Morphometric differences of Spirlin, *Alburnoides bipunctatus* Bloch 1782 from the Major Catchments of Transylvania

Tudor PĂPUC¹, Daniel COCAN¹, Călin LAȚIU¹, Paul UIUIU¹, Vioara MIREȘAN^{1*}

¹Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Mănăștur Street, 400372, Romania

*Corresponding author, e-mail: vmiresan@yahoo.com; vioara.miresan@usamvcluj.ro

Bulletin UASVM Animal Science and Biotechnologies 74(2)/ 2017

Print ISSN 1843-5262; Electronic ISSN 1843-536X

DOI:10.15835/buasvmcn-asb: 0030

ABSTRACT

Spirlin (*Alburnoides bipunctatus*) is found in great numbers in most Transylvanian rivers. The species has an important role in the ecosystems in which it is found in terms of feeding and habitat occupation. The morphometric characters of this species vary between different habitats, outlining morphometric plasticity. Morphometric profiles were made for different populations of Spirlin, to evaluate differences in body shape. Considering that different environmental conditions influence the morphology of Spirlin populations, morphometric characteristics were determined. In order to assess differences in spirlin body shape, specimens from the four major Transylvanian catchments were collected by angling techniques. The specimens were preserved and transported to the University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, where morphometric measurements and weight determinations were conducted in the Physiology of Aquatic Organisms Laboratory. Spirlin from Mures, Someș, Cris and Viseu catchments were studied, as it follows: 21 specimens from Aries River (Mures catchment), 61 specimens from the river Crisul Repede (Cris catchment), 21 specimens from Someșul Mic River (Someș catchment) and 20 specimens from Viseu River. A number of 39 determinations were made. The obtained results reflect the morphometric differences among populations of Spirlin from some Transylvanian main rivers.

Keywords: *morphometry, Alburnoides bipunctatus, Transylvania*

INTRODUCTION

The native territory of the spirlin (*Alburnoides bipunctatus*) ranges from Europe, from the Atlantic coast of France (Ladiges and Vogt, 1979), to the Middle East, in middle and upper sectors of rivers that drain in the Black, Baltic, Azov and Caspian seas (Berg, 1964). Even though the spirlin is rarely found and receives legislative protection in some countries and regions (Lusk et al., 1998), being endangered (Hensel and Mužík, 2001; Lelek, 1987), in most areas it can be found in large numbers. The microhabitat of the spirlin is usually described in general terms (Tales et al., 2004; Jurajda et al., 2007). The species has high oxygen requirements and it prefers hard substrate and low turbidity (Peñáz, 1995). These conditions make

the spirlin a good indicator of water quality, being sensitive to habitat degradation (Breitenstein and Kirchhofer, 2000). The population dynamics also reflect changes in habitat (Jurajda et al., 1996). The spirlin is also an important item in the trophic chain, being consumed by most predator fish and consuming planktonic and benthic organisms (Treer et al., 2006).

Differences in environmental conditions and water constructions can produce high plasticity in morphometric characteristics (Swain et al., 1991; Azizi et al., 2015). Some authors suggest that morphometry can be related to microhabitat utilization (Kovač et al., 2006; Copp et al., 2010).

In Romania, spirlin was mentioned in some studies (Bănăduc et al., 2013; Curtean-Bănăduc

and Bănăduc, 2007; Györe *et al.*, 2013), but few scientific papers include detailed information about the spirlin (Bănărescu, 1964; Papadopol and Cristofor, 1980; Cocan *et al.*, 2015). The aim of this study is to present the morphometric profile of the spirlin from four rivers from Transylvania, as well as to produce more data regarding this species in Romania.

