

A New Species of the Gobiidae Family in Transylvania Waters: Racer Goby (*Babka gymnotrachelus*, Kessler 1857)

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Abstract

The racer goby (*Babka gymnotrachelus*) is one of the well represented Ponto-Caspian goby species in most Danube Delta Biosphere Reserve lakes and channels, including Razim-Sinoe lagoon complex and lower sector of the Danube. Also, the presence of this species is noted in some lakes near Bucharest. The presence of this species in Transylvania has not been reported until now, during ichthyologic investigations from 2015-2016, seven specimens from Someș River and some of its tributaries, were captured: one specimen was caught in a channel adjacent to Țaga Mare Lake, one specimen was caught in Someșul Mare River (Mica village, Cluj County), two specimens were captured from the confluence of the Someșul Mic River and Fizeș River. The sixth specimen was captured from Fizeș River (Fizeșu Gherlii village, Cluj County) and the last one was also caught from the Fizeș River (Sântioana village, Cluj County). It is possible that the species migrated in Someș Catchment from the Hungarian Danube sector, by the tributaries of Tisa River, or it might have originated from stocking material used in fish farms in Transylvania. The somatic, gravimetric and meristic measurements of the collected specimens were taken in the Acquaculture and Aquatic Organisms Physiology laboratories from the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca and correspond with those mentioned in the published literature regarding this species.

Keywords: *Babka gymnotrachelus*, new species, Transylvanian waters

INTRODUCTION

The racer goby is a Ponto-Caspian species, with a native range consisting in the catchments of the rivers that flow in the Black and Azov Seas, the Marmara Sea, the north and center of the Caspian Sea. In the last decades, the species shows an expansion towards western and northern Europe (Miller, 2003). In Romania, its current presence is limited to the south-east: the lakes near Bucharest, the lakes and channels in the Danube Delta, the shallow waters of the Danube, the coastal lakes. It prefers stagnant freshwaters, with a muddy

substrate. Sexual maturity occurs after the second year of life, at an approximate length of 9-11 cm. Reproduction occurs in April - June, when the female lays about 1.000 eggs in a nest made from vegetal detritus, gravel or shells. The males guard the nest. The feed is represented by a large scale of benthonic invertebrates and occasionally fish eggs and juveniles (Oțel, 2007).

The species was reported lately in some European waters. It spread and adapted to new territories as a consequence of human displacement and transportation, climate change,

water quality improvement, hydraulic engineering and hydropower constructions (e.g.: ripraps, channel constructions). Some major causes are river and sea transport by ships and the great adaptive potential of this species. These are among the elements that mostly affect the invasive spread of Ponto-Caspian gobies.

Discrepant or unsubstantiated information regarding the presence of *Babka gymnotrachelus* species in some territories (Roche *et al.*, 2013) and mistaking to different species occasionally occurs in scientific literature. Regarding the westward migration dynamics, the species was found in Yugoslavia in 1991 (Hegedis *et al.*, 1991). Its presence is reported in the Baltic Sea basin in 1995 (Gollasch, 2006). Two specimens were captured from the Danube in Austria, in 1999 (Anhelt *et al.*, 2001). The first racer goby specimen was caught in the same year, in October, from a Danube armlet near Bratislava (Kautman *et al.*, 2001). In later studies conducted on the Slovak Danube, the species was no longer found and it was presumed that few local populations exist, thus the establishment process of this species in the middle Danube basin is at an initial phase (Jurajda *et al.*, 2005). It appeared in Vistula River in Poland, in 2001 (Kostrzewa and Grabowski, 2001), the hypothesis according to which the species reaches the Baltic Sea basin from the Black Sea basin by the Bug-Prityat Canal, which connects the two basins, was launched.

