

BARBUS MERIDIONALIS RISSO, 1827 POPULATIONS STATUS IN THE VIȘEU RIVER BASIN (MARAMUREȘ MOUNTAINS NATURE PARK)

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ABSTRACT

The ecological state of lotic ecosystems occupied naturally by *Barbus meridionalis*, in the Vișeu Basin within the Maramureș Mountains Natural Park, vary among good to reduced. The inventoried human activities which negatively influence the ecologic state of the *Barbus meridionalis* species habitats and populations are the organic and mining pollution, and poaching. The habitats with low and inadequate conditions created a reduced status of the *Barbus meridionalis* populations; the status of *Barbus meridionalis* populations is not so much affected in the cases of habitats of average to good condition. *Barbus meridionalis* is considered a relatively common fish species in the researched watershed despite the fact that its populations ecological status has decreased from 2007-2015, but the restoration potential in the area for improving this species status is high.

RESUMEN: Estado de las poblaciones de *Barbus meridionalis* Risso 1827, en la cuenca del río Vișeu (Parque Natural Montañas Maramureș).

El estado de los ecosistemas lóticos que ocupa de forma natural *Barbus meridionalis* en la cuenca Vișeu, dentro del Parque Natural Montañas Maramures, varía entre bueno a deteriorado. El inventario de actividades humanas que tienen un efecto negativo sobre el estado del hábitat y las poblaciones de *Barbus meridionalis*, incluyen la contaminación orgánica y por minería y la pesca furtiva. Los hábitats cuyas condiciones son inadecuadas para la especie, reducen el tamaño de las poblaciones de *Barbus meridionalis*. Las poblaciones que se encuentran en hábitats en regular o buen estado de conservación, no son afectadas significativamente. Esta especie es considerada como un pez común en la cuenca, a pesar de que el estado de sus poblaciones se ha deteriorado de 2007 a 2015; existe, sin embargo, un gran potencial de restauración en el área como para mejorar el estado de la especie.

REZUMAT: Starea populațiilor de *Barbus meridionalis* Risso, 1827, în bazinul râului Vișeu (Parcul Natural Munții Maramureșului).

Starea ecologică a ecosistemelor lotice ocupate în mod natural de *Barbus meridionalis* în bazinul Vișeu, din Parcul Natural Munții Maramureșului, variază între bună și slabă. Activitățile umane inventariate, care influențează negativ starea ecologică a habitatelor și populațiilor speciei *Barbus meridionalis* sunt poluarea organică și mineritul și braconajul. Habitatetele cu condiții ecologice inadecvate induc o stare slabă a populațiilor de *Barbus meridionalis*; starea populațiilor de *Barbus meridionalis* nu este atât de afectată, în cazurile habitatelor cu o stare medie spre bună. *Barbus meridionalis* este considerată o specie relativ comună în bazinul studiat, în ciuda faptului că starea ecologică a populațiilor acesteia a scăzut din 2007 în 2015, dar potențialul de restaurare a habitatelor în zonă, pentru îmbunătățirea stării acestei specii, este ridicat.

INTRODUCTION

Most of the Maramureș Mountains Nature Park's streams and rivers are situated in the Vișeu Basin and there are hardly any in the Bistrița Aurie Basin, in the northern Romanian Carpathians (Chiș, 2008; Costea, 2008).

The Vișeu River is one of the principal tributaries of the Danube River, entering into the much bigger Tisa River. It is over 80 km in length and has a multiannual regular discharge of 30.7 m³/s at its lower part in the proximity at its confluence with the Tisa. The origin is located in the Prislop Pass (1,416 m) and it flows into the Tisa River, in near the locality Valea Vișeului, the basin cover-up a surface of 1,606 km². (Ujvari, 1972)

The rather big diversity of lotic and lenitic ecosystems, and their protected species in the Vișeu Watershed are very important from the conservation perspective. The fish are not excluded from this situation, as noted by a variety of ichthyologists in the last century and more. Over 50% of the fish species existing in the studied Maramureș Mountains Nature Park are of protection importance: *Eudontomyzon danfordi* Regan, 1911, *Thymallus thymallus* (Linnaeus, 1758), *Leuciscus souffia* (Risso, 1827), *Romanogobio uranoscopus* (Agassiz, 1828), ***Barbus meridionalis* Risso, 1827**, *Sabanejewia aurata* (De Filippi, 1863), *Cottus gobio* Linnaeus, 1758, and *Hucho hucho* (Linnaeus, 1758). (Bănărescu, 1964; Staicu et al., 1998)

