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THE MORPHOLOGICAL CHARACTERISTICS OF THE DANUBE RUFFE, *GYMNOCEPHALUS BALONI* (PERCIFORMES, PERCIDAE), IN THE UPPER REACHES OF THE DNIPRO RIVER, UKRAINE

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The Morphological Characteristics of the Danube Ruffe, *Gymnocephalus baloni* (Perciformes, Percidae), in the Upper Reaches of the Dnipro River, Ukraine. Tsyba, A. O., Kokodiy, S. V. — In the upper reaches of the Dnipro it was found a Danube ruffe population. It differs from the population of the middle reaches of the Dnipro by a longer caudal peduncle. The Danube ruffe differs from sympatric populations of the common ruffe by 10 features. For a fast and precise identification of these two species, it was proposed to use the height of the membrane between the first and second rays of the anal fin as a percentageto the length of the body.

Key words: Pisces, *Gymnocephalus baloni*, *Gymnocephalus cernuus*, ruffe, morphology, Upper Dnipro.

Introduction

The Danube ruffe *Gymnocephalus baloni* Holcik et Hensel, 1974 refers to the poorly studied species in Ukraine (Movchan, 2011) and is included in the Red Book of Ukraine under the “unrated” category (2009). Within Ukraine, it is known from the Lower Danube, the Middle Dnipro and its tributaries: Supij, Sula, Trubizh (Catalogue..., 2003). In the upper reaches of the Dnipro this species known only in its tributaries. In the Desna River basin it was caught by Alexandrova in 1976, Yu. Movchan and others in 1980, 1983, 1988 (Catalogue..., 2003) and O. Zhylyka (2008); and in the Pripyat river basin it was caught by Yu. Movchan, S. Solomko in 1984 (Catalogue..., 2003) and S. Loparëv (1998).

In his book, Yu. Movchan (2011) writes that the Danube ruffe is reliably known of the Dnipro river basin in the Desna River, Kyiv and Kremenchug reservoirs. Although the Kanev Reservoir was not indicated in the book, the samples of the Danube ruffe from this water reservoir presented in the Zoological Museum (Catalogue..., 2003), and the Kyiv Reservoir, as a habitat of the species was not mentioned by ichthyologists. This inaccuracy can be attributed to a typographical error during the preparation of the text.

In many places the Danube ruffe lives with the ruffe *Gymnocephalus cernuus* (Linnaeus, 1758) together and can form hybrids (Holčík, Hensel, 1974). In the middle reaches of the Dnipro River both species of ruffes are usually inhabit nearby. However, some localities are inhabited by the ruffe only or the both species are represented, but the Danube ruffe prevails there (Alexandrova, 1974).

J. Holčík and K. Hensel (1974) provide a key for the identification of *Gymnocephalus* species (Subgenus *Acerina*):

- flanks with irregular spots of different size grouped in 4–6 transverse bands; opercle with two distinct spines; distal edge of dorsal fin perpendicular to caudal peduncle line — *Gymnocephalus baloni*;
- flanks with numerous small irregular spots of different size; opercle with one spine; distal edge of dorsal fin oblique — *Gymnocephalus cernuus*.

Hungarian authors (Specziár, Vida, 1995) have listed the characters for the separation of these two closely related species. This, apart from features that indicated Holčík and Hensel, number of preopercular spikes, body height, and the form of the soft membrane connecting two rays in the anal fin. However, the first characteristic cannot be used, because their results show a great overlapping. The second characteristic usually separates the two species very well (Danube ruffe has larger relative body depth) with a reliability of 90–96 %. *G. baloni* has deeply notched the membrane and *G. cernuus* has barely notched membrane. The third characteristic is of no use when working with specimens, in which the membrane separates itself. In other instances it is a reliable character and can be used with 97–96 % reliability (Specziár, Vida, 1995).

The morphological differences populations of the ruffe and Danube ruffe were examined by A. Alexandrova (1974), A. Specziár and A. Vida (1995). Samples of populations in the Middle Dnipro (Alexandrova, 1974) were significantly different by 6 meristic characters and 23 plastic signs (table 1).

Table 1. The morphological comparison of *Gymnocephalus baloni* and *Gymnocephalus cernuus* collected from the Dniro River in different periods

