

On some interesting Romanian gudgeons (Cyprinidae: *Romanogobio*) found in the collection of Museum and Institute of Zoology PAS

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Abstract. Eight gudgeons labelled as belonging to probably extinct cyprinid species, *Romanogobio antipai*, were found in the collection of Museum and Institute of Zoology of the Polish Academy of Sciences in Warsaw. The fish are from Dâmbovița and Ialomița Rivers, Southern Romania, and were collected by T. Nalbant in 1955 and P. Bănărescu in 1958, respectively. Detailed morphometric and meristic characteristics of these specimens were presented in the current paper. It is concluded that whereas the gudgeons from Dâmbovița could be classified as *Romanogobio* cf. *antipai*, the fish from Ialomița River are most probably of other related species, *Romanogobio kesslerii*.

Key Words: biodiversity, Cyprinidae, extinct species, gudgeon, *Romanogobio antipai*.

Streszczenie. Osiem osobników oznaczonych jako należące do prawdopodobnie wymarłego gatunku kielbka, *Romanogobio antipai*, zostało znalezione w zbiorach Muzeum i Instytutu Zoologii PAN w Warszawie. Ryby te pochodzą z rzek Dâmbovița i Ialomița na południu Rumunii i zostały zebrane przez, odpowiednio, T. Nalbanta w 1955 i P. Bănărescu w 1958 r. W niniejszej pracy przedstawiono szczegółowy opis morfometryczny i merystyczny odnalezionych osobników. Kielbkie z rzeki Dâmbovița mogą istotnie zostać zaklasyfikowane jako przedstawiciele *Romanogobio* cf. *antipai*, jednak osobniki z rzeki Ialomița wydają się należeć do innego gatunku, *Romanogobio kesslerii*.

Słowa kluczowe: bioróżnorodność, Cyprinidae, gatunek wymarły, kielb, *Romanogobio antipai*.

Rezumat. Opt porcușori considerați ca aparținând speciei ciprinide, probabil dispărute, *Romanogobio antipai*, au fost găsiți în colecția Muzeului Institutului de Zoologie al Academiei Poloneze de Științe din Varșovia. Peștii provin din râurile Dâmbovița și Ialomița, sudul României, fiind colectați de către T. Nalbant în 1955 și respectiv de P. Bănărescu în anul 1958. În lucrarea de față sunt prezentate detaliat caracterele meristice și morfometrice ale acestor specimene. S-a concluzionat că, în timp ce porcușorii din Dâmbovița ar putea fi încadrați ca *Romanogobio* cf. *antipai*, peștii din Ialomița sunt, cel mai probabil, porcușori aparținând unei specii înrudite, *Romanogobio kesslerii*.

Cuvinte cheie: biodiversitate, Cyprinidae, specie dispărută, porcușor, *Romanogobio antipai*.

Introduction. Gudgeons, a subfamily within the family Cyprinidae, are a group of fish with a real importance for both conservation and ecology (Banaduc 2009; Nowak et al 2008a). Although they are non-important from economical point of view, the extraordinary invasive potential of some gudgeon species (namely the topmouth gudgeon *Pseudorasbora parva* (Temminck et Schlegel, 1842) – cf. Falka et al 2004; Gavriloiu et al 2008; Nowak et al 2008c) makes them important for fish production in fish farms and conservation of native ecosystems. Irrespective, many ambiguities and not-solved problems involved in the systematics of this group of fishes make them an extremely interesting subject for endless investigations of taxonomists (e.g., Bănărescu 1992; Mendel et al 2006, 2008ab; Nowak et al 2008ab).