The distribution of *Barbus meridionalis* (Actinopterygii, Cypriniformes, Cyprinidae, Barbinae) is contained in the Danube, Nistru/Dniester, Odra, Vistula and Vardar watersheds. It is also present in the Romanian hydrographic basins, and also in its neighboring countries, but not only: Hungary, Serbia, Croatia, Bulgaria, Moldavia and Ukraine (Bănăduc, 2011; Bănăduc et al., 2012; Cakic et al., 1998; Lenhardt et al., 1996; Moșu et al., 2006; Velykopolsky and Didenko, 2010; Guti, 1995; Trichkova et al., 2009).

Barbus meridionalis is included in the Habitats Directive (92/43/EC) Annex II. In Eastern and Central Europe, it is a quite common species with a good umbrella species potential; a similar situation exists in the Romanian hydrographic net as well. This species is a lithophilic, reophilic and benthopelagic freshwater fish that lives in ecosystems with water temperatures below 25°C in streams located over 500 m above sea level. It is a short-living species in mountainous, tableland and a few lowland rivers with appropriate ecosystems. It is favoured by fast flowing and clear aquatic sectors and hard lithologic substrata. In the second or third year of life it reaches reproduction age. Reproduction happens in the spring season; every now and then is extended until the summer season (from May to July). Along the reproduction period, they congregate in flocks and are in motion upstream and seek good gravel and stones substrata. The food of alevines reside principally of benthic invertebrates (trichopterans, ephemeropterans, tendipedes, gamarids, oligochetes, etc.) and plant litter. The adults feed on these macroinvertebrates too and with fries and alevines (Baensch and Riehl, 1995; Kottelat and Freyhof, 1972; Bănăduc et al., 2011).

The preservation measures for this species should aim for a favorable conservation status, which should mirror a good equilibrium of the total pressures influencing this species that can alter its long-term life quality. In this context, particular actions should be identified and proposed for the specific situation of the study area. In the context in which the human impact is one of the main worldwide determinants that cause structural alterations in fish associations (Bănăduc et al., 2016; Halpern et al., 2015), the central aim of this research is to evaluate the conservation status of the *Barbus meridionalis* populations living in the Maramureș Mountains Nature Park (Eastern Carpathians) and the particular results are to bring to light some site management elements for improving the ecological condition of these populations.

MATERIAL AND METHODS

Research on the *Barbus meridionalis* populations of the Maramureș Mountains Natural Park were done in 2007-2015, and included 370 sampling lotic sectors (Fig. 1). This research consisted of studied species mapping, evaluation of the present preservation status, and characterization of the elements which induce the actual populations status.

The research is based on the working hypothesis (a) and null hypothesis (b): 1a. Aquatic habitats with low ecologic conditions reduced the *Barbus meridionalis* populations; 1b. There will be no variation in the *Barbus meridionalis* populations between habitats of reduced, average or good condition; 2a. The populations of *Barbus meridionalis* has decreased along the period 2007-2015; the population of *Barbus meridionalis* has not decreased in the same period.