Two specimens were captured in the Danube, in Hungary, in September, 2004 (Guti, 2006), its presence being later confirmed by other authors (Weiperth *et al.*, 2013). Years later, the species invaded a few Danube tributaries from Bulgaria (Zarev *et al.*, 2013), like Yantra River (Vassilev *et al.*, 2008). The racer goby is reported in the German Danube in September of 2011, near the town of Regensburg (Haertl *et al.*, 2012). Furthermore, the species was recorded in the same year in the Rhine (Borcherding *et al.*, 2011), but further analysis concludes that the sampled specimens were erroneously identified, being in fact either monkey gobies, either hybrids. The species shows up remotely in Austria and Germany, neighboring urban centers and industrial harbors (Roche *et al.*, 2013), hence being presumed that it was accidentally transported along with ballast water in ship tanks. Additionally, the studies on the German and Austrian Danube course were

conducted on the navigation channel, but the species prefers shallow, muddy waters, which was why it was found only in some areas (Haertl *et al.*, 2012). There are two genetically distinct populations in Poland, a local one and an invasive one (Grabowski *et al.*, 2016).

Bij de Vaate *et al.*, (2002) identified three potential main invasion corridors, which developed as a result of canal constructing: the north corridor includes the Volga River, Beloye, Onega and Ladoga Lakes, Neva River and then the Baltic Sea; the central corridor consists in the Dnieper, Vistula, Noteć, Warta, Oder, Elba rivers, the Rhine and then the North Sea; the southern corridor includes the Danube, the Rhine and the North Sea. It is presumed that these corridors have significantly influenced the range expansion of gobies in Europe (Kostrzewa and Grabowski, 2003).

MATERIALS AND METHODS

Studies regarding the presence and distribution of *Babka gymnotrachelus* in the Someș Catchment (Fig. 1) were conducted from August 2015 to July 2016. Overall, seven specimens were caught from five sampling sites (Fig. 1, Tab. 1), an adult specimen and six juvenile specimens. They were preserved in formalin solution until further analysis. The collection method used was angling, using housefly maggots (*Musca domestica*) and red worms (*Eisenia foetida*) as bait. The first racer goby was caught in an adjacent channel to Țaga Mare Lake, and the second one was caught in Someșul Mare River, near Mica village (Cluj County). The following sampling points were selected between the two localities. The biometric and gravimetric measurements were taken in the Acquaculture and Aquatic Organisms Physiology laboratories from the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Forty-seven phenotypic characters and six meristic characters were determined (Fig. 2, Tab. 2 and Tab. 3). The measurements were taken using an electronic scale and an electronic caliper, being later analyzed with the Piximetre 5.9. software. The digital photographs were taken with a Nikon P530 Coolpix camera and edited in Paint.net 4.0.5.

Several measurements were taken in order to make a phenotypic depiction of the captured racer goby specimens, focusing on characters regarding the morphology of the head, body and fins. The

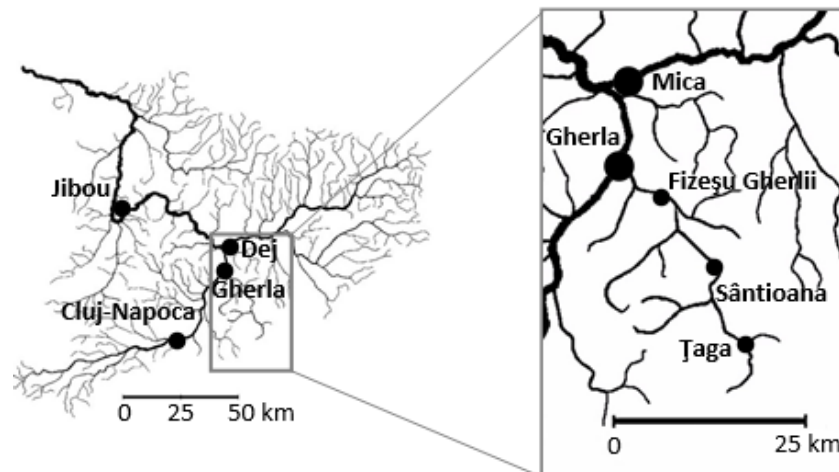


Fig. 1. Someș Catchment (left) and racer goby (*Babka gymnotrachelus*) sampling sites (right)