Material, Method and Results. Eight interesting specimens of the Romanian gudgeons (genus *Romanogobio* Bănărescu, 1961) were found in the collection of Museum and

Institute of Zoology, Polish Academy of Sciences in Warsaw (MIZ). Five of them (MIZ 18704-18708), originally labelled as "*Gobio kessleri kessleri* Dybowski >< *Gobio k. antipai* Bănărescu", were collected on March 6, 1955 in Dâmbovița River at Bucharest by T. Nalbant (Fig. 1). Next three specimens (MIZ 18709-18711), labelled in the same way, were harvested from Ialomița River at Târgoviște on October 15, 1958 by P. Bănărescu. All the fish are stored in 4% water solution of formaldehyde. The specimens were brought to Poland by H. Rolik during her studies on systematic position of the population of the sand gudgeon *Romanogobio kesslerii* (Dybowski, 1864)¹ from the San River system (within the Vistula River drainage, the Baltic Sea basin), the only one population of this species known to occur outside of the Black Sea basin (Rolik 1959, 1965; Bănărescu 1999; Nowak et al 2006; Nowak & Popek, in press).

Table 1
Morphometric characteristic of the analysed gudgeons (MIZ 187604-187611)

Measurement	Dâmbovița River (n = 5)		Ialomița River (n = 3)	
	Range	Mean±S.D.	Range	Mean±S.D.
Total length (TL), mm	46.60-66.37 ^a	53.81±8.64	58.35-72.51 ^b	65.43±10.01 ^b
Body length (L), mm	39.76-57.27	47.68±7.97	46.82-59.51	53.65±6.40
Standard length (SL), mm	37.80-55.59	45.77±8.19	45.42-57.98	51.93±6.29
In % of SL				
Body depth at dorsal fin origin	16.53-20.73	18.01±1.66	16.34-17.54	17.08±0.65
Caudal peduncle depth	6.78-7.26	7.05±0.18	6.52-6.93	6.67±0.22
Body width at dorsal fin origin	12.13-15.51	13.39±1.34	12.40-13.92	13.30±0.80
Caudal peduncle width at anal fin insertion	7.14-9.05	8.00±0.80	6.83-8.04	7.51±0.62
Predorsal length	44.58-48.05	46.43±1.44	46.17-47.10	46.66±0.47
Postdorsal length	41.27-43.17	42.02±0.71	41.50-43.46	42.79±1.11
Prepelvic length	46.95-48.95	48.04±0.83	47.46-49.26	48.22±0.93
Preanal length	68.35-71.40	70.02±1.22	68.39-70.65	69.35±1.17
Pectoral to pelvic fin origin distance	24.19-26.71	25.41±1.11	24.17-24.65	24.49±0.27
Pelvic to anal fin origin distance	21.10-23.81	22.01±1.05	19.74-21.13	20.54±0.72
Caudal peduncle length	21.83-24.24	22.76±0.93	22.01-23.60	22.66±0.83
Length of the longest dorsal fin ray	20.39-22.04	20.99±0.67	21.27-24.09	22.93±1.48
Dorsal fin base length	12.98-15.27	14.10±1.02	13.97-14.59	14.30±0.31
Length of the longest anal fin ray	15.70-16.69	16.31±0.44	17.08-20.48	18.28±1.91
Anal fin base length	8.24-9.39	8.82±0.42	7.84-9.58	8.54±0.92
Pectoral fin length	19.07-20.60	20.02±0.65	22.49-23.27	22.90±0.39
Pelvic fin length	15.11-17.64	16.78±1.03	18.16-19.66	18.81±0.77
Upper caudal fin lobe length	21.81-25.13 ^a	23.03±1.50 ^a	26.28-26.82 ^b	26.55±0.38 ^b
Lower caudal fin lobe length	19.70-22.49 ^a	21.42±1.20 ^a	25.12-25.60	25.36±0.24
Pelvic fin base to anus distance	5.93-7.56	6.55±0.71	6.03-8.62	7.16±1.33
Anus to anal fin origin distance	10.11-12.12	11.05±0.88	9.05-9.78	9.52±0.41
Head length (HL)	23.75-25.93	25.10±0.89	25.32-27.45	26.12±1.16
In % of HL				
Head depth at nape	54.08-60.53	57.65±2.30	51.38-52.38	51.93±0.51
Head depth at eye centre	43.95-49.49	47.05±1.99	42.70-43.37	42.95±0.37
Snout length	35.82-39.81	37.91±1.60	37.00-43.20	39.08±3.57
Eye diameter	21.82-24.92	23.52±1.24	21.49-23.41	22.55±0.98
Postorbital distance	40.82-44.24	42.18±1.37	39.10-46.04	43.05±3.57
Head width at opercles	50.00-58.76	54.75±3.51	47.91-50.41	49.21±1.25
Interorbital width	26.06-28.48	27.63±0.98	24.11-25.66	25.08±0.84
Barbel length	30.48-43.78	39.42±5.46	38.73-42.64	40.98±2.02
Upper jaw length	26.52-31.02	28.57±1.83	29.49-35.37	32.15±2.98
Lower jaw length	20.23-22.62	20.95±0.99	24.27-26.16	25.44±1.02