MATERIAL AND METHODS

The studied specimens of spirlin were caught in 4 locations. 61 specimens were caught from Crisul Repede River of the Cris River Catchment, 21 specimens were collected from Somesul Mic River of the Somes River catchment, 21 specimens were collected from Aries River of the Mures River catchment and 20 specimens were caught from Viseu River catchment. The time period in which the specimens were collected spanned over 1 year, from March 2016 to the same month of the next year. The collection method consisted in angling, being a less invasive method (Bartholomew and Bohnsack, 2005; Cooke and Schramm, 2007) and a total of 123 specimens were studied. The sampling points are presented in Table 1.

The morphometric measurements could not be conducted *in situ*. The spirlin specimens were preserved in formalin solution (2%) and transported to the University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca. A number of 36 measurements were conducted using an electronic scale, an electronic caliper and the Piximetre 5.9 software. The following measurements were taken: body weight (BW), body depth (BD), great perimeter (GP), small perimeter (SP), inter-orbital distance (I-oD), nostril interval (N-I), commissure interval (CI), total length (TL), standard length (SL), maximum height (H), minimum height (h), caudal peduncle length (CPL), head length (HL), head height (HH), snout length (SnL), upper jaw length (UjL), lower

jaw length (LjL), pre-orbital distance (Pre-o-D), postorbital distance (Post-o-D), eye diameter (ED), pre-dorsal length (Pr-dL), post-dorsal length (Po-dL), pre-pectoral length (Pr-pL), post-pectoral length (Po-pL), pre-ventral length (Pr-vL), post-ventral length (Po-vL), pre-anal length (Pr-aL), post-anal length (Po-aL), pectoral-anal length (P-A), pectoral-dorsal length (P-D), pectoral-ventral length (P-V), dorsal-ventral length (D-V), dorsal-anal length (D-A), ventral-anal length (V-A), dorsal fin height (DfH), pectoral fins length (PfL), ventral fins length (VfL), anal fin height (AfH), caudal fin length (CfL).

The obtained data was interpreted using the GraphPad Prism 6.07 software, rendering the mean value of a characteristic for each location, the standard error, the standard deviation, the coefficient of variation, the minimum and the maximum value. Based on these measurements, some body proportions were determined and compared. The body ratios are: head length in total length ratio (HL/TL), maximum height in total length ratio (H/TL), minimum height in total length ratio (h/TL), dorsal fin height in total length ratio (DfH/TL), snout length in head length ratio (SnL/HL), lower jaw length in upper jaw length ratio (LjL/UjL) and eye diameter in head length ratio (ED/HL).

RESULTS AND DISCUSSIONS

The obtained results from the biological material collected from Crisul Repede River (Ciucea) are presented in Table 2. Following in tables 3, 4 and 5 are presented the results from Somesul Mic River, Aries River and Viseu river respectively.

Using the above information, some body proportions were determined, as presented in Table 6. The head length in total length ratio is between 18-19% for Somesul Mic, Aries and Viseu specimens, while it is over 19% for Crisul Repede

Tab. 1. Spirlin sampling points and GPS coordinates.

No.	Location	Date of sampling	Specimens caught	GPS coordinates
1	Crisul Repede River (Ciucea)	2016 March	61	46°56'44.1"N - 22°49'03.6"E
2	Somesul Mic River (Mintiu Gherlii)	2016 July	21	47°03'55.2"N - 23°55'27.2"E
3	Aries River	2016 September	21	46°30'36.2"N - 23°33'55.2"E
4	Viseu River (Petrova)	2017 March	20	47°50'47.3"N - 24°12'21.6"E

Tab. 2. Body measurements of spirulin (*Alburnoides bipunctatus*) from Crisul Repede - mean values and variability (n=61)