Tab.1. Racer goby (*Babka gymnotrachelus*) sampling points and GPS coordinates

No.	Location	Date of sampling	Specimens caught	GPS coordinates
1	Țaga (Țaga Mare Lake)	August 2015	1	N46°93'81" - E24°06'86"
2	Mica (Someș river)	September 2015	1	N47°15'13" - E23°91'93"
3	Gherla (Someș-Fizeș confluence)	July 2016	2	N47°05'03" - E23°92'03"
4	Fizeșu Gherlii (Fizeș river)	July 2016	2	N47°02'15" - E23°97'30"
5	Sântioana (Fizeș River)	July 2016	1	N46°96'33" - E24°01'90"

following head measurements were determined: inter-orbital distance (I-oD) [1], nostrils intervals (N1-I, N2-I) [2, 3], commissure interval (CI) [4], head length (HL) [5], head height (HH) [6], eye diameter (ED) [7], pre-orbital distance (Pre-o-D) [8], post-orbital distance (Post-o-D) [12], upper jaw length (UjL) [9], lower jaw length (LjL) [10] and snout length (SnL) [11].

The next phenotypic character values were determined concerning the body: body weight (BW), total length (TL) [13], standard length (SL) [14], maximum height (H) [15], minimum height (h) [16], great perimeter (GP), small perimeter (SP) and body depth (BD). The last characters, as well as the body weight are not represented graphically.

RESULTS AND DISCUSSION

The obtained values regarding the somatic measurements of racer goby captured in

Transylvania waters are presented in table 2. As it can be seen, the specimen caught in Someșul Mare River, downstream of Mica Dam, is an adult

male (male – highlighting the genital papilla), having a length approaching the maximum values (Bănărescu, 1964) and a melanic body colouring specific to the reproductive period (Oțel, 2007). The other six specimens had shorter lengths, with their age evaluated at one year. Also, the adult specimen was captured in areas with high water flow velocities, with a rocky substrate, whereas the smaller specimens were caught in sections with lower flow velocities, with shallow water and muddy substrate.

According to published literature (Bănărescu, 1964) the maximum height (H) of the racer goby is equal to 17-22.5% of the standard length (SL). In the case of the adult male specimen captured at Mica, this ratio is 17.67%, while the ratio for the young specimens is between 17.68–20.45%. Also, the ratio between the body depth (BD) and the maximum height (H) must be placed between 75 – 96%. Our results confirm this ratio, the mean being equal to 81.80% (74.15% - 89.52%). The head length (HL) proportion is higher compared to the standard length (SL), the literature mentioning