^a Damaged caudal fin of the largest specimen

^b Damaged upper lobe of the caudal fin of one specimen

¹ Note that the sand gudgeon for a long time has been classified as *Gobio kessleri*. The genus *Romanogobio* has been definitely separated from *Gobio* since the work of Naseka (1996; see also the review in: Nowak et al 2008a). In order to avoid possible ambiguities in the current work we applied actual scientific names of all the species, unless otherwise was stated.

The Danube delta gudgeon *Romanogobio antipai* (Bănărescu, 1953) was initially recognised as one of the four subspecies of the sand gudgeon *R. kesslerii* by Bănărescu (1953: *Gobio kesslerii antipai* ssp. nov.). The remaining three were (using original terms): the nominative form *Gobio kesslerii kesslerii* (Dybowski, 1864), *Gobio kesslerii banaticus* Bănărescu, 1960 and *Gobio kesslerii banarescui* Dimovski et Grupche, 1974. Except the last one, which taxonomic validity is under discussion, all others are currently recognised as valid species (cf. Nowak et al 2008a). *R. antipai* has been considered as a subspecies for a long time (Bănărescu 1964, 1992; Kottelat 1997). Bănărescu (1999) speculated its validity in the species rank, nevertheless he treated it consequently as a subspecies. Finally it was recognised as a separate evolutionary lineage, i.e. valid distinct species under the conditions of the evolutionary species concept (Nalbant 2003; Naseka & Freyhof 2004; Kottelat & Freyhof 2007; Freyhof & Kottelat 2008; Nowak et al 2008a). The evolutionary species concept (Wiley & Mayden 2000; Kottelat & Freyhof 2007) is the only species concept used in the current paper.



Figure 1. *Romanogobio* cf. *antipai* from Dâmbovița River, MIZ 187604, 55.16 mm SL.

In spite of taxonomic considerations, *R. antipai* was recorded for the last time in nature in the 1960s. The latest investigations of J. Freyhof and N. Bogutskaya, during the period of 2001-2003, failed to find any single specimen of this species (Freyhof & Kottelat 2008). Therefore, for the present moment it is considered extinct (Bănărescu 1994; Kottelat & Freyhof 2007; Freyhof & Kottelat 2008).

Taking into account the fact that *R. antipai* has most probably went extinct, we conducted detailed morphological investigation in order to clarify if the mentioned gudgeons from the collection of MIZ indeed belong to that species.

Detailed morphometric characteristic of the gudgeons analysed was presented in Table 1 and general appearance of the one specimen from Dâmbovița River can be obtained from Figure 1. All the measurements were made directly from point to point using a dial calliper (± 0.02 mm), following the scheme of Hubbs & Lagler (1947). Additional measurements are mainly self-explanatory (Tab. 1), and mostly follow the description given by Nowak et al (2008b). Standard length (SL) was taken from the tip of the upper jaw (snout) to the end of hypural complex (Hubbs & Lagler 1947; Kottelat & Freyhof 2007; Nowak et al 2008b), whereas body length (L) was measured to the posterior-most point of the last scale in midlateral row, as widely accepted in Central and Eastern Europe (e.g., Bănărescu 1964; see also the discussion in: Nowak et al 2008b). Last ray in dorsal and anal fin, which is divided to the very base, however is based on a single pterygiophore, was counted as 1 ray.