Morphometric characteristics	Abbreviation	MU	X ± sx	Min	Max	V%	s
Body weight	BW	g	10±0.32	7	21	23.87	2.55
Body depth	BD	cm	1.12±0.01	0.93	1.45	9.59	0.10
Great perimeter	GP	cm	5.45±0.07	4.56	8.14	10.52	0.57
Small perimeter	SP	cm	2.21±0.02	1.83	2.58	0.07	0.16
Inter-orbital distance	I-oD	cm	0.67±0.007	0.54	0.83	8.80	0.05
Nostril interval	N-I	cm	0.39±0.005	0.29	0.50	10.35	0.04
Commissure interval	CI	cm	0.72±0.01	0.53	0.97	14.45	0.10
Total length	TL	cm	9.82±0.08	8.51	11.89	6.84	0.67
Standard length	SL	cm	8.24±0.07	7.12	10.25	7.36	0.60
Maximum height	H	cm	2.09±0.02	1.68	2.80	9.45	0.19
Minimum height	h	cm	0.78±0.008	0.65	0.94	8.25	0.06
Caudal peduncle length	CPL	cm	1.51±0.02	1.21	1.97	10.64	0.16
Head length	HL	cm	1.94±0.02	1.57	2.42	9.68	0.18
Head height	HH	cm	1.51±0.01	1.29	1.88	8.58	0.13
Snout length	SnL	cm	0.56±0.01	0.43	0.89	14.19	0.08
Upper jaw length	UjL	cm	0.50±0.01	0.36	0.73	16.31	0.08
Lower jaw length	LjL	cm	0.50±0.01	0.35	0.76	16.76	0.08
Pre-orbital distance	Pre-o-D	cm	0.45±0.01	0.26	0.70	19.16	0.08
Postorbital distance	Post-o-D	cm	0.87±0.009	0.73	1.06	8.78	0.07
Eye diameter	ED	cm	0.55±0.007	0.45	0.77	10.00	0.05
Pre-dorsal length	Pr-dL	cm	4.45±0.04	3.75	5.49	7.64	0.34
Post-dorsal length	Po-dL	cm	4.04±0.04	3.46	5.03	7.90	0.32
Pre-pectoral length	Pr-pL	cm	2.01±0.02	1.66	2.49	9.53	0.19
Post-pectoral length	Po-pL	cm	6.32±0.06	5.38	7.98	8.10	0.51
Pre-ventral length	Pr-vL	cm	3.94±0.04	3.40	4.93	9.03	0.35
Post-ventral length	Po-vL	cm	4.52±0.04	3.67	5.74	7.93	0.35
Pre-anal length	Pr-aL	cm	5.38±0.05	4.63	6.70	7.94	0.42
Post-anal length	Po-aL	cm	3.08±0.03	2.53	3.87	8.01	0.24
Pectoral-anal length	P-A	cm	3.40±0.04	2.75	4.36	9.13	0.31
Pectoral-dorsal length	P-D	cm	2.89±0.03	2.33	3.70	8.97	0.26
Pectoral-ventral length	P-V	cm	1.93±0.02	1.51	2.46	11.08	0.21
Dorsal-ventral length	D-V	cm	2.08±0.02	1.68	2.77	9.46	0.19
Dorsal-anal length	D-A	cm	2.21±0.02	1.84	2.85	8.28	0.18
Ventral-anal length	V-A	cm	1.49±0.02	1.15	1.92	11.06	0.16
Dorsal fin height	DfH	cm	1.81±0.02	1.48	2.38	8.73	0.15
Pectoral fins length	PfL	cm	1.37±0.02	1.00	1.78	13.43	0.18
Ventral fins length	VfL	cm	1.19±0.01	0.82	1.64	11.61	0.13
Anal fin height	AfH	cm	1.34±0.01	0.98	1.72	11.23	0.15
Caudal fin length	Cfl	cm	1.77±0.02	1.46	2.20	8.84	0.15

Note: MU - measurement unit; X - mean value; sx - standard error; V% - coefficient of variation; s - standard deviation; Min - minimum value; Max - maximum value.

