

## Fish communities of the small rivers of Turda and Tureni Gorges

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**SUMMARY.** In 2014 the fish fauna of watercourses from the following two Natura 2000 SCIs were investigated: Tureni Gorge (ROSCI0034) and Turda Gorge (ROSCI0035). The research focused on fish species of community interest (Habitats Directive, Annex II), their position in the ichthyocoenose (numerical abundance, biomass, ecological significance and IBI). Ten fish species were captured in the investigated SCI Rivers, half of them being fish species of community interest present in Annex II of the Habitats Directive.

**Keywords:** abundance, biomass, fish ecological parameters

### Introduction

The Tureni Gorge (ROSCI0034) includes a small SCI area with a total surface of 134 ha, out of which aquatic surfaces represent less than 1%. The area has a small number of habitats (according to standard Natura 2000 Form), crisscrossed by the small Valea Racilor River. The Tureni Gorge protected area is the result of karst phenomena manifested in Jurassic limestone (tithonic) located at the contact of the Trascău Mountains with the Turda-Alba Iulia Depression (part of the Transylvanian Basin). The appearance of the area is that of a karst canyon, V-shaped, with limestone walls rising between 20 meters (in Tureni quarry right at the entrance to the gorge) and 105 meters high within the gorge. The distance between the walls increases in the second half of the gorge, reaching 160 meters at the exit towards the Copăceni locality. The length of the watercourse of the Valea Racilor River is 1850 meters.

The Turda Gorge (ROSCI0035) has been recognized since 1938 as a natural reserve of national importance following the proposal of Professor Alexandru Borza. Within a relatively small area (324 ha), it hosts primarily scientific treasures – of botanical, zoological, ecological, geological, historical and spelunking value. The

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Turda Gorge protected area is located 7 km west of Turda locality, on the eastern edge of the Trascău Mountains along the Hășdate River watercourse (tributary of the Arieș River). The Turda Gorge is an epigenetic gorge consisting of limestone of Jurassic age, its walls reaching 300-320 meters above the current level of the Hășdate River, mostly very steep, almost vertical. It contains interesting endokarstic phenomena (caverns, caves), which mark the landscape value of this area.

All Romanian SCIs jointly contain 26 fish species of community interest (Tatole *et al.*, 2009) in accordance with the Habitats Directive 1992 and Law 49/2011 completing O.U.G. 57/2007, but in both studied SCIs just 1 species of community interest was present in Natura 2000 Standard Form: *Cobitis taenia* (*C. elongatoides*) (Nalbant, 1993; 1994; 2003), in accordance with the nomenclature adopted under the Habitats Directive species lists.

Both of the small rivers (Hășdate River in the Turda Gorge and Valea Racilor River in the Tureni Gorge) are tributaries to the Arieș River which discharges in the Mureș basin (part of the Transylvanian basin) that belongs to the Danube basin.

Some historical data about fish fauna are found in Bănărescu (1964), but only for the Hășdate River (with 6 fish species found: *Cobitis taenia*, *Barbus meridionalis*, *Barbatula barbatula*, *Gobio obtusirostris*, *Squalius cephalus* and *Phoxinus phoxinus*). Fish data is lacking from the Valea Racilor River, which confers greater importance to this paper - especially for future studies.

## Materials and methods

Investigations were conducted during July 2014 in both of the studied Natura 2000 SCIs: ROSCI0034 Tureni Gorge and ROSCI0035 Turda Gorge.

Due to the rivers being small in the studied area, only electrofishing was used for sampling with a SAMUS 725MP device using a 12V accumulator and 5-60 Amps with an output of 600 W. The electrofishing was carried out during the day in 2 sampling sites for Tureni Gorge and 3 for Turda Gorge (Table 4). The fish fauna community was assessed, especially the presence of species of community interest (Directive Habitats, Annex II), quantitative structure (numerical abundance, biomass), ecological indices (Table 1), IBI (biological integrity index) (Table 2, Table 3), specimen dimensions, overall status of aquatic habitats in terms of existing anthropogenic pressures.

