Valley (Upper Crişul Negru / Fekete-Körös) upstream the dam lake from Luncasprie (Bihor County, Romania)

Elzárt halpopulációk a Vida-patakban (Fekete-Körös felső szakasza) a Luncasprie duzzasztógát felett (Bihar megye, Románia)

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Kulcsszavak: halfauna, duzzasztógát, folyó folytonossága, migráció, potamodróm halak

Abstract

Our recent studies upon the fish fauna from the dammed rivers reveals the presence of a new insulated and/or captive fish population in a tributary of the upper River Crişul Negru (Fekete Körös), the Vida brook. The observations accomplished in the last two years on that river allow us to formulate conclusions upon the diverse effects of the insulation process upon the native fish species and populations.

The latest data also proved that in the rivers which have remained unaffected by humans upstream of the reservoirs, the fish fauna remain more or less well preserved and stable. The fish species and populations investigated during our study have been separated from the downstream once since the year 1967 and the populations maintain their good conditions. Thus, except the salmons (brown trout *Salmo trutta*), the other species were not directly affected. These observations offer us a new picture regarding to the dam lakes impact upon the fish fauna.

The present-day opinion, concerning to the dammed rivers are referred as invariable negatively affected. Contrary conclusions on this case are sustained by the numerous specimens from native species (*Eudontomyzon danfordi, Cottus gobio, Phoxinus phoxinus, Barbus biharicus, Alburnoides bipunctatus* and *Barbatula barbatula*) collected from upstream ofthe reservoir. Because the isolation of these population new questions regarding the morphological variability on those populations are rising.

Kivonat

Azokon a folyókon, amelyeken duzzasztógátak létesültek, új, elzárt populációk alakulnak ki, és ezt tapasztaltuk a Fekete-Körös egyik mellékvízfolyásában, a Vida-patakban is. Az elmúlt két év vizsgálatai lehetővé tették számunkra, hogy a hosszirányú átjárhatóság megszűnésének következményeivel kapcsolatban a halközösség egyes populációira vonatkozóan új következtetéseket vonjunk le.

Az előző években gyüjtöt adatok bizonyítják, hogy a fennmaradó, emberileg nem érintet duzasztó gáton felüli folyószakaszokon a halfauna többé vagy kevésbé jól megőrzött és stabil marad. Annak ellenére, hogy a vizsgálat során megfigyelt fajok 1967-től el vannak választva a folyó alsóbb szakaszaitól, a populációik többnyire jó állapotban vannak. A lazacfélék közé tartozó őshonos pisztrángtól (*Salmo trutta*) eltekintve, más fajok nem voltak közvetlenül érintve. Kutatásunk a duzzasztógátak hatásának egy új képét mutatja ki.

A jelenlegi vélemények szerint azok a folyók, amelyeken duzzasztogátak léteznek, mindig negativ hatás alatt állnak. Ezzel ellentétben ez esetben számos őshonos faj példányait mutattuk ki a gát felett (*Eudontomyzon danfordi, Cottus gobio, Phoxinus phoxinus, Barbus biharicus, Alburnoides bipunctatus* és *Barbatula barbatula*). A meglévő populációk morfológiai variabilitásával kapcsolatban azonban további kérdések merülnek fel, amelyeket csak további vizsgálatok tisztázhatnak.

Introduction

Studies concerning captive fishes in the areas affected by the barrages and their reservoirs were extended for the upper stretches of a brook in the mountainous area of Crişuri/ Körös river system. The main goal of this study was to assess the fish populations which become insulated in the upper channel of a brook at the upstream of the reservoirs.

The effect of barrages upon the river fish fauna is very significant, mainly because they are generating strong fragmentations of fish populations. The migratory fishes are seriously

endangered in dammed rivers (Pelicice and Agostinho 2008, Pompeu et al. 2011, Van Puijenbroek et al. 2018). A distinctive category of fishes are represented by potamodromous species (Myers 1949, Telcean & Bănărescu 2002, Telcean & Cupşa 2015) which are menaced by the barrages in numerous river systems (Pelicice et al. 2015, Györe et al. 2013). The negative effects of barrages and reservoirs were recently studied by numerous authors (Bănărescu 1994, Bănăduc, 2010, Harka 1996, 2006, Keckeis 2001, Telcean 1997, Telcean et al. 2006, 2017). As general conclusion these have long term negative influences upon the fish species diversity, in species mating and species survival. Their effects are now strengthening those arising from water pollution, overfishing or poaching and climatic changes. The fish mobility onto fluvial systems is the main condition for population stability in many species.