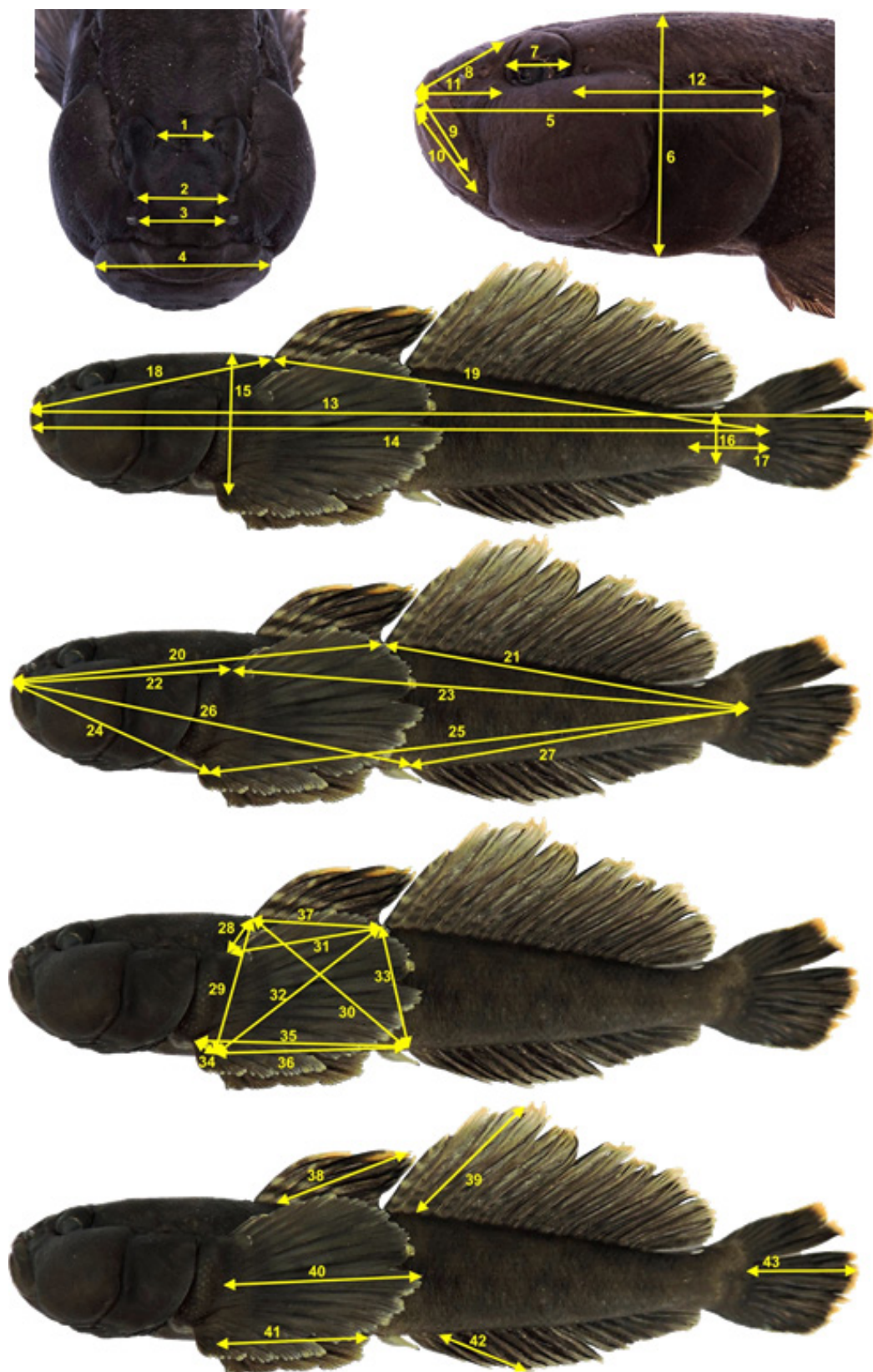


Fig. 2. Graphic representation of the measurements of the racer goby (*Babka gymnotrachelus*)

Tab. 2. Phenotypic character values determined for the specimens of racer goby (*Babka gymnotrachelus*) sampled in the Someș Catchment

Character	MU	Țaga	Mica	Gherla		Fizeșu Gherlii		Sântioana
				1	2	1	2	
Body weight (BW)	g	3.00	16.00	3.00	2.00	3.00	3.00	2.00
Total length (TL)	cm	6.93	11.76	6.65	6.22	5.87	5.79	5.30
Standard length (SL)	cm	5.70	10.07	5.65	5.32	4.92	4.89	4.44
Great perimeter (GP)	cm	3.31	5.19	3.46	3.26	2.95	3.08	2.32
Small perimeter (SP)	cm	1.15	2.22	1.55	1.30	1.27	1.38	1.12
Maximum height (H)	cm	1.05	1.78	1.10	0.97	0.87	1.00	0.88
Minimum height (h)	cm	0.47	0.73	0.47	0.35	0.41	0.42	0.39
Body depth (BD)	cm	0.94	1.32	0.87	0.80	0.72	0.76	0.78
Caudal peduncle length (CpL)	cm	0.72	1.24	0.69	0.62	0.53	0.53	0.48
Head length (HL)	cm	1.91	2.40	1.56	1.51	1.54	1.53	1.19
Head height (HH)	cm	1.02	1.75	1.09	0.99	0.98	0.99	0.91
Snout length (SnL)	cm	0.47	0.80	0.42	0.41	0.38	0.35	0.36
Eye diameter (ED)	cm	0.37	0.36	0.30	0.27	0.30	0.30	0.28
Upper jaw length (UjL)	cm	0.51	0.76	0.41	0.46	0.42	0.42	0.35
Lower jaw length (LjL)	cm	0.54	0.61	0.39	0.43	0.40	0.38	0.25
Inter-orbital distance (I-oD)	cm	0.19	0.50	0.24	0.21	0.14	0.15	0.10
Pre-orbital distance (Pre-o-D)	cm	0.58	0.73	0.43	0.42	0.38	0.34	0.32
Post-orbital distance (Post-o-D)	cm	1.00	1.22	0.68	0.64	0.70	0.57	0.43
Nostrils 1 interval (N1-I)	cm	0.26	0.63	0.42	0.37	0.32	0.39	0.23
Nostrils 2 interval (N2-I)	cm	0.21	0.56	0.36	0.34	0.30	0.34	0.20
Commissure interval (CI)	cm	0.62	1.31	0.70	0.67	0.70	0.68	0.50