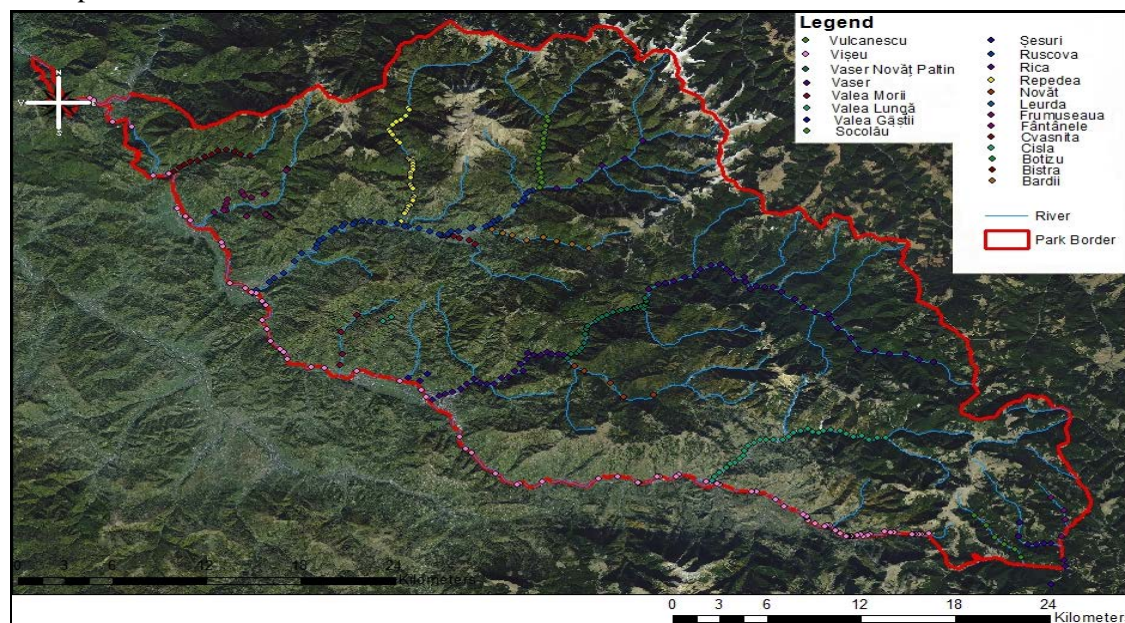


Figure 1: The 370 sampling stations location; GIS support Danci O.

To evaluate the *Barbus meridionalis* populations' status in the Maramureș Mountains Nature Park, quantitative samples were taken from sampling stations within a three kilometers range between two successive stations on all potential habitats with suitable environments for the studied fish species. The locations of the sampling stations admit the evaluation of the effects of the human impact on the researched fish populations, containing the biotope characteristics changing, riverbed exploitation, hydrotechnical works, pollution sources, unrestrained sport fishing and poaching.

Fish fauna quantitative sampling was done through electronarcosis, per time and effort unit, and per each researched lotic section (two hours on the Vișeu River, one hour on Ruscova, and 30 minutes on the other smaller rivers), on five longitudinal sectors of 100 m length. After the fish identification, all fish were immediately released back in their habitat.

The number of fish sampled in the time/effort unit in each station can be converted by correlation in the following fish species classes: (C) – common, (R) – rare, or (V) – very rare, like in the Natura 2000 standard data form filling guidelines, "In mammals, amphibians, reptiles and fishes, no numeric information can be indicative and then the size/density of the population is evaluated as common species – (C), rare – (R), or very rare species – (V)".

The elements used to evaluate the studied fish population statuses are: population size, areal size, balanced sharing of individuals by classes of age, and the proportion of fish individuals of *Barbus meridionalis* in the local fish associations structure.

Analogous to the Natura 2000 guidance, standard data from the criteria “The conservation degree of specific habitats”, and the subcriteria: i) the degree of conservation of the habitat features which are important for the species; ii) possibilities for recovery.

The criterion i) requires a total assessment of the typical features of the habitat concerning the needs of the studied species. “The best expertise”, is applied to rank these criteria: I. elements in excellent condition, II. well preserved elements, III. elements in moderately or partially degraded condition.

In the situation in which the subclass I is granted “I: elements in excellent condition” or “II: well preserved elements”, the criteria B (b) should be grouped as “A: excellent conservation”, or “B: good conservation”, indifferent of the other sub-criteria.

In the case of the sub-criterion ii) which is considered exclusively if the items are partially deteriorated, an evaluation of the studied population viability is necessary. The achieved classification system is: I. not difficult recovery; II. possible restoration with average effort; III. questionable or unattainable restoration.

The procedure for classification is based on the sub-criteria: A – excellent conservation = elements in excellent condition, indifferent of classification of the possibility for recovery; B – good conservation = elements in moderate or incompletely degraded condition and not difficult to restore; C – moderate or decreased conservation = all other mixtures.

In all researched areas, the following was evaluated: condition, pressures/threats of habitats and populations of *Barbus meridionalis*.

The studied lotic sections to evaluate the conservation status of *Barbus meridionalis* in the researched basin were approached in areas where the studied populations are permanent, with the potential of well preserved typical habitats, as well as lotic sectors located at the borderline of the local studied basin range area for the studied fish species, which include sectors where human activities can present danger in the local populations’ status – the Representativity Criteria.