The captures were sorted by species (fish species identification using Bănărescu, 1964 with updates after Bănărescu, 1994; 2004; Nalbant, 2003; Lelek 1987; Kottelat, 1997; Kottelat and Freyhof, 2007; Froese and Pauly, 2016) weighing and length measurement were performed. The numerical abundances and biomass were determined for each species and site, in order to find the status of species in the fish community, using CPUE (“Catch per Unit Effort”, means individuals / hour or individuals / 100 m<sup>2</sup>). After field measurements, the remaining individuals were released into the river. Human impact was also estimated.

**Table 1.**

Quantitative population indices  
(Botnariuc and Vădineanu, 1982, Gomoiu and Skolka, 2001, Muhlenberg, 1993, Odum, 1975, Sârbu and Benedek, 2004, Schwerdtfeger, 1975, Simionescu, 1984, Şindriliariu *et al.*, 2002)

Dominance (D)			Constancy (C)		Ecological significance (W)	
Class		%	Class	%	Class	%
sporadic	D1	<1	very rare	C1=0-10	accidental	W1< 0.1
subrecedent	D2	1 (2 <sup>0</sup> ) - <2	rare	C2=10.1-25	accessory	W2=0.1-1
recedent	D3	2 (2 <sup>1</sup> ) - <4	widespread	C3=25.1-45	associate	W3=1-5
subdominant	D4	4 (2 <sup>2</sup> ) - <8	frequent	C4=45.1-70	complementary	W4=5-10
dominant	D5	8 (2 <sup>3</sup> ) - 16	very frequent	C5=70.1-100	characteristic	W5=10-20
eudominant	D6	>16 (2 <sup>4</sup> )			main, leading	W6>20

**Table 2.**

Criteria for determining fish IBI  
(Ureche, 2008 after Battes, 1991, Karr, 1986 and Miller, 1985)

PARAMETERS CATEGORIES	PARAMETER	EVALUATION INTEGRITY CLASS		
		5	3	1
Composition and abundance of species	1. Total number of fish species	> 90% (abund.)	50-90 % constant	<50% (rare)
	2. Total number of cyprinids	> 45%	20-45%	<20%
	3. Total number of salmonids	> 5%	1-5%	<1%
	4. Others fish species	> 20%	5-20%	<5%
	5. Total number of native fish species	> 68%	35-67%	<34%
	6. Total number of non-native species	<1%	1-10%	>10%
	7. Total number of disappearing fish species	<1%	1-10%	>10%
Composition of the food fish populations	8. Proportion of zoobenthivorous species	> 45%	20-45%	<20%
	9. Proportion of carnivore species	> 5%	1-5%	<1%
	10. Proportion of carnivore and planctivorous	<20%	20-45%	>45%
	11. Proportion herbivorous and detritivores	<25%	25-50%	>50%
Stock and general state of fish populations	12. Numerical Stock (ex./100 m <sup>2</sup> )	> 100 ex (>20 ex)	10-100 (5-20)	<10 (<5)
	13. Gravimetrical Stock (g/100 m <sup>2</sup> )	> 1000 g (>5000 g)	100-1000 (500-5000)	<10 (<5)
	14. Proportion of hybrid individuals	0%	0-1 %	> 1%
	15. Proportion of ill individuals	0%	0-1 %	> 1%

Some specimens were collected and preserved in liquid for more detailed taxonomical analysis for species for which correct identification was doubtful, according to the latest systematic reviews. Water temperature was identified using an electronic thermometer, water depth and turbidity with a Secchi disk, and geographic coordinates with GPS Garmin e-trex 30 (Table 4).

**Table 3.**

Framing levels of the evaluation integrity degree in fish ecosystems  
(Ureche 2008 after Battes, 1991, Karr 1986 and Miller, 1985)

No.	APRECIATION	SCORE		EVALUATION INTEGRITY CLASS	
		Small rivers (Miller A, 1985)	Medium and big rivers and reservoirs		
			Karr J. R. & Co., 1986	Battes K. W., 1991	
1	Excellent	37-40	57-60	70-75	I
2	Excellent-good	34-36	53-56	66-69	II
3	Good	30-33	48-52	59-65	III
4	Moderate-good	28-29	45-47	55-58	IV
5	Moderate	23-27	39-44	47-54	V
6	Poor-Moderate	21-22	36-38	43-46	VI
7	Poor	16-20	28-35	35-42	VII
8	Poor-Very low	12-15.	24-27	20-34	VIII
9	Very low	<12	<23	<20	IX

## Results and discussion

In the Turda Gorge, 3 sites were sampled between 46.56946° - 46.5611° lat. N and 23.69058° - 23.6675° long. E, with water depths less than 70 cm, turbulent water, a 20°C water temperature and the bottom mostly boulders and stones, with only stones upstream (Table 4).