a ratio between 28 and 32%. Our results regarding HL-SL ratio, are ranged between 23.83% (the adult male captured at Mica) and 33.50% (the specimen caught at Țaga). The head length and standard length mean ratio is 28.96%. Regarding the eye diameter (ED) and head length (HL) ratio, it must be placed within the 18.60% - 31.00% interval. The mean value of this ratio, according to our results, is 19.16%. The lowest value was obtained from the adult male specimen (Mica) – 15.00%, and the highest value was obtained from the smallest specimen from Sântioana (Fizeș River) (23.52%). It is possible that along with body development and aging, the ratio between the eye diameter (ED) and head length (HL) might decrease. The proportion of 18.60% - 31.00% presented by Bănărescu (1964), is referring to racer goby specimens caught in Razelm Lake, Călărași ponds and Colentina Catchment. Surely, the basic feed and the environment conditions from the native place of this species differ from those found in Transylvania, which is why the ED-

HL proportion has mean values that fall in those cited in the published literature just above the lower limit. A similar situation occurred in the case of the eye diameter (ED) and inter-orbital distance (I-oD) ratio. The mean value of this ratio is 173.51% (Bănărescu mentioning the 104.00 and 360% interval for this ratio). It is possible that changes might occur during the ontogenetic development, the lowest value being obtained from the adult male specimen (Mica – 72.00%), whereas the highest value was obtained from the smallest specimen, caught at Sântioana (280.00%).

The caudal peduncle is short, as mentioned in the published literature, the caudal peduncle length (CpL) and standard length (SL) ratio of the captured specimens being equal to 11.60%, with a low of 10.77% (the first specimen from Fizeșu Gherlii) and a high of 12.63% (the Țaga Lake specimen). The mean value of the pre-dorsal length 1 (Pr-dL1) and standard length (SL) ratio is 33.86%, and the mean value of the ratio between the pre-dorsal length 2 (Pr-dL2) and the

Tab. 3. Determined biometric values of the racer gobies (*Babka gymnotrachelus*) captured in the Someș river basin

Character	MU	Țaga	Mica	Gherla		Fizeșu Gherlii		Sântioana
				1	2	1	2	
Pre-dorsal length 1 (Pr-dL1)	cm	2.33	3.22	1.80	1.76	1.71	1.61	1.40
Post-dorsal length 1 (Po-dL1)	cm	3.97	7.05	3.90	3.49	3.29	3.28	3.08
Pre-dorsal length 2 (Pr-dL2)	cm	3.21	4.92	2.65	2.58	2.34	2.29	2.04
Post-dorsal length 2 (Po-dL2)	cm	3.00	5.30	3.02	2.66	2.60	2.59	2.46
Pre-pectoral length (Pr-pL)	cm	1.94	2.95	1.68	1.59	1.54	1.46	1.12
Post-pectoral length (Po-pL)	cm	3.92	7.11	3.90	3.58	3.30	3.34	3.39
Pre-ventral length (Pr-vL)	cm	1.85	2.88	1.69	1.56	1.46	1.50	1.39
Post-ventral length (Po-vL)	cm	3.91	7.41	4.07	3.71	3.45	3.38	3.31
Pre-anal length (Pr-sL)	cm	3.28	5.27	3.09	2.88	2.62	2.58	2.64
Post-anal length (Po-aL)	cm	2.48	4.91	2.64	2.34	2.24	2.26	1.95
Dorsal1-pectoral length (D1-pL)	cm	0.59	0.70	0.59	0.56	0.53	0.51	0.60
Dorsal2-pectoral length (D2-pL)	cm	1.29	2.11	1.10	1.13	0.90	0.92	1.03
Dorsal1-ventral length (D1-vL)	cm	1.18	1.88	1.16	1.02	0.94	1.00	1.03
Dorsal2-ventral length (D2-vL)	cm	1.57	2.75	1.49	1.39	1.20	1.23	1.22
Dorsal1-anal length (D1-aL)	cm	1.73	2.68	1.74	1.45	1.32	1.36	1.48
Dorsal2-anal length (D2-aL)	cm	1.08	1.70	1.07	0.85	0.87	0.87	1.01
Dorsal1-Dorsal2 length (D1-D2)	cm	1.02	1.75	0.89	0.78	0.70	0.77	0.63
Pectoral-Ventral length (P-V)	cm	0.61	0.46	0.23	0.36	0.21	0.33	0.48
Pectoral-Anal length (P-A)	cm	1.55	2.45	1.43	1.30	1.13	1.09	1.54
Ventral-Anal length (V-A)	cm	1.39	2.58	1.41	1.35	1.16	1.14	1.38
Dorsal fin1 height (Df1H)	cm	0.45	1.53	0.75	0.59	0.71	0.65	0.42
Dorsal fin2 height (Df2H)	cm	0.65	2.15	0.97	0.84	0.87	0.76	0.62
Pectoral fin length (PfL)	cm	0.67	2.25	1.08	1.06	1.03	0.99	0.83
Ventral fin length (VfL)	cm	0.85	1.94	0.99	0.95	0.79	0.87	0.60
Anal fin length (AfL)	cm	0.41	1.04	0.48	0.46	0.43	0.44	0.37
Caudal fin length (CfL)	cm	1.10	1.65	1.07	1.10	1.00	1.01	0.84