Barbus meridionalis Riso, 1827 (Natura 2000 Code 1138), (RO – moioagă, moiță, cărăușă, jumugă, jamlă, jamnă, mreană pătată, mreană vânătă, mreană de munte, mreană de vale; BG – Cherna, DE – Forellenbarbe, Semling, Afterbarbe; FR – Barbeau truite, Truitat, Turquan; GB – Mediterranean barbell; HU – Petenyi-márna; CS – Potocna mrena) with its terra typica in the Mureș River in Transylvania/Romania has the following general descriptive elements: elongated body; the superior body profile is an ascendant curveline from the snout to the dorsal fin, without reaching the dorsal fin; the last simple radia of the dorsal fin is thin, flexible and not jagged; the ventral fins are inserted backward to the dorsal fin insertion; the dorsal fin edge is plain or slightly fluted; the lips are relatively fleshy and developed; the posterior whiskers are sometimes long, exceeding the eye; the back of the body is dark brown-rusty colored, with darker and lighter spots, the flanks are yellow-rusty with spots, the ventral side is light yellow; the dorsal and caudal fins have accentuated spots, the rest of the fins are yellowish; the whiskers are yellowish with no red axis; and it can reach 28-30 cm in length. The general ecologic elements are: benthopelagic and freshwater fish; a short-lived species which is found in mountainous and hilly rivers, with springs in this area; prefer the clear and fast flowing water sectors and the hard substrata; no migrations were registered; the reproduction happens in the spring, sometimes is prolonged until the summer; its food consists mainly of benthic aquatic invertebrates (tendipedes, ephemeropterans, trichopterans, gamarids, oligochetes and rarely plants) (Bănărescu, 1964; Bănărescu and Bănăduc, 2007).

RESULTS

The river sectors where *Barbus meridionalis* (Fig. 2) was sampled during the study period are presented in table 1 (Fig. 3), for the studied lotic sectors, the catch index values were offered in the paper (individual numbers per time and effort unit).



Figure 2: Sampled *Barbus meridionalis* Risso, 1827 individuals.

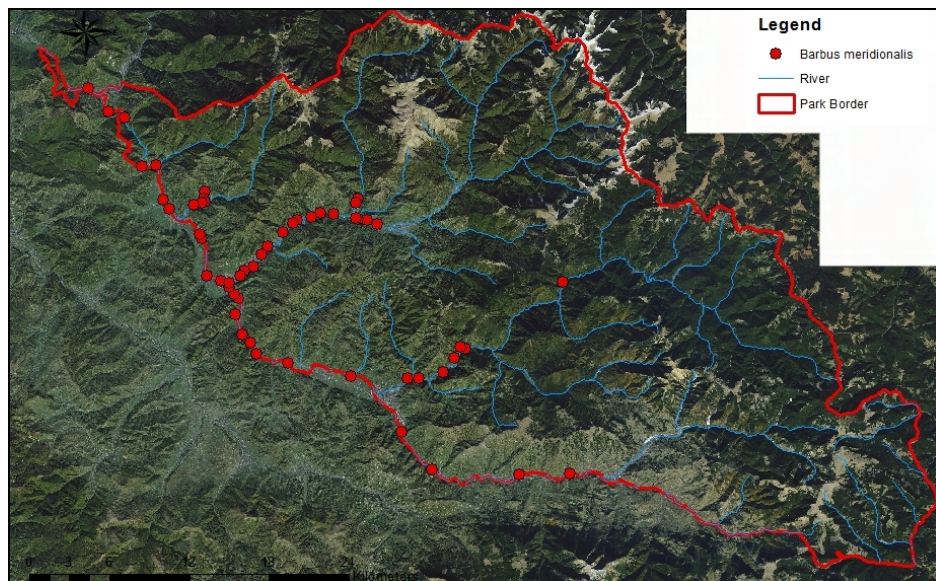


Figure 3: Sampling stations location where *Barbus meridionalis* was found in Vișeu Basin/ Maramureș Mountains Nature Park; GIS support Danci O.

Table 1: *Barbus meridionalis* sampling points in the study area.