In the Tureni Gorge 2 sites were sampled between 46.60455° - 46.36556° lat. N and 23.71501° - 23.42361° long. E, with water depths less than 100 cm, clear water, 20°C water and the bottom mostly boulders and stones, rarely mud (Table 4).

In the summer of 2014, 10 fish species were captured, including 5 species of community interest and 4 according to Natura 2000 Standard Form, meaning *Barbus meridionalis* (present in Romania after Kotlik *et al.*, 2002, Iftime 2004, Antal *et al.*, 2015), *Romanogobio (Gobio) kessleri*, *Romanogobio vladykovi (Gobio albipinnatus)* and *Rhodeus amarus* added. A usually common species for 2014 catches and Natura 2000 Standard Form (2007) is *Cobitis taenia*, which was absent in the Turda Gorge (Table 5). It is hard to say what caused *C. taenia* to be missing from the Turda Gorge. The fact that *Phoxinus phoxinus* was also absent indicates that there may be some negative impact affecting these two species. Other possibilities might be bad sampling time for those species or that they could not be observed in turbulent waters (0.6-0.8 in T/D report in Table 4).

**Table 4.**

Geographic coordinates and some physical parameters  
from the sampled points of the Turda and Tureni Gorges

SITE CODE		GEOGRAPHIC COORDINATES		DATE	Beginning time hour	Working Time (h:minutes)	Surface of fishing (m <sup>2</sup> )	BOTTOM	T°C water	WATER DEPTH (D) (cm)	TRANSPARENCY (T) (cm)	T/D
Tureni14E2	Tureni14E1	46.60455°	46.36556°	15.07.2014	13:30	0:15	25.00	boulders and stones, rarely mud	20	100	100	1.0
		23.71501°	23.42361°	15.07.2014	10:00	0:15	25.00	boulders and stones, rarely mud	20	50	50	1.0
Turda14E2	Turda14E1	46.5611°	46.56946°	16.07.2015	12:30	0:15	25.00	boulders and stones	20	40	30	0.8
		23.69058°	23.6675°	16.07.2015	14:30	0:15	25.00	stones	20	50	30	0.6
Turda14E1	Turda14E1	46.56352°	46.56946°	16.07.2015	11:00	0:15	25.00	boulders and stones	20	70	50	0.7
		23.68709°	23.6675°	16.07.2015	11:00	0:15	25.00	boulders and stones	20	70	50	0.7

Table 5.