Tab. 3. Body measurements of spirlin (*Alburnoides bipunctatus*) from Somesul Mic - mean values and variability (n=21)

Morphometric characteristics	Abbreviation	MU	X ± sx	Min	Max	V%	s
Body weight	BW	g	8.85±1.02	4	22	51.83	4.59
Body depth	BD	cm	1.08±0.04	0.84	1.51	19.27	0.20
Great perimeter	GP	cm	4.96±0.20	3.88	7.05	18.11	0.89
Small perimeter	SP	cm	1.91±0.07	1.48	2.59	17.79	0.34
Inter-orbital distance	I-oD	cm	0.59±0.02	0.44	0.90	18.28	0.02
Nostril interval	N-I	cm	0.34±0.01	0.22	0.49	18.05	0.01
Commissure interval	CI	cm	0.50±0.01	0.36	0.72	17.26	0.08
Total length	TL	cm	8.89±0.29	6.81	12.2	14.95	1.33
Standard length	SL	cm	7.40±0.25	5.93	10.3	15.28	1.31
Maximum height	H	cm	1.91±0.08	1.47	2.78	19.04	0.36
Minimum height	h	cm	0.69±0.02	0.53	0.92	14.74	0.10
Caudal peduncle length	CPL	cm	1.33±0.05	0.97	2.01	18.15	0.24
Head length	HL	cm	1.68±0.06	1.35	2.52	16.82	0.28
Head height	HH	cm	1.24±0.04	0.94	1.77	16.29	0.20
Snout length	SnL	cm	0.51±0.02	0.40	0.84	21.32	0.11
Upper jaw length	UjL	cm	0.52±0.01	0.39	0.75	15.59	0.08
Lower jaw length	LjL	cm	0.53±0.01	0.43	0.80	15.66	0.08
Pre-orbital distance	Pre-o-D	cm	0.39±0.02	0.29	0.66	23.03	0.09
Postorbital distance	Post-o-D	cm	0.77±0.03	0.58	1.18	17.36	0.13
Eye diameter	ED	cm	0.49±0.01	0.41	0.71	14.65	0.07
Pre-dorsal length	Pr-dL	cm	3.95±0.14	3.15	5.54	16.30	0.64
Post-dorsal length	Po-dL	cm	3.66±0.11	2.95	4.97	14.57	0.53
Pre-pectoral length	Pr-pL	cm	1.72±0.06	1.36	2.48	15.88	0.27
Post-pectoral length	Po-pL	cm	5.81±0.19	4.54	7.99	15.37	0.89
Pre-ventral length	Pr-vL	cm	3.44±0.13	2.54	4.73	16.89	0.58
Post-ventral length	Po-vL	cm	4.21±0.13	3.36	5.89	14.37	0.60
Pre-anal length	Pr-aL	cm	4.75±0.17	3.64	6.51	16.53	0.78
Post-anal length	Po-aL	cm	2.86±0.08	2.34	4.02	14.05	0.40
Pectoral-anal length	P-A	cm	3.07±0.12	2.26	4.11	17.54	0.54
Pectoral-dorsal length	P-D	cm	2.69±0.10	2.08	3.77	17.30	0.46
Pectoral-ventral length	P-V	cm	1.73±0.07	1.17	2.37	19.37	0.33
Dorsal-ventral length	D-V	cm	1.96±0.07	1.54	2.86	17.91	0.35
Dorsal-anal length	D-A	cm	1.97±0.07	1.50	2.77	17.81	0.35
Ventral-anal length	V-A	cm	1.37±0.05	0.98	1.91	17.63	0.24
Dorsal fin height	DfH	cm	1.62±0.05	1.22	2.27	15.68	0.25
Pectoral fins length	PfL	cm	1.12±0.04	0.78	1.73	19.66	0.22
Ventral fins length	VfL	cm	1.02±0.04	0.73	1.53	18.67	0.19
Anal fin height	AfH	cm	1.24±0.04	0.89	1.77	16.11	0.20
Caudal fin length	Cfl	cm	1.59±0.06	1.00	2.25	18.01	0.28

Note: MU - measurement unit; X - mean value; sx - standard error; V% - coefficient of variation; s - standard deviation; Min - minimum value; Max - maximum value.