In the tributary Vida brook, upstream of the dam lake we have identified a fish fauna that maintain its former natural condition. This fact gives us a new picture about the insulating process and its influences upon the fish populations in the uppermost stretches of the rivulets and brooks. Our observations concerning the captive fishes along the dammed rivers were discussed also in the previous paper dedicated to the fish fauna that become captive in the river stretches from successive dams and reservoirs from the middle Crişul Repede/Sebes-Körös (Telcean & Cupşa 2015). Recent data obtained in 2017 and 2018 refers to the fish fauna from the Vida brook. The results revealed that some fish species in these captive populations in the uppermost area of the tributary were abled to maintain their former natural state.

The Vida brook is a second order tributary of Crişul Negru /Fekete Körös River. It flows in the western side of the Padurea Craiului Mountains (Apuseni region). Like in the case of many other rivers in the Crişuri/Körös river system (the Tisa watershed), the upper stretch of Vida tributary has been dammed since the year 1967. The dam built there has approximately 10 m in tool and 70 m in long. It is placed near the locality Luncasprie (Bihor County) at the confluence of brooks Vida and Topliţa. The storage capacity is about 400.000 cubic meters and its reservoir occupies a stretch of 2 kilometers along the former channel. This reservoir has some peculiarities like the fact that the water volume cannot be evacuated otherwise than thru the overflow (funnel shaped) located next to the barrage. The water falls from a high of 10 m thru the overflow well and thus is not suitable for fish passing. This barrage has no fish passage.

The study upon the captive fish populations from the middle channel of Crisul Repede / Sebes-Körös revealed that the fish species are differently affected by dam lakes, according to their habitat requirements and their specific mobility (Telcean & Cupşa 2015). The large adapted fish species which are encountered both in running water and lakes, seem to be less affected or even favored by reservoirs and modifications in the riverbed (Telcean et al. 2017). The invasive exotic species are also favored in the new aquatic habitats in the dammed rivers (Reshetnikov 2004). The abandoned weirs are also obstructive for diadromous fish species and also for small sized fishes (Telcean et al. 2017). We have studied the fish community and its conservation state after a long period of insulation (more than 50 years) in the Vida brook, upstream the reservoir. The aim of this study was to reveal the modifications of a fish community as a consequence of its isolation in a less affected area. It is worth to mention that in the dam lake since the construction year, the local anglers have repetedly introduced specimens of different common native species from the lakes situated in the plain region (*Ctenopharyngodon idella, Abramis brama, Carassius gibelio, Perca fluviatilis*). These species maintain their less numerous populations only in the area of the dam lake.

Materials and methods

The samples were collected using an electro-fishing gear type Samus MP 750 and a supplementary catching net held behind the anode (mesh size 0.5 cm). The sampling methods and procedures were accomplished adopting the standard normative (CEN 2003 Water quality). The riverbed of the studied area consists exclusively of gravels and pebbles. The water flow was predominantly fast and the depth ranged between 0.5 and 1.5 m, corresponding to metarithronal habitat type (Illies & Botosaneanu 1963).

The fish samples were collected in 2017 and 2018 during the late spring (May). Our observations were focused on the occurrence of fish species along the riverbed to a distance of 17 km upstream the dam lake from Vida brook. A number of 14 samples were taken along the main channel of the brook and one for the dam lake (tab. 1). For each of given sample sites in the brook, a distance of 150 m was tested. This corresponds with 10 to 20 times the river width. We used the whipping method with a single electrode. Sampling from a boat was used only on the dam lake where the water depth ranged between 2 and 7 m. The collected fish specimens were identified at the sampling site and immediately released back to the environment. The occurrence of species was registered using a voice recorder, thus, the final counting of specimens was performed later, after the sampling procedure.

Results

Altogether 8 native fish species were identified in the sampling area upstream the dam lake in Vida brook. We have also identified an exotic trout species (*Salvelinus fontinalis)* and a lamprey species (*Eudontomyzon danfordi*). The sampled species are representatives of Salmonidae, Cyprinidae, Nemacheilidae and Cottidae.

A number of four species are restricted to the dam lake: *Rhodeus amarus, Perca fluviatilis, Carassius gibelio* and *Ctenopharyngodon idella* (Table 1). The last two cyprinids are non-native species introduced by anglers. The dam lake from Vida brook has no fish passing facilities thus the fish communities become captive in the reservoir after its construction and in the remnant upstream sector of the former rivulet. The fish specimens cannot attain the downstream habitats like they did before the dam construction. The insulating process has started since 1967 when the barrage was settled and it affects the upstream migration of the potamodromous fishes from the main stream of Crişul Negru /Fekete Körös River.