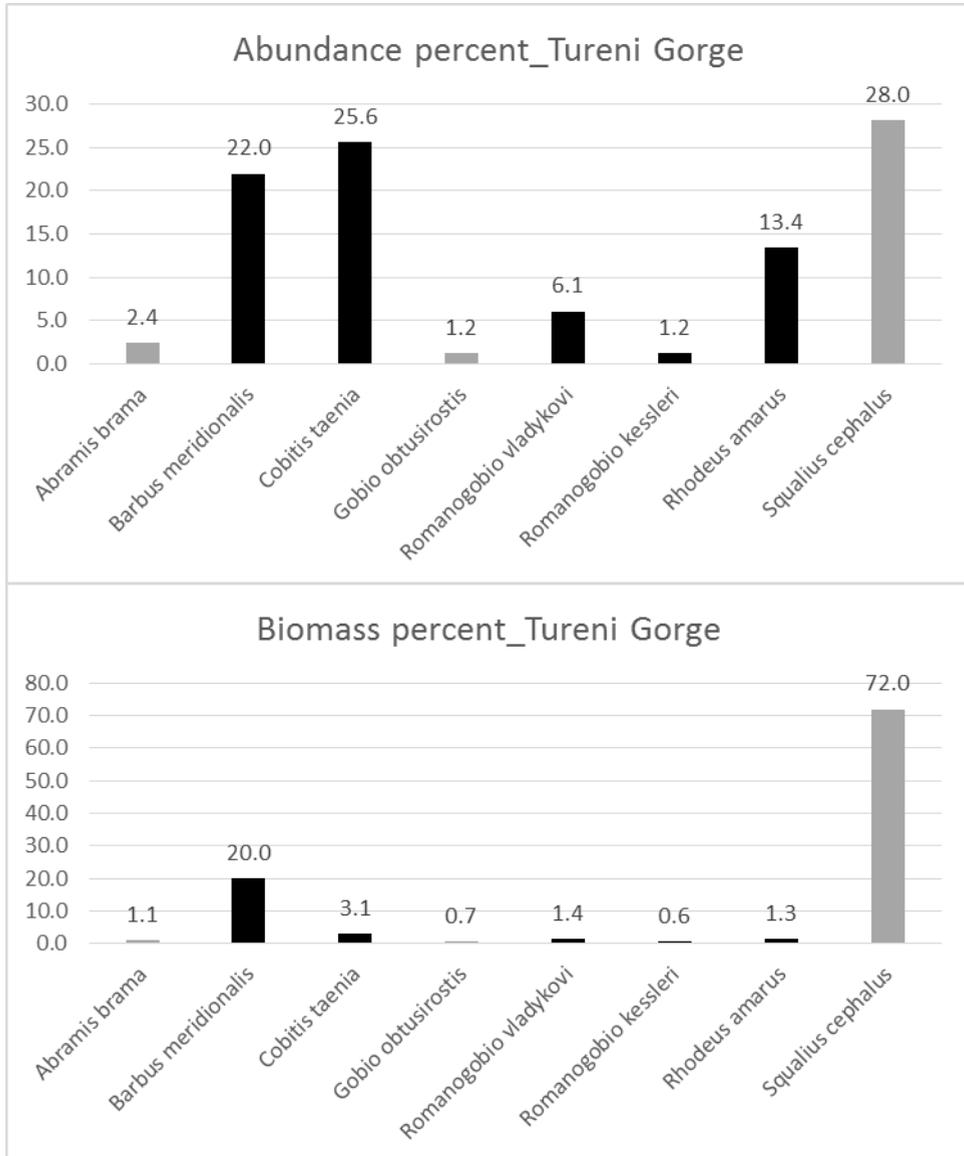
Species richness in both studied Romanian SCIs  
 (1=presence species, bold are species of community interest)  
 Legend: carn=carnivorous, erb=herbivorous, zoobent= zoobenthivorous,  
 ihti-ichthyvorous (piscivorous), omni=omnivorous, detrit=detritivores

No.	Species	Feed	Bănărescu 1964	Tureni Gorge	Turda Gorge
1	<i>Abramis brama</i>	Zoobent		1	
2	<i>Alburnoides bipunctatus</i>	Omni, zoobent			1
3	<i>Barbatula barbatula</i>	Zoobent, detrit	1		1
4	<b><i>Barbus meridionalis</i></b>	<b>Zoobent</b>	<b>1</b>	<b>1</b>	<b>1</b>
5	<b><i>Cobitis elongatoides</i> (<i>Cobitis taenia</i>)</b>	<b>Omni, zoobent,</b>	<b>1</b>	<b>1</b>	
6	<i>Gobio obtusirostis</i>	Omni, zoobent	1	1	
7	<i>Phoxinus phoxinus</i>	zoobent	1		
8	<b><i>Romanogobio vladykovi</i> (<i>Gobio albipinnatus</i>)</b>	<b>Omni, zoobent</b>		<b>1</b>	<b>1</b>
9	<b><i>Romanogobio kesslerii</i> (<i>Gobio kessleri</i>)</b>	<b>Omni, zoobent</b>		<b>1</b>	<b>1</b>
10	<b><i>Rhodeus amarus</i></b>	<b>erb</b>		<b>1</b>	<b>1</b>
11	<i>Squalius cephalus</i>	Carn, ihti	1	1	1
	TOTAL		6	8	7
	<b>Community Interest Species</b>		<b>2</b>	<b>5</b>	<b>4</b>