Tab. 4. Body measurements of spiralin (*Alburnoides bipunctatus*) from Aries - mean values and variability (n=21)

Morphometric characteristics	Abbreviation	MU	X ± sx	Min	Max	V%	s
Body weight	BW	g	5.57±0.36	3	9	29.08	1.62
Body depth	BD	cm	0.91±0.01	0.79	1.07	8.32	0.07
Great perimeter	GP	cm	4.36±0.09	3.62	5.22	9.63	0.42
Small perimeter	SP	cm	1.82±0.03	1.51	2.19	9.46	0.17
Inter-orbital distance	I-oD	cm	0.55±0.01	0.49	0.67	8.59	0.04
Nostril interval	N-I	cm	0.30±0.006	0.25	0.35	9.04	0.02
Commissure interval	CI	cm	0.42±0.008	0.36	0.50	9.14	0.03
Total length	TL	cm	8.76±0.15	7.62	10.3	7.68	0.67
Standard length	SL	cm	7.13±0.12	6.22	8.41	7.76	0.55
Maximum height	H	cm	1.71±0.03	1.39	2.01	10.15	0.17
Minimum height	h	cm	0.66±0.01	0.57	0.77	8.18	0.05
Caudal peduncle length	CPL	cm	1.36±0.02	1.18	1.55	7.34	0.10
Head length	HL	cm	1.59±0.02	1.43	1.83	7.44	0.11
Head height	HH	cm	1.18±0.02	1.04	1.36	8.07	0.09
Snout length	SnL	cm	0.46±0.01	0.39	0.61	12.43	0.05
Upper jaw length	UjL	cm	0.52±0.01	0.40	0.63	11.03	0.05
Lower jaw length	LjL	cm	0.55±0.01	0.45	0.65	9.48	0.05
Pre-orbital distance	Pre-o-D	cm	0.35±0.01	0.30	0.45	13.06	0.04
Postorbital distance	Post-o-D	cm	0.72±0.01	0.65	0.81	6.85	0.04
Eye diameter	ED	cm	0.51±0.007	0.47	0.59	6.36	0.03
Pre-dorsal length	Pr-dL	cm	3.72±0.06	3.39	4.28	7.17	0.26
Post-dorsal length	Po-dL	cm	3.61±0.07	3.19	4.31	8.16	0.29
Pre-pectoral length	Pr-pL	cm	1.65±0.03	1.43	1.89	7.92	0.13
Post-pectoral length	Po-pL	cm	5.64±0.11	5.07	6.77	8.16	0.46
Pre-ventral length	Pr-vL	cm	3.29±0.06	2.92	3.88	8.64	0.28
Post-ventral length	Po-vL	cm	4.17±0.11	3.56	5.45	10.97	0.45
Pre-anal length	Pr-aL	cm	4.59±0.09	4.01	5.43	8.87	0.40
Post-anal length	Po-aL	cm	2.80±0.04	2.51	3.20	6.48	0.18
Pectoral-anal length	P-A	cm	2.97±0.07	2.51	3.68	10.20	0.30
Pectoral-dorsal length	P-D	cm	2.47±0.05	2.18	2.96	9.02	0.22
Pectoral-ventral length	P-V	cm	1.66±0.04	1.40	2.08	10.57	0.17
Dorsal-ventral length	D-V	cm	1.73±0.04	1.50	2.02	9.82	0.17
Dorsal-anal length	D-A	cm	1.86±0.04	1.58	2.20	10.48	0.19
Ventral-anal length	V-A	cm	1.32±0.04	1.07	1.67	13.61	0.18
Dorsal fin height	DfH	cm	1.71±0.03	1.44	2.05	9.56	0.16
Pectoral fins length	PfL	cm	1.30±0.03	1.12	1.54	10.07	0.13
Ventral fins length	VfL	cm	1.07±0.03	0.83	1.28	12.75	0.13
Anal fin height	AfH	cm	1.20±0.03	1.02	1.46	10.33	0.12
Caudal fin length	Cfl	cm	1.71±0.03	1.48	1.99	8.47	0.14

Note: MU - measurement unit; X - mean value; sx - standard error; V% - coefficient of variation; s - standard deviation; Min - minimum value; Max - maximum value.