standard length (SL) is 48.70%. The mean ratio value between the pectoral fin length (PfL) and the standard length (SL) has the value of 18.99%, the values being very close in the case of six specimens (18.69%-22.34%), excepting the Țaga Lake specimen (11.75%). In the latter case, an erosion of the pectoral fins is possible, leading to a low ratio value, under the interval between 20.00% and 26.10% specified in the published literature (Bănărescu, 1964). The literature mentions an interval between 16.00% and 22.00% for the ventral fin length (VfL) and standard length ratio (SL). The mean value obtained for this ratio is 16.70%.

From a morphological point of view, the body is slightly laterally flattened, the recorded values of the maximum height (H) for all the

specimens being somewhat higher than the body depth (BD) values. The head of the racer goby is larger compared to other body sizes, the maximum height (H) being usually recorded in the nape area. Regarding the head, the dorsal profile is convex, presenting a pronounced upward slope on the oral-aboral axis. The convexity is declining aboral from the eyes, and the profile becomes almost rectilinear from the nape in the caudal direction.

In the biometric practice, alongside with the phenotypic characters, distances between various anatomical components are studied topographically (in the case of fish these include the pre- and post- fins distances and the distances between fins) as well as the length of the fins. These determinations can establish a basis for fish species

Tab. 4. Meristic measurements determined from the racer goby (*Babka gymnotrachelus*)

Nr.	Location	SML	D1	D2	P	V	A
1	Țaga (Țaga Mare lake)	56	VI	I 15	17	10	I 12
2	Mica (Someș river)	61	VII	I 17	18	10	I 15
3	Gherla 1 (Someș-Fizeș confluence)	59	VI	I 15	16	10	I 15
4	Gherla 2 (Someș-Fizeș confluence)	58	VI	I 17	17	10	I 14
5	Fizeșu Gherlii 1 (Fizeș river)	62	VI	I 16	17	10	I 13
6	Fizeșu Gherlii 2 (Fizeș river)	60	VI	I 18	16	10	I 15
7	Sântioana (Fizeș river)	61	VI	I 15	16	10	I 12

Note: SML-scales on median line; D1-dorsal fin 1; D2-dorsal fin 2; P-pectoral fin; V-ventral fin; A-anal fin



Fig. 3. Racer goby (*Babka gymnotrachelus*) specimens and pontian monkey goby (*Neogobius fluviatilis*) captured in the Someș Catchment: a – racer goby adult specimen (Someșul Mare River – Mica); b - pontian monkey goby specimen (Someșul Mare River – Mica); c, d – juvenile racer goby specimens (Fizeș River – Fizeșu Gherlii)

assessment keys, as is in the case of gobies, which morphologically greatly resemble one another, even though there are presently known over 170 species (Thacker and Roje, 2011).