Tab 1. Fish species, sampling stations and GPS coordinates in Vida brook
1. táblázat. Halfajok, mintavételi helyek és GPS koordináták a Vida-völgyben

	Sampling stations and GPS coordinates															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Lake	Total
SPECIES	46°53'27.82"N 22°26'27.77"E	46°53'11.95"N 22°25'35.77"E	46°53'12.00"N 22°23'56.38"E	46°53'17.20"N 22°23'49.46"E	46°53'50.86"N 22°23'17.66"E	46°54'6.28"N 22°23'11.18"E	46°54'18.94"N 22°22'4.18"E	46°53'47.70"N 22°21'56.95"E	46°53'40.23"N 22°21'3.19"E	46°53'33.40"N 22°20'26.39"E	46°53'27.88"N 22°20'3.73"E	46°52'48.34"N 22°18'47.66"E	46°52'38.06"N 22°18'25.30"E	46°52'25.58"N 22°18'19.21"E	46°51'50.73"N 22°18'21.75"E	
Eudontomyzon danfordi	-	-	11	8	2	5	-	-	-	-	-	-	-	-	-	26
Salmo trutta	-	28	12	5	-	7	12	4	3	-	1	-	3	-	-	75
**Salvelinus fontinalis*	-	1	-	-	-	-	-	-	-	1	2	-	-	-	-	4
Squalius cephalus	-	-	-	-	-	-	21	41	20	66	97	18	105	62	97	527
Alburnoides bipunctatus	-	-	-	-	-	-	3	-	1	3	14	4	4	6	-	35
Barbus bibaricus	-	-	-	-	1	-	15	2	5	7	42	8	11	18	-	109
Phoxinus phoxinus	-	-	3	-	13	33	15	1	-	4	13	2	-	-	-	84
Gobio carpathicus (*G. gobio*)	-	-	-	-	-	-	-	-	-	-	-	-	-	3	8	11
Rhodeus amarus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	39
**Ctenopharyngodon idella*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6
**Carassius gibelio*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	11
Barbatula barbatula	-	-	-	-	-	1	20	3	-	1	14	-	-	-	2	41
Perca fluviatilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5
Cottus gobio	13	4	29	1	19	9	43	9	8	7	27	18	2	-	-	189

* allochthonous species

The reservoir offers a specific habitat of still shallow water with silted bottom. This biotope is optimal for cyprinid species spawning and their multiplication affect the trout population in the area. A total number of 527 specimens of *Squalius cephalus* were sampled and 109 of *Barbus biharicus* (Antal et al. 2016). The former rheophilic species from the upper Vida brook are well conserved here, perhaps as a result of less human influence in the area. A total number of 84 specimens of *Phoxinus phoxinus* and 35 of *Alburnoides bipunctatus* were sampled in running water. The lamprey species *Eudontomyzon danfordi* was also abundant (26 specimens). It was sampled in larval stage as ammocoetes and as sub-adults (18 specimens of 26). This species is a good biological indicator of cold and well oxygenated waters.

A total number of 75 specimens of *Salmo trutta* were sampled mainly in the upper sector of the brook. The population remained abundant due to the repeatedly restocking activities carried out by local angler's association in the last five years. The most competitive species *Squalius cephalus* spreads far upstream from the lake and have a negative effect on the trout population. Together with the native trout species, the non-native trout *Salvelinus fontinalis* introduced here has to face the same competition. Only 4 specimens of this trout species were identified in the Vida brook.

The Cottidae species group with its representatives *Cottus gobio* deserves a special remark in this study. Its population is well conserved here and has maintained its abundance and former spreading area about along 17 km on the remnant brook channel upstream the dam lake. This is probably the largest and most well conserved population of this species in the Crisuri/ Körös watershed. A number of 189 specimens of this species were sampled from the stony bottom of this brook.

The small sized fish *Phoxinus phoxinus* is also well represented here. The species is also pertaining to representative of former fish fauna from the Vida brook, before the dam construction. A number of 84 specimens of this fish species were identified in samples especially on the upper sector of the channel.

Other two common species spread also in the tail of the lake and in the proximal stretch of the brook. These species are the common gudgeon *Gobio carpathicus* – 11 specimens and stone loach *Barbatula barbatula* – 41 specimens.

The Biharian barbel *Barbus biharicus* is probably the most affected species by the insulating process. Its former populations were extended far downstream in Vida tributary and also in the main channel of Crişul Negru/Fekete Körös River. The remnant population from upstream the dam lake is surviving on an approximately 10 km stretch of the remained riverbed. A total number of 109 specimens were sampled here.

The dominant fish species in the dam lake are the cyprinids. The most frequent encountered species are *Squalius cephalus* with 97 specimens sampled in lake, followed by *Rhodeus amarus* with 39 specimens, *Gobio carpathicus* 8 specimens and non-native Gibel carp *Carassius gibelio* with 11 specimens. The only representative of Nemacheilidae family identified in still water was *Barbatula barbatula* - 2 specimens, which normally prefers running waters with stony bottom, often covered by light sediments. This species which was more abundant in this brook before the damming, nowadays, maintain an insular distribution upstream the reservoir. Its numerous presence was recorded downstream the barrage. The standing water from the lake seems to be not suitable for the species *Barbatula barbatula* or for the barbel *Barbus biharicus* which not occur here.