Tab. 5. Body measurements of spiralin (*Alburnoides bipunctatus*) from Viseu - mean values and variability (n=20)

Morphometric characteristics	Abbreviation	MU	X ± sx	Min	Max	V%	s
Body weight	BW	g	5.37±0.59	3.12	14.52	48.11	2.58
Body depth	BD	cm	0.83±0.03	0.64	1.23	16.55	0.13
Great perimeter	GP	cm	3.98±0.16	3.11	6.03	17.58	0.70
Small perimeter	SP	cm	1.60±0.04	1.32	2.20	13.37	0.21
Inter-orbital distance	I-oD	cm	0.49±0.01	0.42	0.66	12.96	0.06
Nostril interval	N-I	cm	0.25±0.007	0.18	0.32	13.22	0.03
Commissure interval	CI	cm	0.47±0.01	0.36	0.62	14.50	0.06
Total length	TL	cm	8.08±0.22	7.02	11.03	11.89	0.96
Standard length	SL	cm	6.59±0.18	5.71	9.05	12.32	0.81
Maximum height	H	cm	1.55±0.05	1.28	2.34	16.36	0.25
Minimum height	h	cm	0.60±0.01	0.52	0.85	12.86	0.07
Caudal peduncle length	CPL	cm	1.34±0.04	0.85	1.73	14.77	0.19
Head length	HL	cm	1.52±0.04	1.31	2.01	11.90	0.18
Head height	HH	cm	1.11±0.03	0.95	1.50	12.63	0.14
Snout length	SnL	cm	0.51±0.01	0.37	0.73	16.72	0.08
Upper jaw length	UjL	cm	0.52±0.01	0.42	0.66	11.69	0.06
Lower jaw length	LjL	cm	0.55±0.01	0.44	0.71	11.37	0.06
Pre-orbital distance	Pre-o-D	cm	0.39±0.01	0.29	0.58	18.27	0.07
Postorbital distance	Post-o-D	cm	0.62±0.02	0.53	0.90	14.81	0.09
Eye diameter	ED	cm	0.47±0.009	0.43	0.58	8.36	0.03
Pre-dorsal length	Pr-dL	cm	3.49±0.10	3.00	4.77	12.50	0.43
Post-dorsal length	Po-dL	cm	3.27±0.09	2.71	4.55	12.73	0.41
Pre-pectoral length	Pr-pL	cm	1.57±0.03	1.37	2.06	10.81	0.16
Post-pectoral length	Po-pL	cm	5.10±0.15	4.35	7.12	12.85	0.65
Pre-ventral length	Pr-vL	cm	3.00±0.07	2.60	3.98	11.55	0.34
Post-ventral length	Po-vL	cm	3.74±0.11	3.14	5.31	13.48	0.50
Pre-anal length	Pr-aL	cm	4.16±0.11	3.56	5.71	12.35	0.51
Post-anal length	Po-aL	cm	2.58±0.07	2.14	3.56	12.60	0.32
Pectoral-anal length	P-A	cm	2.62±0.08	2.16	3.73	13.63	0.35
Pectoral-dorsal length	P-D	cm	2.26±0.07	1.87	3.35	15.04	0.34
Pectoral-ventral length	P-V	cm	1.45±0.04	1.26	1.96	12.62	0.18
Dorsal-ventral length	D-V	cm	1.58±0.05	1.29	2.40	16.40	0.26
Dorsal-anal length	D-A	cm	1.63±0.05	1.30	2.44	15.17	0.24
Ventral-anal length	V-A	cm	1.19±0.04	0.95	1.77	16.00	0.19
Dorsal fin height	DfH	cm	1.49±0.03	1.18	1.96	11.43	0.17
Pectoral fins length	PfL	cm	1.16±0.02	1.00	1.41	9.30	0.10
Ventral fins length	VfL	cm	0.97±0.02	0.75	1.20	12.40	0.12
Anal fin height	AfH	cm	1.06±0.03	0.83	1.52	15.22	0.16
Caudal fin length	Cfl	cm	1.52±0.03	1.27	1.96	10.02	0.15

Note: MU - measurement unit; X - mean value; sx - standard error; V% - coefficient of variation; s - standard deviation; Min - minimum value; Max - maximum value.