The gudgeons from Dâmbovița River are of 37.80-55.59 mm in SL and 46.60-66.37 mm in TL (the largest specimen has damaged tips of both lobes of the caudal fin) and the specimens from Ialomița River are of 45.42-57.98 mm in SL and 58.35-72.51 mm in TL (one specimen has damaged upper lobe of the caudal fin, however it is neither the largest nor the smallest one). Their original colouration cannot be followed due to a long

storage in the formaldehyde solution (Fig. 1). All the specimens have well developed epithelial crests on the dorsal scales. Also in all specimens the anus is placed much closer to the pelvic fins (5.93-7.56% of SL in Dâmbovița and 6.03-8.62% of SL in Ialomița River) than to the anal fin (10.11-12.12% and 9.05-9.78% of SL, respectively).

Original key characters used to distinguish *R. antipai* from closely related gudgeons, *R. kesslerii* and *R. banaticus*, were given by Bănărescu (1953, 1964, 1999) as following: small eye, its diameter in specimens of 40-55 mm L amounting only 5.3-5.4% of L (vs. 5.5-5.9% in *R. kesslerii* and 5.9-6.3% in *R. banaticus*) and 72% of interorbital width (vs. 80-92% in *R. kesslerii* and 90-98% in *R. banaticus*); relatively high body, its depth varying between 17.0 and 20.7% of L with an average of 18.55% at 40-55 mm L or 19.3% at 60-80 mm L; usually 4 scales between lateral line and pelvic fin origin (vs. usually 3 in other species of the *R. kesslerii* group); and dorsal crest stronger than in other sympatric gudgeons. Kottelat & Freyhof (2007) stated that *R. antipai* is distinguished from *R. kesslerii* by 4 scales between lateral line and pelvic fin origin (vs. 3 in *R. kesslerii*) and very small eye, its diameter reaching 17-23% of HL (vs. 20-28%). Bănărescu (1953, 1964, 1999) and Nalbant (2003) gave additionally a part of information about the ecology of *R. antipai*, which distinguishes it from sympatric *Romanogobio vladykovi* (Fang, 1943), *R. kesslerii* and *R. banaticus*. The first species occurs on bottom of Danube River itself and the tributaries in deep parts of the river with strong and fast current. Unlike *R. vladykovi*, *R. antipai* does not inhabit either slow flowing part of rivers or any stagnant water bodies. *R. antipai* was considered to be the smallest of all species of *kesslerii* group, not exceeding 55-60 mm in SL (Bănărescu 1999).

Comparison of these key characters and features of the analysed specimens was shown in Table 2. The gudgeons from Dâmbovița and Ialomița Rivers differ from typical *R. antipai* in certain features. Especially the latter are not so deep-bodied and small-eyed as specimens of *R. antipai* usually are (Tab. 2), whereas these two characters are considered the most important in distinguishing *R. antipai* from *R. kesslerii* (Bănărescu 1953, 1964, 1999). In all three specimens from Ialomița River eye diameter is almost equal to interorbital width, what is characteristic to other species of the *R. kesslerii* group (Bănărescu 1953, 1964, 1999). When compared to values given by Bănărescu (1953, 1964) for *R. antipai* and the different populations of *R. kesslerii* of the similar length as usually attained by the first species (that is, 40-60 mm TL), the gudgeons from Dâmbovița (5.42-6.04% of L) and Ialomița Rivers (5.61-5.81% of L) have eyes somehow larger than *R. antipai* (4.9-5.8% of L) and smaller than *R. kesslerii* (5.72-6.40% of L). Also when eye diameter is expressed in percents of interorbital width the situation is similar, or even more clear, and specimens analysed (81.18-87.50% in Dâmbovița and 83.74-94.35% in Ialomița River) resemble the latter species (82.83-93.30%) far more than the former (61.0-81.0%).

All the specimens have long barbels, extending behind the posterior margin of the eye. Their relative length varies from 30.48% to 43.78% of HL, that is 7.33-10.79% of L. Bănărescu (1953) gave the values of 11.50% of L for *R. antipai*, 9.25-10.55% of L for different populations of *R. kesslerii* of the similar length, and 11.40% L for the gudgeons from Ialomița River. This author (Bănărescu 1953) considered relative length of the barbels to be an important taxonomic and phylogenetic trait. In that context analysed specimens from Dâmbovița and Ialomița Rivers resemble *R. kesslerii* somehow more than *R. antipai*.