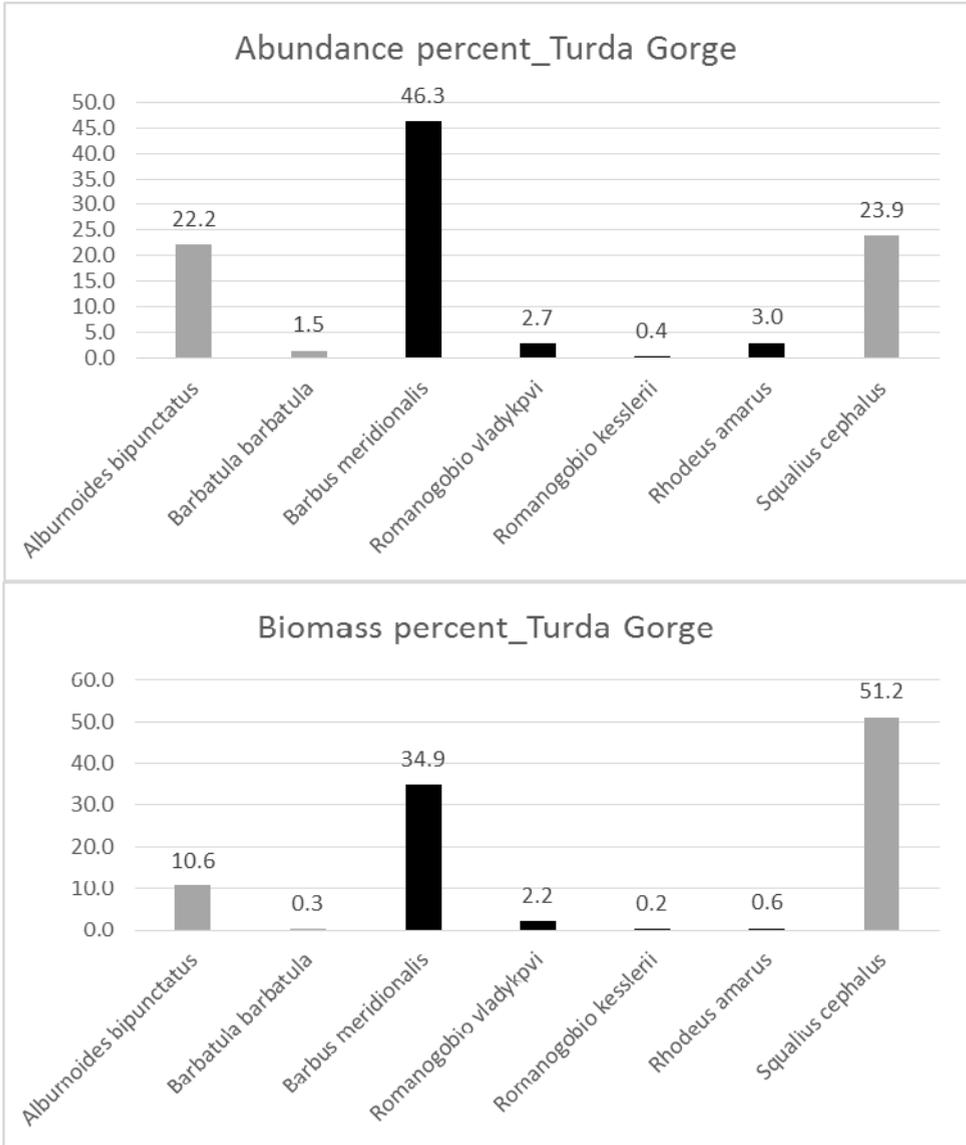
Fish abundance and biomass are presented in percentages in Fig. 1 and Fig. 2 for each studied SCIs.

In the Tureni Gorge in the Valea Racilor River *S. cephalus* is numerically dominant, while two fish species of community interest, *C. taenia* and *B. meridionalis*, are also with high values, but in biomass *S. cephalus* is far ahead of *B. meridionalis* and others species (Fig. 1).