In the lake the perch species *Perca fluviatilis* was introduced by anglers, the single piscivorous species identified here. A number of 5 specimens were caught. Between the non-native introduced species is the grass carp *Ctenopharyngodon idella*. The specimens were not able be captured, but they were observed at the water surface. A number of 6 large specimens of grass carp were observed in the dam lake. This species is probably most numerous than the perch. The presence of non-native species in the reservoirs seems to be favored by local habitat conditions.

Discussion

The remnant brook upstream the barrage is typical for the metarhithronal category of mountainous water flows. The predominant fast flowing water and the stony bottoms are are the most important characteristics in the area in fish spreading. This riverbed has less human influence, thus the species communities maintain their natural condition.

Regarding to the fish communities established in the Vida brook, we have observed that the rheophilic species group that were maintained are represented by a number of 6 species (*Alburnoides bipunctatus, Barbus biharicus, Phoxinus phoxinus, Barbatula barbatula, Cottus gobio* and the lamprey species *Eudontomyzon danfordi*). Their habitat requirements and preferences for running and well oxygenated waters are assigned them as representatives of former fish fauna before the damming.

Nowadays, the widest distributed species in the remnant Vida brook is the European sculpin *C. gobio* which occupies the entire riverbed from the spring area to the dam lake (189 specimens sampled). It is probably the best maintained population of this species in the Crisuri/ Körös watershed.

Another cyprinid fish from rheophilic group is *A. bipunctatus* (35 specimens sampled). It is important to mention that all the specimens of *A. bipunctatus* were recorded only in running water (the last 7 sampling stations) and they are not present in the lake. This population can be considered the less numerous. This argued that the species *A. bipunctatus* is pertaining to the former rheophilic species group, probably more frequent into the upper brook before the damming.

The small sized fish *P. phoxinus* is the singular rheophilic species able to accompany permanently (regardless of the season) the trout species *Salmo trutta* in its specific habitat.

Another fish in that group is *B. biharicus* with 109 specimens sampled only in running waters. This species apparently is not affected by the long period of its captivity in the upper Vida brook (over 50 years). The numerous specimens sampled upstream the dam lake shows that *B. biharicus* population maintains its natural condition. According to our recent observations, the species of genus *Barbus* have a strong tendency to expand upstream in the Crişul Negru /Fekete Körös River. This phenomenon caused probably by the warming of the river, periodically favors the endogamy on these species which so are reproduced together (Peňáz 1996, Heggenes et Röed 2006, Neraas et Spruell 2001). The captive population of Biharian barbel from upper Vida seems to be unaffected by this phenomenon.

The stone loach *B. barbatula* sampled also mainly in the running water is pertaining to the former fish fauna in this brook.

The other cyprinid species which are expanded in running water (*Squalius cephalus* and *Gobio gobio*) have a characteristic of patchy distribution along the riverbed. This emerges from the species limited adaptability. In the case of new penetrated chub *S. cephalus*, the numerous specimens identified far upstream the dam lake (382 specimens) is proving that it is the most adaptable species but however it is not able to resist in the fast waters from trout zone. In contrary is that of the Carpathian gudgeon species are not well adapted in fast waters. Its distribution do not exceeds the tail of lake and neighboring riverbed. The cyprinid species deserve a special remark regarding of their seasonal mobility. The majority of species including the rheophilic ones need to retire for wintering in deep and slow running waters. The dam lake from the upper Vida brook is a veritable shelter during the winter for cyprinids There is an exception for the common minnow *P. phoxinus* which stay together with the trout species *S. trutta* and *Salvelinus fontinalis* during the winter.

The captive fish populations from upper Vida maintain their natural state. The long period of isolation however, did not significantly affected the fish fauna from the upper Vida brook. This is due to the relatively long sector of the remained riverbed upstream the barrage (approximately 17 km). This study is probably one of the few (if not the only one) in the matter of river damming which reveals a harmless effects of dam lakes and barrage upon the fish populations. The harmless effect observed here is owed to the species assemblage who comprises mainly of sedentary rheophilic fishes. There is a singular possible positive influence of isolation. This refers to isolation as preventing factor in case of endogamy. The other previous similar study from the middle Crisul Repede/ Sebes-Körös has revealed the negative effect of barrage upon the fish fauna (Telcean & Cupsa 2015). An

important role on fish fauna conservation on dammed rivers seems to have the length of the unaffected riverbed upstream, the absence of water level fluctuations and also the lack of human impact. None of these are identified in Crisul Repede/Sebes-Körös, thus the negative impact of damming from here is significant.

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