No. crt.	Lotic system	Station code	Lat. (N')	Long. (E')	Catch index no. ind./100 m × 30 min	Characteristic habitat state
1.	Vişeu River	39	47 39 30.9	24 37 03.9	1	reduced
2.	Vişeu River	43	47 39 26.1	24 34 0.3	1	reduced
3.	Vişeu River	47	47 39 36.6	24 28 49.4	1	reduced
4.	Vişeu River	50	47 41 07.4	24 26 57.0	1	reduced
5.	Vişeu River	53	47 43 24.0	24 23 53.7	1	reduced
6.	Vişeu River	55	47 43 54.9	24 20 04.5	3	reduced
7.	Vişeu River	57	47 44 16.2	24 18 11.5	1	reduced
8.	Vişeu River	59	47 44 41.5	24 17 49.2	6	reduced
9.	Vişeu River	60	47 45 01.4	24 17 20.4	12	average
10.	Vişeu River	62	47 45 52.5	24 16 53.8	2	average
11.	Vişeu River	63	47 46 29.7	24 17 03.6	32	average
12.	Vişeu River	64	47 46 40.3	24 16 52.0	42	good
13.	Vişeu River	65	47 46 58.9	24 16 32.4	39	good
14.	Vişeu River	67	47 47 11.3	24 16 01.2	26	good

Table 1 (continued): *Barbus meridionalis* sampling points in the study area.

No. crt.	Lotic system	Station code	Lat. (N')	Long. (E')	Catch index no. ind./100 m × 30 min	Characteristic habitat state
15.	Vișeu River	68	47 47 23.3	24 15 11.8	11	good
16.	Vișeu River	69	47 48 55.0	24 14 50.1	9	good
17.	Vișeu River	70	47 49 04.9	24 14 44.8	7	good
18.	Vișeu River	72	47 50 07.4	24 12 54.1	36	good
19.	Vișeu River	73	47 50 27.7	24 12 29.2	45	good
20.	Vișeu River	74	47 51 53.1	24 12 03.0	52	good
21.	Vișeu River	75	47 51 49.4	24 11 12.2	55	good
22.	Vișeu River	76	47 53 47.5	24 10 06.7	56	good
23.	Vișeu River	77	47 54 00.3	24 09 07.7	48	good
24.	Vișeu River	79	47 54 58.5	24 07 56.4	50	good
25.	Repedea River	29	47 50 36.1	24 24 14.8	5	good
26.	Repedea River	31	47 50 24.8	24 24 07.9	7	good
27.	Vaser River	37	47 44 30.6	24 30 44.0	3	average
28.	Vaser River	38	47 44 36.0	24 30 26.2	9	average

Table 1 (continued): *Barbus meridionalis* sampling points in the study area.

No. crt.	Lotic system	Station code	Lat. (N')	Long. (E')	Catch index no. ind./100 m × 30 min	Characteristic habitat state
29.	Vaser River	40	47 44 09.1	24 30 04.0	6	average
30.	Vaser River	43	47 43 35.3	24 29 26.7	12	average
31.	Vaser River	47	47 43 19.5	24 27 58.3	21	average
32.	Vaser River	49	47 43 19.3	24 27 18.1	8	average
33.	Novăț Stream	31	47 47 15.0	24 36 35.6	2	average
34.	Ruscova River	19	47 49 34.5	24 25 24.3	1	reduced
35.	Ruscova River	20	47 49 42.7	24 24 47.8	1	average
36.	Ruscova River	21	47 49 46.8	24 24 16.3	1	average
37.	Ruscova River	22	47 49 47.7	24 24 05.6	3	average
38.	Ruscova River	25	47 49 56.6	24 22 46.3	7	average
39.	Ruscova River	27	47 49 59.4	24 21 58.5	5	average
40.	Ruscova River	30	47 49 49.7	24 21 25.4	11	average
41.	Ruscova River	33	47 49 42.5	24 20 33.9	13	average
42.	Ruscova River	34	47 49 33.8	24 20 20.9	9	average
43.	Ruscova River	36	47 49 1.0	24 19 45.5	4	average
44.	Ruscova River	39	47 48 36.9	24 18 50.8	13	average
45.	Ruscova River	40	47 48 18.0	24 18 29.4	15	average

Table 1 (continued): *Barbus meridionalis* sampling points in the study area.