In the Turda Gorge in the Hășdate River *B. meridionalis* is numerically dominant, followed by *S. cephalus* and *A. bipunctatus*, but in biomass *S. cephalus* is far ahead of *B. meridionalis* and *A. bipunctatus* (Fig. 2).



**Figure 1.** Fish abundance (top figure) and biomass (bottom figure) percentages from ROSCI0034 Tureni Gorge (black columns are fish species of community interest)



**Figure 2.** Fish abundance (top figure) and biomass (bottom figure) percentages from ROSCI0035 Turda Gorge (black columns are fish species of community interest)

#### ROSCI0034 Tureni Gorge

The fish fauna from this SCI is composed of 8 fish species including the presence of 5 species of community interest, versus SCI Standard Form only with *Cobitis taenia*. The fish fauna is dominated in abundance and biomass by *Barbus meridionalis*,

*Cobitis taenia* and *Squalius cephalus* (Fig. 1). This SCI River is affected mostly by tourists and pollution from households but with a small negative impact.

#### ROSCI0035 Turda Gorge

In this SCI 7 fish species were captured, including 4 species of community interest. The newly captured species were *Barbus meridionalis*, *Romanogobio kessleri*, *R. vladykovi* and *Rhodeus amarus* compared with existing Standard Form of SCI with *Cobitis taenia* which wasn't found during the sampling period. The fish fauna is dominated in abundance by *Barbus meridionalis*, *Squalius cephalus* and *Alburnoides bipunctatus* (Fig. 2). Regarding anthropogenic impacts, disturbances are caused mostly by angling, tourists and sheepfolds (sheep enter the water to drink and disturb water quality), with a small to medium negative impact.

The ichthyocoenosis from the Valea Racilor River of Tureni Gorge is characterized by the main, eudominant species *S. cephalus*, but an accidental fish species is *Abramis brama* (Table 6).

The ichthyocoenosis from the Haşdate river of Turda Gorge is characterized by the main, eudominant species *S. cephalus*, *B. meridionalis* and *A. bipunctatus*, no fish species is accidental, but most are accessory-associate fish species (Table 6).

**Table 6.**

Ecological significance from the rivers of the Tureni and Turda Gorges

No.	Species	Tureni Gorge			Turda Gorge		
		D class	C class	W class	D class	C class	W class
1	<i>Abramis brama</i>	D2	C2	W1			
2	<i>Alburnoides bipunctatus</i>				D6	C5	W6
3	<i>Barbatula barbatula</i>				D2	C4	W3
4	<i>Barbus meridionalis</i>	D6	C3	W5	D6	C5	W6
5	<i>Cobitis taenia</i>	D6	C4	W6			
6	<i>Gobio obtusirostis</i>	D2	C2	W2			
7	<i>Romanogobio vladykovi</i>	D4	C4	W3	D3	C3	W2
8	<i>Romanogobio kessleri</i>	D2	C4	W2	D1	C2	W2
9	<i>Rhodeus amarus</i>	D5	C5	W5	D3	C3	W3
10	<i>Squalius cephalus</i>	D6	C5	W6	D6	C5	W6

According to IBI the scores for both studied areas are classified as good (Table 3) mean values are 63 for Turda Gorge and 61 for Tureni Gorge in evaluation marks class III (Table 7).

Table 7.

IBI results for fish fauna from the rivers of the Tureni and Turda Gorges

Category	Parameter	Evaluation marks	
		Turda	Tureni
Composition and abundance of species	1	5	5
	2	5	5
	3	1	1
	4	3	3
	5	5	5
	6	5	5
	7	5	5
Food composition for fish populations	8	5	5
	9	5	5
	10	1	1
	11	3	3
Stock and general state of fish populations	12	5	3
	13	5	5
	14	5	5
	15	5	5
SCORE		63	61
Appreciations		Good	Good
Evaluation integrity class		III	III

