

ICHTIOGENOSIS STRUCTURE OF AGRIȘ AND ALMAȘ RIVERS (SĂLAJ CONTY)

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ABSTRACT: Agraș and Almas Rivers are tributaries of the Someș River from Salaj County. Both rivers originate from the North slope of Meseș Montain and flows into the Someș River, near the Jibou town. Both are rivers with a relatively natural state, less affected by anthropogenic factors, exceptions are endangered areas where were built longitudinal dams for flood protection. So far, on these rivers there were no ichthyological research conducted. Based on the collected material we performed a complex comparative evaluation of ichtiocenosis of this two rivers and due to their considerable value, we proposed the establishment of a protected area encompassing the entire basin of these rivers.

Keywords: ecological guild, reproductive guild, spread in Romania, distribution change, abundance, status, frequency, constancy, dominance, diversity index

MATERIALS AND METHODS:

During 9-10 September 2014 there were performed five collection points on Agraș River, and on the river Almas were performed four collection points. (Fig. 1).

There were captured and determined 1615 fish specimens, identifying a total of 16 species, 14 in each river (Table 1). All specimens caught were released alive to the site collection after determination.

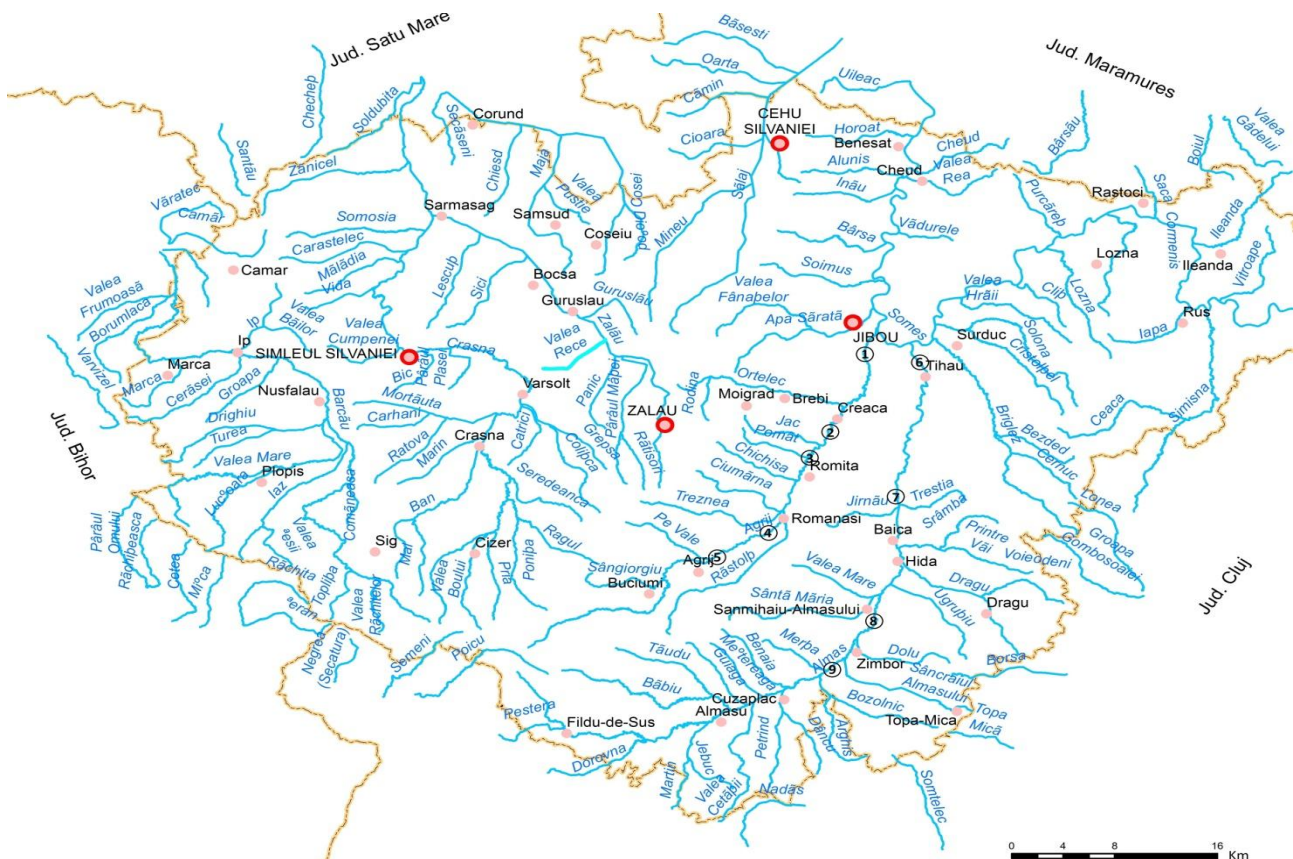


Fig. 1. Collection points on Agraș and Almas Rivers (marked with red circles)