All three specimens from Ialomița River have only 3 scales between lateral line and pelvic fin origin, whereas *R. antipai* has 4. This number of scales is found only in two specimens from Dâmbovița River. The other three have 3 scales.

The gudgeons from Dâmbovița River have 2 (in 3 specimens) or 3 (2) scales between the tip of the pectoral fin and the origin of the pelvic fin, whereas in the specimens from Ialomița River the distance is much shorter, they have only 1 (in 2 specimens) or even ½ (1) scale there. In the case of the latter river it has already been observed by Bănărescu (1953): in all three specimens analysed by him pectoral fins extended above the insertion of the pelvic fins. Very long, longer than in *R. kesslerii*, pectoral fins are the characteristic trait of *R. antipai*. Nevertheless, the identification

cannot be based solely on that feature due to the fact that length of the paired fins can vary within a large limit and depends on sex and ecological conditions, e.g., water current velocity (Bănărescu 1953, 1999).

Table 2

Meristic characteristic of the analysed gudgeons (MIZ 187604-187611)

Character	Dâmbovița R. (n = 5)		Ialomița R. (n = 3)	
	Range	Mean±S.D.	Range	Mean±S.D.
Perforated scales in lateral row	40-41	40.40±0.55	41-42	41.67±0.58
Perforated scales in lateral line	38-39	38.40±0.55	39-40	39.67±0.58
Scales between lateral line and dorsal fin origin	4-6	5.00±0.71	5	5.00
Scales between lateral line and pelvic fin origin	3-4	3.40±0.55	3	3.00
Unbranched rays in dorsal fin	3	3.00	3	3.00
Branched rays in dorsal fin	7-8	7.80±0.45	8	8.00
Unbranched rays in anal fin	2	2.00	2	2.00
Branched rays in anal fin	6	6.00	6	6.00
Rays in pectoral fin	13-14	13.40±0.55	14	14.00
Scales between anus and anal fin origin	5-6	5.40±0.55	5-6	5.33±0.58
Circumpeduncular rows of scales	10-12	10.80±1.10	11-12	11.67±0.58
Predorsal scales	13-16	14.80±1.30	14-15	14.33±0.58
Scales between tip of the pectoral fin and pelvic fin origin	2-3	2.40±0.55	0.5-1	0.83±0.29

Bănărescu (1953) referred to the gudgeons from Ialomița River as to the nominative form *G. kessleri kessleri* (i.e. *R. kesslerii* using the appropriate actual scientific name). Nonetheless, in later papers (Bănărescu 1964, 1999) he wrote about the populations from both Dâmbovița and Ialomița Rivers as somehow more deep-bodied and small-eyed than typical *R. kesslerii*, thus resembling *R. antipai*. Therefore he concluded them to be "intermediates" between subspecies *G. kessleri kessleri* and *G. kessleri antipai* (Bănărescu 1964). Also Nalbant (1956), among other gudgeons, namely *Gobio gobio carpathicus* Vladykov, 1925, *G. kessleri kessleri* and *Gobio uranoscopus frici* Vladykov, 1925 collected in Dâmbovița River, found a single specimen which he classified as *G. kessleri antipai*. Nevertheless, taxonomic status of the populations from these two rivers has never been thoroughly solved out.

Taking into account all these ambiguities, species identity of analysed specimens from MIZ cannot be assigned definitely. Probably only molecular studies could solve the question if they really are *R. antipai* or *R. kesslerii*, however they are unavailable due to the fact that the gudgeons are fixed and stored in the solution of formaldehyde. It cannot be also excluded that the analysed gudgeons are of hybrid origin. As it was clearly shown in recent years, hybridisation events are common among the species of both European genera of gudgeons, *Gobio* and *Romanogobio* (Mendel et al 2006, 2008ab). It is possible that *R. antipai*, a species restricted rather to the main Danube River, might penetrated the lower stretches of Dâmbovița River in spawning period and a part of the population could remained in the river for a longer time and hybridised with autochthonous *R. kesslerii* (Nalbant, pers. comm., 2009).