No. crt.	Lotic system	Station code	Lat. (N')	Long. (E')	Catch index no. ind./100 m × 30 min	Characteristic habitat state
46.	Ruscova River	41	47 47 47.5	24 17 58.4	6	average
47.	Ruscova River	42	47 47 36.6	24 17 27.1	8	average
48.	Ruscova River	43	47 47 25.6	24 17 11.0	22	average
49.	Ruscova River	44	47 47 07.0	24 16 32.0	15	average
50.	Frumușeasca River	12	47 50 49.1	24 15 00.5	1	average
51.	Frumușeasca River	14	47 50 31.4	24 14 55.8	1	average
52.	Frumușeasca River	16	47 50 24.3	24 14 58.8	4	average
53.	Frumușeasca River	17	47 50 23.0	24 14 51.3	3	reduced
54.	Frumușeasca River	18	47 50 16.7	24 14 21.4	2	reduced

DISCUSSION

Based on the results of this research, and consistent with the *Barbus meridionalis* fish species' ecological and biological necessities and local ecological status, three risk elements (pressures and threats): organic pollution, poaching and pollution resulted from mining activities were found.

Organic pollution coming from sewage systems, agriculture and fish farms have a negative impact on the Vișeu River basin ichthyofauna. It is a persistent and bad situation connected to improper sewage systems and inefficient wastewater treatment; also to farms, in the Vișeu Basin, mainly on the Vișeu River, situation which induce a permanent negative impact on fish fauna (Oprean et al., 2009).

Poaching. During the field research, around the clock poaching activities (in over 20% of our field trips) using a great variety of home-made electrofishing gears were observed. Also, poachers were observed during their illegal activities using a large variety of substances for killing and collecting fish of all dimensions. By asking 431 local people in the Maramureș Mountains Nature Park, it seems that poaching is a frequent activity in all seasons in the Vișeu Basin, and this induces an important diminishing of the *Barbus meridionalis* abundance and modifications of the age class structure of the local populations.

Mining activities pollution. The long term pollution resulting from heavy metal mining and storage activities in an old mining industry area (Fig. 6) of Țâșla Stream basin are negatively influencing not only the Țâșla lotic aquatic habitats, but also the habitats and species of interest of the upstream Vişeu River; the effects of the precipitations washing from waters of the mine galleries and greened refuse heaps is a heavy one in the Țâșla Stream basin and is also serious on the upstream Vişeu River (Staicu et al., 1998). The synergism among the identified human impact puts pressure on numerous lotic sectors in the researched area (Figs. 4 and 5) and the evaluation score for the researched fish species is not at the natural potential.

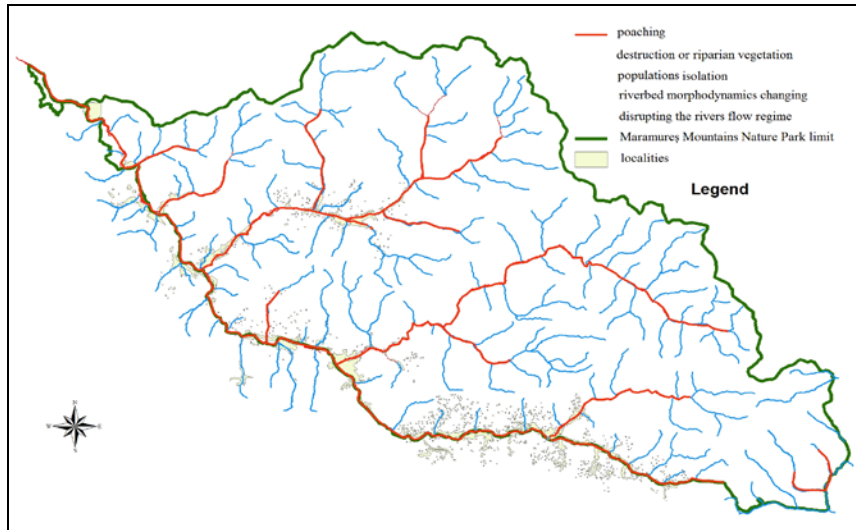


Figure 4: Diagnosed combined pressures and threats for *Barbus meridionalis* in the studied Vişeu River basin/Maramureş Mountains Nature Park area.