Data processing was done by the principles proposed by Bănărescu (1964) and by the methods recommended by Pricope et al. (2004). Ecological

guilds were established based on the Spindler (1997) and Sallai (2002) scientific papers, and the reproductive guilds after Balon (1975).

Table 1
The number of collected fish specimens

Fishing points		Agiş						Almaş						
		1	2	3	4	5	Total	1	2	3	4	Total		
Nr.	Fish species													
1	<i>Leuciscus leuciscus</i>	1	2	2			5	1				1		
2	<i>Squalius cephalus</i>	79	72	72	33	50	306	72	22	108	103	305		
3	<i>Aspius aspius</i>		1	1			2							
4	<i>Alburnus alburnus</i>	13	5			1	19	50	6	3	8	67		
5	<i>Alburnoides bipunctatus</i>	17	4	6	16	1	44	14	2	1		17		
6	<i>Chondrostoma nasus</i>			8			8	6				6		
7	<i>Barbus barbus</i>							15				15		
8	<i>Barbus carpathicus</i>	95	51	45	103	115	409	13	15	57	56	141		
9	<i>Gobio carpathicus</i>	6		5		2	13	2	3	7	9	21		
10	<i>Romanogobio kesslerii</i>	7	7	12		2	28	1	1	7		9		
11	<i>Pseudorasbora parva</i>	2		1		1	4	1	1			2		
12	<i>Rhodeus amarus</i>	26	2	1			29		7			7		
13	<i>Carassius gibelio</i>										1	1		
14	<i>Sabanejewia balcanica</i>		1		5	3	9		6	7	40	53		
15	<i>Barbatula barbatula</i>			6		4	10	1	68	13		82		
16	<i>Perca fluviatilis</i>	1		1			2							
		Total						888	Total					727

To species spread în Romania (R. Ro - range in Romania) Bănărescu (1964) establishes the categories: generalized (w-wide), geographically restricted (gr-Geographically restricted) and ecologically restricted (er - ecologically restricted), and for modification and characterization spread categories (re - range evolution): increasing (exp - in expansion), in regress (r - in regress) and constant (c - unchanged). Variation abundance may be increasing (i - increased), decreased (d - decreased) or stable (c - constant). Based on these values are considered extinct species (ext - extinct), highly endangered (s.th - strongly threaten), endangered (th - threaten), vulnerable (vu - vulnerable), less vulnerable (l.vu - little vulnerable) and not endangered (S - Safe).

Species frequency (F) has been calculated using the formula: $F = \frac{P}{P_t} \cdot 100$, P = number of samples where the species is found and P_t = total samples.

Constant (C) is expressed as a percentage and degree of frequency of species is considered as constant, accessory and accidental.

Dominant (D) indicates the ratio between number of species compared to the total number of specimens, according to the relation $D = \frac{nA}{N} \cdot 100$, where nA is the

number of species A and N the total number of fish in cenosis. The species can be eudominant, dominant, subdominant, recedent and subrecedent.

Ecological significance index (W) was calculated using the formula $W = \frac{C \cdot D}{10000} \cdot 100$, fish species are divided into categories: ruling characteristic complementary associates and accidental.

Diversity index (Shannon-Weaver) was calculated using the formula $H' = \sum_{i=1}^S P_i \cdot \ln P_i$, where S = number of species, and P_i = number of representation of each species in cenosis.

RESULTS AND DISCUSSION:

Regarding the ecological guilds, 8 species belong to A reofil category, 3 species belong to B reofil category and only 3 are eurytop species. Therefore, the dominant species are the species adapted to mountainous and foothill fast flowing waters. Repartition on reproductive guilds denotes that 7 are species litofile species, 2 are psamofil species, and only two species are phyto-litofil and 4 fitofil; most choose the substrate so fast nude in the rivers where aquatic vegetation is low (Table 2).