## Conclusions

In 2014, in both the Tureni and Turda Gorge SCIs, 10 fish species were captured - including 5 species of community interest. Four more species of community interest were captured: *Barbus meridionalis*, *Rhodeus amarus*, *Gobio (Romanogobio) kessleri* and *Gobio albipinnatus (R. vladikovy)* versus Natura 2000 Standard SCI Form, which had only one species *Cobitis taenia*. The species of community interest *Cobitis taenia* was found only in the Tureni Gorge, absent in the Turda Gorge. Fish abundance and biomass are both dominated by *Barbus meridionalis* and *Squalius cephalus*, with small differences between sites. Turda Gorge is closer to the Trascău mountains proven by the presence of submountain fish species in the area like *Barbatula barbatula* and *Alburnoides bipunctatus*, also in the past was present *Phoxinus phoxinus*. Anthropogenic influence occurs only with low to medium negative impact represented by angling, tourism, household pollution and sheepfolds in the neighborhood that disturb water quality. Fish associations are represented by the main species *S. cephalus* and *B. meridionalis* with small differences between sites, and an accidental species, *Abramis brama*. Ichthyocoenosis for both the small rivers studied are less affected, appreciation category is good and with class III Evaluation marks according to IBI.

### Acknowledgements

The data provided for this paper were made within the project of biodiversity inventory for Natura 2000 SCIs Tureni and Turda Gorges named “Conservation and participatory management of Natura 2000 SCIs Turda and Tureni Gorges” financed by County Council of Cluj and the paper is an opportunity to show our gratitude. Also our thanks to DDNIRD driver (Dragan Cornel) even for field work help in summer of 2014.

### REFERENCES

- Antal, L., László, B., Kotlík, P., Mozsár, A., Czeglédi, I., Oldal, M., Kemenesi, G., Jakab, F., Nagy, S. A. (2015) Phylogenetic evidence for a new species of *Barbus* in the Danube River basin. Elsevier, *Molecular Phylogenetics and Evolution* **96**, 187–194
- Battes, K. W. (1991) Acvacultură, prezent și perspectivă. *Ecologia et Aquac. Limnica*, **2** **11**, 337–425
- Bănărescu, P. (1964) Fauna R.P.R., Vol. XIII. *Pisces-Osteichthyes*. Ed. Academiei R.P.R., București, pp 962
- Bănărescu, P. (1994) The present-day conservation status of the freshwater fish fauna of Romania. In: *Ocrotirea naturii și mediului înconjurător*, Acad. Rom. Tom **38**, No 1, 1–16
- Bănărescu, P. (2004) Situația actuală a ihtiofaunei de apă dulce a României sub aspect faunistic, taxonomic și al protecției. *Studia Universitatis Vasile Goldiș Arad, Seria Științele Vieții*, **14**, 43–49
- Botnariuc, N., Vădineanu, A. (1982) *Ecologie*, Edit. Did. și Ped., București, pp. 359 – 418 (Anexele 1 – 12) (In Romanian)
- Iftime, A. (2004) Preliminary data on the distribution of two twin species of the genera *Barbus* (Pisces: Teleostei: Cyprinidae) in Southern Romania. *Travaux du Museum Nationale d'Histoire Naturelle „Grigore Antipa”*, Vol. XLVII, București, 263–268
- Froese, R., Pauly, D. (eds.) (2016) FishBase. World Wide Web electronic publication. [www.fishbase.org](http://www.fishbase.org), version (08/2016)
- Gomoiu, M. T., Skolka, M. (2001) *Ecologie. Metodologii pentru studii ecologice*, Ovidius University Press, Constanța (In Romanian), pp. 170
- Karr, J. R., Fausch, K. D., Angermeier, P. L., Yant, P. R., Schlosser, I. J. (1986) Assessing biological integrity in running waters: a method and its rationale, *Illinois Natural History Survey, Special Publication* **5**, pp. 28
- Kotlík, P., Costas, S., Tsigenopoulos, C., Rab, P., Berrebi, P. (2002) Two new *Barbus* species from the Danube River basin, with redescription of *B. petenyi* (Teleostei: Cyprinidae) *Folia Zool.* **51**(3), 227–240
- Kottelat, M. (1997) European freshwater fishes: a heuristic checklist of the freshwater fishes of Europe (exclusive of former USSR), with an introduction for non-systematists and comments on nomenclature and conservation, *Biologia (Bratislava)*, **52** (Supplement 5), pp. 271
- Kottelat, M., Freyhof, J. (2007) *Handbook of European Freshwater Fishes*, Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany, pp. 464