Table 3

Key characters of the gudgeons of the *Romanogobio kessleri* species group according to the literature in comparison with data obtained from the analysed specimens (MIZ 187604-187611); character's arithmetic mean and its S.D. were given in parentheses

Character	<i>R. kesslerii</i>	<i>R. banaticus</i>	<i>R. banarescui</i>	<i>R. antipai</i>	Dâmbovița	Ialomîța
Eye diameter in % of L	5.16-6.40 ¹	5.92-6.70 ¹ 5.9-6.3 ² 5.2-6.9 ³	5.2-7.2 ⁴ (6.13) ⁴	5.3-5.4 ^{1,2} 4.9-5.8 ³ (5.32) ³	5.42-6.04 (5.65±0.24)	5.61-5.81 (5.69±0.10)
	5.5-5.9 ²					
	4.9-6.7 ³ (5.5) ³					
Eye diameter in % of interorbital width	81.25-93.30 ¹	90.50-98.50 ¹ 90-98 ² 80.0-106.0 ³	75.0-113.1 ⁴ (91.40) ⁴	61.0-81.0 ^{1,2,3} (71.36) ^{1,2,3} --- ⁵ (80.90) ⁵	81.18-87.50 (85.13±2.66)	83.74-94.35 (89.99±5.55)
	80-92 ²					
	69.0-94.0 ³ (81.0) ³					
Eye diameter in % of HL	19.8-25.9 ³ (22.2) ³	19.1-28.0 ³	20.7-28.5 ⁴ (24.37) ⁴	19.0-22.9 ³ (20.77) ³ 17-23 ⁶	21.82-24.92 (23.52±1.24)	21.49-23.41 (22.55±0.98)
	18.6-24.7 ⁵ (22.47) ⁵					
	16.10-18.50 ¹					
Body depth in % of L	17.8-21.0 ³	15.80-16.54 ¹ 14.3-18.8 ³	14.7-23.1 ⁴ (18.19) ⁴	17.0-20.7 ^{1,2,3} (18.55) ^{1,2,3}	15.57-20.11 (17.28±1.77)	15.85-16.90 (16.52±0.59)
	16.1-20.1 ⁵ (18.4) ⁵					
	16.10-18.50 ¹					
Scales between lateral line and pelvic fin origin	3 (rarely 4) ^{2,3,6}	3 (rarely 4) ^{2,3,6}	3 (rarely 4) ^{2,3,6}	3-4 ² 4 ^{3,6}	3-4 (3.40±0.55)	3 (3.00)
SL in mm	extending 60 ^{1,2,3,6}	extending 60 ^{1,2,3,6}	extending 60 ^{3,4,6}	not extending 60 ^{1,2,3,6}	37.80-55.59 (45.77±8.19)	45.42-57.98 (51.93±6.29)

References to Table 2:

¹ Bănărescu (1953)

² Bănărescu (1964)

³ Bănărescu (1999)

⁴ Dimovski & Grupche (1974)

⁵ Movčan & Smirnov (1981)

⁶ Kottelat & Freyhof (2007)

Conclusion. Summarising, the specimens from Ialomița River almost definitely do not belong to the extinct cyprinid species, *R. antipai*. Most probably they are representatives of *R. kesslerii*. The gudgeons from Dâmbovița River resemble *R. antipai* much more, however their identity also cannot be specified doubtlessly. Thus for the present moment they could be identified only as *Romanogobio* cf. *antipai*. One cannot exclude that in the light of further comparative morphological analyses their identity would be specified more properly. According to Nalbant (pers. comm., 2009) the population of Dâmbovița River, either of the species *R. kesslerii* or *R. antipai*, has most probably went extinct due to a strong water pollution and anthropogenic alterations in that river. All the more, the eight specimens discussed in the current paper are very interesting and valuable exhibits of the collection of Museum and Institute of Zoology, Polish Academy of Sciences.

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