Table 2
Ecological and reproductive guilds of fishes

	Fish species	Ecological guild	Reprod. guild
1	<i>Leuciscus leuciscus</i>	reofil A	fito-litofil
2	<i>Squalius cephalus</i>	reofil A	litofil
3	<i>Aspius aspius</i>	reofil B	litofil
4	<i>Alburnus alburnus</i>	euritop	fito-litofil
5	<i>Alburnoides bipunctatus</i>	reofil A	litofil
6	<i>Chondrostoma nasus</i>	reofil A	litofil
7	<i>Barbus barbus</i>	reofil A	litofil
8	<i>Barbus carpathicus</i>	reofil A	litofil
9	<i>Gobio carpathicus</i>	reofil B	psamofil
10	<i>Romanogobio kesslerii</i>	reofil A	psamofil
11	<i>Pseudorasbora parva</i>	exotic	litofil
12	<i>Rhodeus amarus</i>	euritop	ostracofil
13	<i>Carassius gibelio</i>	euritop	fitofil
14	<i>Sabanejewia balcanica</i>	reofil B	fitofil
15	<i>Barbatula barbatula</i>	reofil A	fitofil
16	<i>Perca fluviatilis</i>	euritop	fitofil

From the point of view of the spread in Romania, from 14 native species, 11 has a general spread, *Leuciscus leuciscus* has a limited ecological distribution and *Romanogobio kesslerii* and *Sabanejewia Balkan* has a geographically limited spread.

In increasing spread, 7 species have spread constant, and only 4 are expanding, and only 3 (*Leuciscus leuciscus*, *Barbus Barbus*, *Romanogobio kesslerii*) are in decline. The numerical evolution shows a similar picture: 6 species were abundant

constance, 5 were effective in increasing and the 3 species mention already are in decline spread and decreasing number.

Ecological status of 12 species seems to be satisfactory. Only *Romanogobio kessleri* appears to be vulnerable, and *Leuciscus leuciscus*, is considered by Bănărescu to be extended (Table 3). With this latest assessment we can not but agree, since in most waters of the North-West of Romania studied by us, the species was present, indeed, in a small number.

Table 3
The range in Romania, range evolution, abundance evolution and status of fish species (after Bănărescu)

	Fish species	R. Ro	r.e	ab	St
1	<i>Leuciscus leuciscus</i>	e.r	r	d	ext
2	<i>Squalius cephalus</i>	w	exp	i	S
3	<i>Aspius aspius</i>	w	c	c	S
4	<i>Alburnus alburnus</i>	w	exp	i	S
5	<i>Alburnoides bipunctatus</i>	w	c	c	S
6	<i>Chondrostoma nasus</i>	w	c	c	S
7	<i>Barbus barbus</i>	w	r	d	S
8	<i>Barbus carpathicus</i>	w	c	c	S
9	<i>Gobio carpathicus</i>	w	exp	i	S
10	<i>Romanogobio kesslerii</i>	g.r	r	d	vu
11	<i>Pseudorasbora parva</i>				
12	<i>Rhodeus amarus</i>	w	exp	i	S
13	<i>Carassius gibelio</i>				
14	<i>Sabanejewia balcanica</i>	g.r	c	c	S
15	<i>Barbatula barbatula</i>	w	c	c	S
16	<i>Perca fluviatilis</i>	w	c	i	S

We found a great abundance in both rivers in all collection points for species *Squalius cephalus* and *Barbus carpathicus*. From Agraş River is missing *Barbus barbus* și *Carassius gibelio*, and from Almaş, is missing *Aspius aspius* and *Perca fluviatilis*. A zonal presence of species *Aspius aspius*, *Rhodeus amarus*,

Barbus Barbus and *Perca fluviatilis*, it is found only in the lower, near Someș, occasionally rises from the main stream river's to its tributaries. A low abundance and presence of *Leuciscus leuciscus*, *Chondrostoma nasus*, *Carassius gibelio* (Table 4) was found only in certain points of the rivers.