Tab. 6. Body proportions for specimens collected from the 4 locations

LOCATION	Crisul Repede	Somesul Mic	Aries	Viseu
Ratio				
HL/TL	19.75%	18.89%	18.15%	18.81%
H/TL	21.28%	21.48%	19.52%	19.18%
h/TL	7.94%	7.76%	7.53%	7.42%
DfH/TL	18.43%	18.22%	19.52%	18.44%
SnL/HL	28.86%	30.35%	28.93%	33.55%
LjL/UjL	100%	101.92%	105.76%	105.76%
ED/HL	28.35%	29.16%	32.07%	30.92%

specimens. The maximum height in total length ratio is above 21% for Crisul Repede and Somesul Mic specimens, while it is slightly over 19% for Aries and Viseu spiralin. The minimum height in total length ratio is situated between 7-9% for all locations. The dorsal fin height in total length ratio is found between 18-19% for spiralin from Crisul Repede, Somesul Mic and Viseu, but it is well over 19% for Aries River. The snout length in head length ratio is above 28% for Crisul Repede and Aries specimens, over 30% for Somesul Mic specimens and over 33% for Viseu specimens. The lower jaw length is equal to the upper jaw length for specimens from Crisul Repede, but as far as the other 3 sampling points are concerned, the lower jaw length exceeds the upper jaw length. The eye diameter in head length ratio also differs in the sampling points, being over 28% for Crisul Repede specimens, over 29% for Somesul Mic specimens, over 30% for Viseu specimens and over 32% for Aries River spiralin.

CONCLUSION

Depending on the habitat in which spiralin is found, morphometric plasticity may be present. Such is the case of spiralin found in the main four catchments of Transylvania: Somes catchment, Mures catchment, Cris catchment and Viseu catchment. The studied specimens of spiralin presented notable differences in body part ratios, being adapted to different environment conditions.

REFERENCES

1. Azizi F, Anvarifar H, Mousavi-Sabet H (2015). Morphological Differentiation Between Isolated Populations of Caspian spiralin (*Alburnoides eichwaldii*) (Pisces: Cyprinidae) Affected by Dam. International Journal of Animal Biology, Vol. 1, No. 2, pp. 28-37.
2. Bartholomew A, Bohnsack JA (2005). A review of catch-and-release angling mortality with implications for no-take reserves. Fish Biology and Fisheries, 15: pp. 129-154.
3. Bănăduc D, Stroilă V, Curtean-Bănăduc A (2013). The fish fauna of the Timiș river (Banat, Romania). Transylv. Rev. Syst. Ecol. Res. 15 - special issue "The Timiș River Basin".
4. Bănărescu P (1964). Fauna Republicii Populare Romîne, Pisces-Osteichthyes (Pești ganoizi și osoși), Vol. XIII. Ed. Academiei Republicii Populare Române, București.
5. Berg LS (1964). Freshwater fishes of the U.S.S.R. and adjacent countries. Volume II, 4th Edition, Israel Program for Scientific Translations Ltd. (Russian version published 1949).
6. Breitenstein ME, Kirchhofer A (2000). Growth, age structure and species association of the cyprinid *Alburnoides bipunctatus* in the River Aare, Switzerland. Folia Zoologica 49, 59-68.
7. Cocan D, Popescu F, Lațiu C, Coșier V, Coroian A, Negrea O, Ihuț A, Mireșan V (2015). Meristic and Morphometric Characteristics of Spiralin, *Alburnoides bipunctatus* Bloch 1782 (Actinopterygii: Cyprinidae) of the Letca Area - Someș River. Bulletin UASVM Animal Science and Biotechnologies 72(2).
8. Cooke SJ, Schramm HL (2007). Catch-and-release science and its application to conservation and management of recreational fisheries. Fisheries Management and Ecology, 14, pp. 73-79.
9. Copp GH, Kováč V, Sírýová S (2010). Microhabitat use by stream-dwelling spiralin *Alburnoides bipunctatus* and accompanying species: implications for conservation. Folia Zoologica, 59 (3): 240-256.
10. Curtean-Bănăduc A, Bănăduc D (2007). Benthic macro-invertebrate and fish communities of some southern Târnava Mare river tributaries (Transylvania, Romania). Transylv. Rev. Syst. Ecol. Res. 4, "The Saxon Villages Region of southeast Transylvania".
11. Györe K, Józsa V, Gál D, Lengyel P (2013). Fish faunal studies in the Körös river system. AACL Bioflux 6(1):34-41.
12. Hensel K, Mužík V (2001). Červený (ekozozologický) zoznam mihúl' (Petromyzontes) a rýb (Osteichthyes) Slovenska [Red (ecozological) list of lampreys (Petromyzontes) and fishes (Osteichthyes) of Slovakia]. In: Baláz D., Marhold K. & Urban P. (eds), Červený zoznam