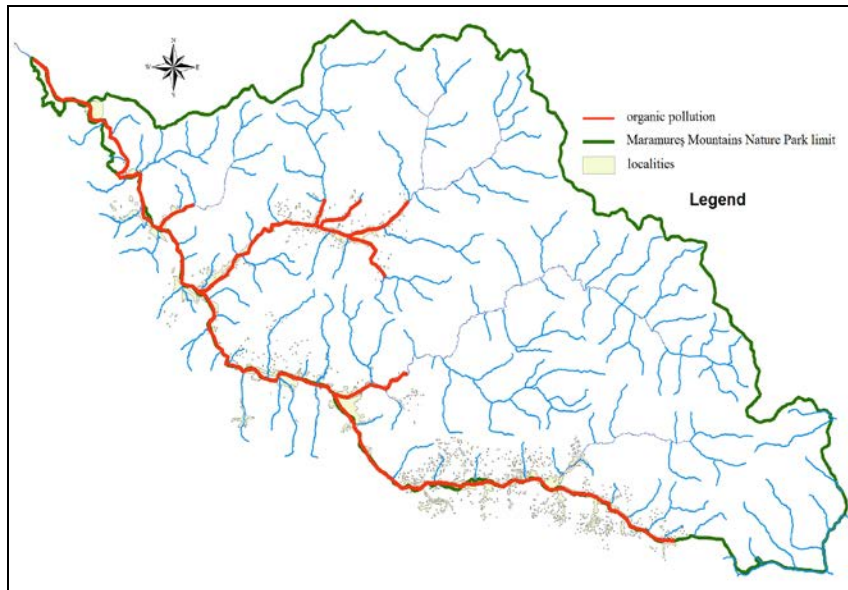


Figure 5: Lotic sectors influenced by organic pollution; in the studied Vişeu River basin/Maramureş Mountains Nature Park area.



Figure 6: Dissaffected mining industrial area and refuse heaps in the Tâșla Stream proximity.

There are some main management measures necessary for the diminishing or elimination of the negative effects of the identified pressures and threats for the *Barbus meridionalis* populations in Vișeu Basin in Maramureș Mountains Nature Park.

Organic pollution. Sewerage systems must be developed throughout all of the Vișeu Basin and also the domestic and zootechnical waters should be properly cleaned in all the basin localities.

Poaching. It is proposed to increase the number of hours of on-site verification of potential poaching activities by the local protected area rangers. The lack of financial resources for these activities can be compensated, at least in part, through permanent cooperation agreements with forestry, police, and gendarmerie, etc. personel, as well as by creating a permanent structure of local volunteers.

Mining activities pollution. The impact of mine drainage and tailing dumps washing can be significantly reduced by sealing existing mine galleries and renaturation/isolation of mine tailing dumps in the Tâșla River basin.

Finally, it is apparent that the aquatic habitats' quality influenced the *Barbus meridionalis* populations: the habitats with low ecologic conditions have reduced the status of *Barbus meridionalis* populations; the status of *Barbus meridionalis* populations is not so much affected in the cases of habitats of average to good conditions. In general, the populations' status of the *Barbus meridionalis* has decreased along the period of 2007-2015.

CONCLUSIONS

Barbus meridionalis Risso, 1827 is one of the fish species of valuable preservation responsibility within the Vișeu Basin, one of the isolated areas in Northern Romania. The status of aquatic ecosystems naturally inhabited by *Barbus meridionalis*, within the Maramureș Mountains Nature Park, oscillates in the best cases among good (27.78% of the lotic sampled sections with *Barbus meridionalis*), average (51.85%), and reduced (20.37%). Excellent conservation status is now missing for populations of this species in the studied basin.

The determined human impact types (organic pollution, poaching and mining activities pollution), diminish the *Barbus meridionalis* habitat's ecologic state and as a result the studied fish species populations, are under their natural potential.

Barbus meridionalis has permanent populations in the studied area, but in their natural potential, in comparison with historical data due to last half of a century, human impact is not fulfilled in terms of aquatic habitat quality and abundance of the studied fish species individuals; in the Vișeu in the upper and middle sectors, the statuses vary from upstream to downstream from reduced to average, and in the middle and lower sectors, the statuses vary from average to good. The sampling sections of the Repedea River fall under the good status, Vaser River is under the average status, Novăț Stream is also under the average status, the Ruscova River is under the average status, and the Frumuseaua River is under the average-reduced status. The habitats of this fish species are large enough as total surface, with relatively good lotic connections within the studied basin to preserve the present ecological state of the Mediterranean barbell species populations.

Based on this research, *Barbus meridionalis* is a relatively common fish species in the Vișeu River basin, and there, where it is at its natural potential in the present, a restoration potential is not difficult to be reached (upper-middle Vișeu River, Vaser River, Novăț Stream, Ruscova River, and Frumuseaua River).

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