Table 4

Numerical abundance of species in samples from Agraş și Almaş

Nr.	Fish species	Agraş					Almaş			
		1	2	3	4	5	6	7	8	9
1	<i>Leuciscus leuciscus</i>	0,40	1,37	1,33			0,58			
2	<i>Squalius cephalus</i>	32,11	49,65	48,00	21,01	27,47	41,86	17,74	52,94	47,68
3	<i>Aspius aspius</i>		0,68	0,66						
4	<i>Alburnus alburnus</i>	5,28	3,44			0,54	29,06	4,83	1,47	3,70
5	<i>Alburnoides bipunctatus</i>	6,91	2,75	4,00	10,19	0,54	8,13	1,61	0,49	
6	<i>Chondrostoma nasus</i>			5,33			3,48			
7	<i>Barbus barbus</i>						8,72			
8	<i>Barbus carpathicus</i>	38,61	35,17	30,00	65,60	63,18	7,55	12,09	27,94	25,92
9	<i>Gobio carpathicus</i>	2,43		3,33		1,09	1,16	2,41	3,43	4,16
10	<i>Romanogobio kesslerii</i>	2,84	4,82	8,00		1,09	0,58	1,75	3,43	
11	<i>Pseudorasbora parva</i>	0,81		0,66		0,54	0,58	1,75		
1	<i>Rhodeus amarus</i>	10,56	1,37	0,66			4,06	0,80		
13	<i>Carassius gibelio</i>								0,49	
14	<i>Sabanejewia balcanica</i>		0,68		3,18	1,64		4,83	3,43	18,51
15	<i>Barbatula barbatula</i>		4,13	4,00		2,19	0,58	54,83	6,37	
16	<i>Perca fluviatilis</i>	0,40	0,68	0,66						

Between the two rivers there are differences in the frequency. The maximum frequency in Agraş River we could find for *Squalius cephalus*, *Alburnoides bipunctatus* și *Barbus carpathicus*, and in Almaş *Squalius cephalus*, *Alburnus alburnus*, *Barbus carpathicus* and *Gobio carpathicus*. A low frequency presents *Chondrostoma nasus* in Agraş, and Almaş *Leuciscus leuciscus*, *Chondrostoma nasus*, *Barbus barbus*, *Rhodeus amarus* și *Carassius gibelio* in Almaş (Table 5).

Squalius cephalus, *Alburnoides bipunctatus*, *Barbus carpathicus*, *Gobio carpathicus*, *Romanogobio kesslerii*, *Pseudorasbora parva* și *Sabanejewia balcanica* are constant species in both rivers, while *Leuciscus leuciscus* is a constant specie in Agraş and incidental to Almaş. *Alburnus alburnus* and *Barbus barbus* are just the opposite, being constant in Almaş and accessories Agraş. *Chondrostoma nasus* is only accidental species in Agraş (Table 5).

Table 5

The frequency and consistency of fish species of Agraş și Almaş

Nr.	Fish species	Agraş		Almaş	
		Frequency	Constancy	Frequency	Constancy
1	<i>Leuciscus leuciscus</i>	60	constant	25	accessory
2	<i>Squalius cephalus</i>	100	constant	100	constant
3	<i>Aspius aspius</i>	40	constant		
4	<i>Alburnus alburnus</i>	40	constant	100	constant
5	<i>Alburnoides bipunctatus</i>	100	constant	75	constant
6	<i>Chondrostoma nasus</i>	20	accidental	25	accessory
7	<i>Barbus barbus</i>			25	accessory
8	<i>Barbus carpathicus</i>	100	constant	100	constant
9	<i>Gobio carpathicus</i>	60	constant	100	constant
10	<i>Romanogobio kesslerii</i>	80	constant	75	constant
11	<i>Pseudorasbora parva</i>	60	constant	50	constant
12	<i>Rhodeus amarus</i>	60	constant	25	accessory
13	<i>Carassius gibelio</i>			25	accessory
14	<i>Sabanejewia balcanica</i>	60	constant	75	constant
15	<i>Barbatula barbatula</i>	40	accessory	75	constant
16	<i>Perca fluviatilis</i>	40	accessory		

In the degree of dominance, most species have the same position in the two rivers, but there are some exceptions: *Alburnus alburnus* is subdominant in Agraş, dominant in Almaş; *Gobio carpathicus* is recedent in Agraş and subdominant in Almaş; *Sabanejewia balcanica* is recedent in Agraş and

dominant in Almaş, *Barbatula barbatula* is recedent in Agraş and even eudominant in Almaş. Instead, *Romanogobio kesslerii* is subdominant in Agraş, recedent in Almaş, and *Rhodeus amarus*, subdominant in Agraş, and subrecedent in Almaş (Table 6).