On this line, we supplemented the previous data with the next determinations: pre-dorsal length 1 (Pr-dL1) [18], post-dorsal length 1 (Po-dL1) [19], pre-dorsal length 2 (Pr-dL2) [20], post-dorsal length 2 (Po-dL2) [21], pre-pectoral length (Pr-pL) [22], post-pectoral length (Po-pL) [23], pre-ventral length (Pr-vL) [24], post-ventral

length (Po-vL) [25], pre-anal length (Pr-sL) [26], post-anal length (Po-aL) [27], dorsal1-pectoral length (D1-pL) [28], dorsal2-pectoral length (D2-pL) [31], dorsal1-ventral length (D1-vL) [29], dorsal2-ventral length (D2-vL) [32], dorsal1-anal length (D1-aL) [30], dorsal2-anal length (D2-aL) [33], dorsal1-dorsal2 length (D1-D2) [37], pectoral-ventral length (P-V) [34], pectoral-anal length (P-A) [35], ventral-anal length (V-A) [36], dorsal fin1 height (Df1H) [38], dorsal fin2 height (Df2H) [39], pectoral fin length (PfL) [40], ventral

fin length (VfL) [41], anal fin length (AfL) [42] and caudal fin length (CfL) [43].

After analyzing all the biometric data, it was concluded that the fin sizes are larger (compared to other fish species) when reported to the body size. Besides the physiological aspects, including the adaptation to fresh water, this aspect helps the species in adapting to various environment circumstances, from shallow and stagnant waters to high water flow rivers. Moreover, the specimen caught from Someșul Mare River, downstream from the Mica Dam, was captured in an area with frequent water floods and furthermore, from the middle section of the stream riverbed.

The following meristic determinations (Tab. 4) were established for the racer gobies caught in the Someș Catchment: SLL 56-62, D1 VI(VII), D2 I 15(16)-17(18), P 16-17(18), A I12(13)-(14)15. The recorded values fit the limits mentioned by the literature. Thus, Bănărescu (1964) states the next meristic measurements for this species: SLL 52-68(69), D1 VI(VII), D2 I(14)15-17(18), A I12-15(16). Haertl *et al.*, (2012) presents similar values: SML (59+3)-(65+4), D1 VI, D2 I17, A I15(14). All these confirm the fact that the species reported by us is in fact the racer goby.

One of the most efficient ways of identifying this species is by the presence of dark diagonal bands on the body sides. These are very visible on the juveniles and in the case of the mature specimen, even though it had a melanic colouring, the bands are still very noticeable (Fig. 3). Therefore the possibility of erroneous species identification is excluded, in the Someș Catchment being earlier identified another goby species (Pontian monkey goby – *Neogobius fluviatilis*) (Cocan *et al.*, 2014), with which the racer goby cannot be mistaken.

The racer goby cannot be mistaken for the pontian monkey goby, both because of its different coloring and different conformation. Significant morphological differences can be observed, especially at head level, the pontian monkey goby having a more elongated profile. Regarding the buccal orifice, even though both species have a terminal disposition of the mouth, its orientation is much more slanted at the racer goby. Also, the racer goby has thicker lips, the upper one being slightly laterally widened and the pre-operculum bones are very developed.

CONCLUSION

The presence of a new gobiidae species, the racer goby (*Babky gymnotrachelus*) in the Someș Catchment is confirmed by the present study. It is the second goby species originating from the Ponto-Caspian area, the Black Sea (Romanian coastline) and south-eastern lakes, after the pontian monkey goby (*Neogobius fluviatilis*), that has been recorded in 2014. The presence of this species can be explained by its migration from the west towards the east, from the Danube, through Tisa, or by the fish material used for restocking Transylvanian fish farms, insufficiently sorted. According to the literature and published scientific papers, may occur in the future other gobies species, migrating from west to east.

The ecological impact of these species on native-endemic species from the Transylvanian freshwaters and also upon fish farms from this area remains to be evaluated, knowing the fact that the racer goby feed includes, among others, fish eggs, fish larvae and juveniles.

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