- rastlín a živočichov Slovenska. Ochr. Prír. 20 (Suppl.): 143–145 (*in Slovak*).
13. Jurajda P, Adámek Z, Janáč M, Valová Z (2007). Fish and macrozoobenthos in the Vlára stream drainage area (Bílé Karpaty Mountains). Czech J. Anim. Sci. 52: 214–225.
 14. Jurajda P, Hohausova E, Prasek V, Dvorak M (1996). Fishes of Polana Mountain Streams. Biologia, 51:173–178.
 15. Kováč V, Katin S, Copp GH, Siryová S (2006). Ontogenetic variability in external morphology and microhabitat use of spiralin *Alburnoides bipunctatus* from the River Rudava (Danube catchment). Journal of Fish Biology, 68, 1257–1270.
 16. Ladiges W, Vogt D (1979). Die Süßwasserfische Europas. Paul Parey, Hamburg & Berlin, 299 pp.
 17. Lelek A (1987). The freshwater fishes of Europe, Vol. 9, Threatened Fishes of Europe. Aula-Verlag, Wiesbaden. 343 pp.
 18. Lusk S, Lusková V, Halačka K, Šlechta V, Šlechtová V (1998). Trends and production of fish communities of the barbel zone in a stream of the Czech Republic. Folia Zool. 47 (Suppl. 1): 67–72.
 19. Papadopol M, Cristofor S (1980). Recherches sur L'ecologie de deux populations *Alburnoides b. bipunctatus* (Bloch), des eaux de la Roumanie (Pisces, Cyprinidae). – Trav. Mus. Hist.nat. Grigore Antipa, 22: 483–493.
 20. Peňáz M (1995): *Alburnoides bipunctatus*. In: Baruš V. & Oliva O. (eds.), Fauna ČR a SR/Mihulovci a ryby II [Fauna of the Czech Republic and Slovakia/Lampreys and fishes II]. Academia, Prague: 151–154. (*in Czech*).
 21. Swain DP, Ridell BE, Murray CB (1991). Morphological differences between hatchery and wild populations of coho salmon (*Oncorhynchus kisutch*): environmental versus genetic origin. CAN J FISH AQUAT SCI, 48, 1783–1791.
 22. Tales E, Keith P, Oberdorff T (2004). Density-range size relationships in French riverine fishes. Oecologia 138: 360–370.
 23. Treer T, Piria M, Aničić I, Safner R, Tomljanović T (2006). Diet and growth of spiralin, *Alburnoides bipunctatus* in the barbel zone of the Sava River. Folia Zoologica, 55(1): 97–106.