Table 6
Fish dominance in Agraş și Almaş

Nr.	Fish species	Agraş		Almaş	
		Value	Character	Value	Character
1	<i>Leuciscus leuciscus</i>	0,56	subrecedent	0,13	subrecedent
2	<i>Squalius cephalus</i>	34,45	eudominant	41,95	eudominant
3	<i>Aspius aspius</i>	0,22	subrecedent		
4	<i>Alburnus alburnus</i>	2,13	subdominant	9,21	dominant
5	<i>Alburnoides bipunctatus</i>	4,95	subdominant	2,33	subdominant
6	<i>Chondrostoma nasus</i>	0,90	subrecedent	0,82	subrecedent
7	<i>Barbus barbus</i>			2,06	subdominant
8	<i>Barbus carpathicus</i>	46,05	eudominant	19,39	eudominant
9	<i>Gobio carpathicus</i>	1,46	recedent	2,88	subdominant
10	<i>Romanogobio kesslerii</i>	3,15	subdominant	1,23	recedent
11	<i>Pseudorasbora parva</i>	0,45	subrecedent	0,27	subrecedent
12	<i>Rhodeus amarus</i>	3,26	subdominant	0,96	subrecedent
13	<i>Carassius gibelio</i>			0,13	subrecedent
14	<i>Sabanejewia balcanica</i>	1,01	recedent	7,29	dominant
15	<i>Barbatula barbatula</i>	1,12	recedent	11,27	eudominant
16	<i>Perca fluviatilis</i>	0,22	subrecedent		

Regarding the ecological significance in Agraş, only two species *Squalius cephalus* și *Barbus carpathicus* are ruling, the other species are related or accidental. In Almaş only *Squalius cephalus* species is ruling and

Barbus carpathicus is characteristic species. Instead, *Alburnus alburnus*, *Sabanejewia balcanica* and *Barbatula barbatula* are complementary species (Table 7).

Table 7
Significance index of fish species from Agraş și Almaş

Nr.	Fish species	Agraş		Almaş	
		Valoare	Clasa	Valoare	Character
1	<i>Leuciscus leuciscus</i>	0,33	accidental	0,03	accidental
2	<i>Squalius cephalus</i>	34,45	leader	41,95	leader
3	<i>Aspius aspius</i>	0,08	accidental		
4	<i>Alburnus alburnus</i>	0,85	accidental	9,21	complementary
5	<i>Alburnoides bipunctatus</i>	4,95	associate	1,71	associate
6	<i>Chondrostoma nasus</i>	0,18	accidental	0,20	accidental
7	<i>Barbus barbus</i>			0,51	accidental
8	<i>Barbus carpathicus</i>	46,05	leader	19,39	leader
9	<i>Gobio carpathicus</i>	0,87	accidental	2,88	associate
10	<i>Romanogobio kesslerii</i>	2,52	associate	0,92	accidental
11	<i>Pseudorasbora parva</i>	0,27	accidental	0,13	accidental
12	<i>Rhodeus amarus</i>	1,95	associate	0,24	accidental
13	<i>Carassius gibelio</i>			0,03	accidental
14	<i>Sabanejewia balcanica</i>	0,60	accidental	5,46	complementary
15	<i>Barbatula barbatula</i>	0,44	accidental	8,45	complementary
16	<i>Perca fluviatilis</i>	0,08	accidental		

The index value of diversity is near for the two rivers: 3.02 to Agraş, and 3.40 to Almaş. These high values indicate that those ecosystems are balanced and less affected by human impact.

Of the 16 fish species identified (Table 8) 8 species are protected by law in one way or another (Wilhelm, Harka 2014).