- Lelek, A. (1987) *The Freshwater Fishes of Europe*, Vol. 9, Threatened Fishes of Europe, Aula-Verlag Wiesbaden, pp. 343
- Miller, D. L. (1985) Technological thinking: its impact on environmental management, *Environmental Management*, **9**, 179-190
- Mühlenberg, M. (1993) *Freilandökologie*, 3. überarbeitete Auflage. - UTB für Wissenschaft 595, Quelle & Meyer, Heidelberg, Wiesbaden, pp. 512
- Nalbant, T. (1993) Some problems in the systematics of the genus *Cobitis* and its relatives (*Pisces, Ostariophysi, Cobitidae*), *Revue Roumaine de Biologie, Serie Biol. Animale*, Tome 38, 2: 101-110
- Nalbant, T. (1994) Studies on loaches (*Pisces: Ostariophysi: Cobitidae*). I, An evaluation of the valid genera of *Cobitinae*, *Trav. Mus. Hist. Nat. "Grigore Antipa"*, **XXXIV**, 375-380
- Nalbant, T. (2003) Checklist of the fishes of Romania. Part one: freshwater and brackishwater fishes, *Studii și Cercetări, Biologie*, **8**, Universitatea Bacău, 122-127
- Nowak, M., Koščo, J., Popek, W. (2008) Review of the current status of systematics of gudgeons (*Gobioninae, Cyprinidae*) in Europe, *AACL Bioflux*, **1**, 27-38
- Odum, E. P. (1975) *Ecology: The link Between the Natural and the Social Sciences. Second Edition*, A Holt International Edition, pp. 244
- Sârbu, I., Benedek, A. M. (2004) *Ecologie practică*, Edit. Univ. „Lucian Blaga”, Sibiu, pp. 260 (In Romanian)
- Schwerdtfeger, F. (1975) *Ökologie der Tiere Band 3: Synökologie*, Paul Parey Verlag. Hamburg, Berlin
- Simionescu, V. (1984) *Lucrări practice de ecologie*, Litogr. Univ. Al. I. Cuza, Iași, pp. 193 (In Romanian)
- Șindrilariu, P. D., Bacalbașa-Dobrovici, N., Freyhof, J., Wolter, C. (2002) The juvenile fish community of the Lower Danube and Danube Delta, In: Brezeanu G., Știucă R. (eds.), *Internat. Assoc. Danube Res.*, **34**, 517 – 526
- Tatole, V., Iftime, A., Stan, M., Iorgu, E. -I., Oțel, V. (2009) *Speciile de animale Natura 2000 din România*, București, pp. 60-86
- Ureche, D. (2008) *Studii ecologice asupra ihtiofaunei în bazinul mijlociu și inferior al râului Siret*, Edit. PIM, Iași, pp. 223 (In Romanian)
- \*\*\* (1992) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and wild fauna and flora (Habitats Directive), In: Official Journal of the European Union, vol.: L206 (published on 22nd of July 1992), 7 – 50, Luxembourg, last update: 2007
- \*\*\* (2007) Ordonanța de Urgență a Guvernului nr. 57 din 20 iunie 2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei și faunei sălbatice. IN: Monitorul Oficial al României, Partea I, anul 175 (XIX), nr. 442 (29 iunie 2007), pag. 1-32, București, Romania
- \*\*\* (2011) Legea nr. 49 din 7 aprilie 2011 pentru aprobarea Ordonanței de urgență a Guvernului nr. 57/2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei și faunei sălbatice. IN: Monitorul Oficial al României, Partea I, anul 179 (XXIII), nr.262 (13 aprilie 2011), pag. 2-12, București, Romania
- \*\*\* (2011) Ordin al Ministrului Mediului și Pădurilor nr. 2387 / 29 IX 2011 pentru modificarea Ordinului Ministrului Mediului și Dezvoltării Durabile nr. 1964/13 XII 2007 privind instituirea regimului de arie naturală protejată a siturilor de importanță comunitară, ca parte integrantă a rețelei ecologice europene Natura 2000 în România. IN: Monitorul Oficial al României, Partea I, anul 179 (XXIII), nr.864 (din 29 noiembrie 2011), pagina 11, București, Romania