Table 8
Protected fish species in Agraş și Almaş

Nr.	Fish species	Bazele ocrotirii						
		Habitats Directive	Law 13/1993	Law 462/2001	Law 49/2011	Red Book	Natura 2000	IUCN List
1	<i>Leuciscus leuciscus</i>					critic pericl.		
2	<i>Squalius cephalus</i>							
3	<i>Aspius aspius</i>	anex 2 and 5	anex 3	anex 2	anex 3		unrated	DD
4	<i>Alburnus alburnus</i>							
5	<i>Alburnoides bipinctatus</i>		anex 3					VU
6	<i>Chondrostoma nasus</i>							
7	<i>Barbus barbus</i>	anex 5						
8	<i>Barbus carpathicus</i>						unrated	
9	<i>Gobio carpathicus</i>							
10	<i>Romanogobio kesslerii</i>	anex 2 and 5	anex 3	anex 2		vulnerable	vulnerable	DD
11	<i>Pseudorasbora parva</i>							
12	<i>Rhodeus amarus</i>	anex 2 and 5	anex 2	anex 2			unrated	
13	<i>Carassius gibelio</i>							
14	<i>Sabanejewia balcanica</i>	anex 2 and 5	anex 3	anex 3	anex 3		unrated	DD
15	<i>Barbatula barbatula</i>							
16	<i>Perca fluviatilis</i>							

CONCLUSIONS:

Agraş and Almaş are two small rivers - with a length of 43.3 and 65.4 kilometers (Ujvari, 1972) - which is not surprising that ichthyofauna is relatively poor. Its structure is varied, however, most species are endemic. Only *Pseudorasbora parva* and *Carassius gibelio* are alien species, and they have actual low. The dominant species are *Squalius cephalus* and *Barbus carpathicus*.

A lot of species has a considerable biological importance and Shannon-Weaver index value shows a balanced structure of cenosis that it is not too much affected by pressure atropic. Many species are protected by law.

The presence of species like *Aspius aspius* și *Barbus barbus* in the lower part of the river shows a viable link to Somes, which can be important especially during breeding and ensure even retreat for fish from Somes in the event of disasters that would affect river main stream.

As a consequence we propose that the two rivers basin be declared a ichthyofaunistic protected area to maintain and continue unaltered.

BIBLIOGRAPHY:

- Ardelean, G. Wilhelm A. S., Wilhelm, S. – 2007 – Az Ér (Ier) folyó halfaunájának ökológiai és természetvédelmi értékelése. Pisces Hungarici, 2: 11-17.
- Balon, E.K. – 1995 – Reproductive guilds of fishes: a proposal and definition. J. Fish. Res. Board Can. 32: 821-864.
- Bănărescu, P. – 1994 – The present-day conservation status of the fresh water fish fauna of Romania. Ocrot. Nat. med. Înconj. 38. 1: 5-20.
- Bănărescu, P. – 2004 – Situația actuală a ihtiofaunei de apă dulce a României sub aspect faunistic, taxonomic și al protecției. Studia Universitatis Vasile Goldiș, Ser. Șt. Vieții, 14: 7-12.
- Bănărescu, P. – 2005 – Pisces. In: Botnariuc, N., Tatole, V. Cartea Roșie a vertebratelor din România. Ed. Curtea Veche, București, pp. 260.
- Györe, K. - 1995 – Magyarország természetvizi halai. Vízi természet- és környezetvédelem: 106-110.
- Harka, Á. – 2011 – Tudományos halnevek a magyar szakirodalomban. Halászat 104/3-4: 99-103.
- Kottelat, M., Freyhof, J. – 2007 – Handbook of European Freshwater Fishes. Kottelat, Cornol,



- Switzerland and Freyhof, Berlin, Germany. pp. 646.
- Pricope, F., Battes, K., Ureche, D., Stoica, I. – 2004 – Metodologia de monitorizare a ihtiofaunei din bazine acvatice naturale și antropice. Studia Univ. „Vasile Goldis”, Seria Șt. Vieții, 14. 27-33.
- Sallai, Z. – 2002 – A Dráva-Mura vízrendszer halfaunisztikai vizsgálata, 1. Halászat, 95.2: 80-91.
- Spindler, T. – 1997 – Fischfauna in Österreich. Bundesministerium für Umwelt, Jugend und Familie, Wien. pp. 140.
- Ichtiocenosis structure of Agraș and Almaș rivers (Sălaj Conty)*
- Tatole, V., Iftime, A., Stan, M., Iorgu, E.I., Iorgu, I., Oțel, V. – 2009- Speciile de animale Natura 2000 din România. București
- Ujvari, I. - 1972 – Geografia apelor României. Ed. Științifică, București, pp. 591.
- Wilhelm, S., Ardelean, G. – 2015 – Az Egregy (Agraș) és Almás (Almaș) (România, Szilágy/Sălaj megye) halfaunája. Pisces Hungarici, IX.
- Wilhelm, S., Harka, Á. - 2014 – Partium halai. Europrint, Székelyhíd, pp. 179.