Measurements	Upper Dniro					Middle Dniro**					I-II		II-III	III-IV
	<i>G. cernuus</i> I n = 15					<i>G. baloni</i> II n = 17					<i>G. cernuus</i> IV n = 60		CD	CD
	M	± m	s	M	± m	s	M	± m	s	M	± m	t	CD	t**
Standard length, cm	9.33	0.24	0.94	9.64	0.22	0.91	9.32	0.13	0.91	10.38	0.13	0.95	0.24	2.76
Spines in D	13.94	0.19	0.80	15.18	0.1	0.39	15.32	0.08	0.39	14.12	0.04	6.34*	1.39	13.48
Soft rays in D	12.56	0.13	0.53	12.35	0.15	0.61	12.13	0.1	0.61	12.6	0.1	1.24	0.26	3.33
Soft rays in A	5.80	0.2	0.83	6.35	0.15	0.61	5.62	0.07	0.61	5.47	0.1	2.26	0.46	1.23
Lateral line scale counts	37.27	0.33	1.32	37.41	0.42	1.73	35.68	0.22	1.73	36.02	0.12	0.27	0.10	1.35
Gill rakers counts	9.33	0.32	1.24	8.24	0.32	1.30	9.5	0.15	1.30	8.93	0.12	2.44	0.60	2.97
Body depth	27.03	0.37	1.42	31.55	0.31	1.28	31.37	0.17	1.28	25.25	0.13	9.48*	2.37	28.60
Caudal peduncle depth	7.81	0.08	0.32	8.39	0.11	0.43	8.32	0.07	0.43	7.73	0.06	4.23*	1.07	6.41
Body width	15.79	0.30	1.19	18.39	0.34	1.40	17.85	0.17	1.40	15.89	0.13	5.62*	1.41	9.35
Predorsal distance	35.18	0.29	1.12	37.24	0.36	1.48	37.1	0.16	1.48	35.23	0.15	4.48*	1.11	8.53
Postdorsal distance	19.08	0.24	0.94	17.32	0.31	1.26	12.76	0.17	1.26	16.73	0.17	4.44*	1.12	16.54
Caudal peduncle length	24.57	0.36	1.40	20.97	0.38	1.59	16.78	0.17	1.59	20.11	0.17	6.77*	1.7	13.88
Preventral distance	33.31	0.34	1.33	35.30	0.32	1.34	36.44	0.14	1.34	33.85	0.14	4.2*	1.05	13.08
Prenal distance	65.28	0.52	2.02	68.32	0.33	1.38	69.71	0.25	1.38	67.15	0.26	5.03*	1.24	7.09
Distance P-V	5.93	0.16	0.60	6.00	0.17	0.71	4.89	0.1	0.71	4.32	0.08	0.28	0.07	4.45
Distance V-A	32.14	0.42	1.62	32.28	0.41	1.68	34.67	0.25	1.68	34.55	0.23	0.25	0.06	0.35
Length of D	53.15	0.44	1.69	56.75	0.24	1.01	56.91	0.23	1.01	53.48	0.24	7.4*	1.83	10.33
Depth of spinous D	20.43	0.25	7.25	21.60	0.27	1.12	20.5	0.18	1.12	19.22	0.2	2.93	0.53	4.76
Depth of soft D	13.38	0.52	3.99	16.58	0.19	0.79	16.1	0.18	0.79	13.13	0.12	5.86*	1.01	13.75
Length of A	11.92	0.21	0.81	14.76	0.27	1.13	14.82	0.14	1.13	12.3	0.1	8.07*	2.04	14.77
Depth of A	14.75	0.24	0.92	17.24	0.31	1.28	16.57	0.17	1.28	14.72	0.14	6.23*	1.58	8.41
Length of P	20.76	0.37	1.44	22.13	0.26	1.05	21.09	0.18	1.05	20.38	0.15	3.09*	0.77	3.03
Length of V	19.72	0.22	0.84	21.81	0.22	0.90	22.93	0.15	0.90	21.27	0.16	6.79*	1.70	7.58
Length of upper C	19.54	0.17	0.66	20.00	0.33	1.34	20.66	0.16	1.34	20.75	0.17	0.79	0.31	0.39
Length of bottom C	18.93	0.14	0.53	19.42	0.26	1.07	20.3	0.16	1.07	20.13	0.18	1.09	0.41	0.71
Head length	30.49	0.21	0.80	31.84	0.26	1.08	32.16	0.13	1.08	30.87	0.15	3.96*	1.00	6.48
Head depth	70.96	0.81	3.14	80.22	0.62	2.56	76.13	0.52	2.56	66.6	0.37	9.18*	2.28	14.8
Length of rostrum	30.23	0.36	1.56	32.37	0.46	1.88	35.17	0.24	1.88	34.02	0.26	4.01*	1.01	3.25
Diameter of eye	29.70	0.34	1.32	31.42	0.49	2.01	29.91	0.25	2.01	27.62	0.21	2.82	0.71	7.0
Postorbital distance	39.56	0.49	1.90	41.23	0.47	1.96	39.91	0.24	1.96	39.85	0.27	2.44	0.61	0.17
Interorbital distance	17.83	0.34	1.43	23.47	0.33	1.12	23.28	0.16	1.12	17.83	0.17	13.9*	3.45	23.39

* p < 0.005, ** (Aleksandrova, 1974).

Material and methods

17 specimens of *G. baloni* and 15 specimens of *G. cernuus* were collected in January 2015 in the upper Dnipro River in Mena District of Chernigiv Region nearby the village of Zagatka (lat 51°20'03" and long 30°38'60"). At this location only the Danube ruffe is confined to the riverbed and dwells at a depth of 5 m. On the contrary, the common ruffe was met only in oxbows of the Dnipro River. For sampling we used the hook-and-line method. All caught specimens were frozen. 5 meristic counts and 25 morphometric measurements were selected for the morphological studies (Sherbucha, 1982). In the article the mean is denoted by *M*, the standard error — *m*, the standard deviation — *s*. The differences were expressed by the coefficient of difference (CD) (Mayr, 1969) and Student's *t*-test. Statistical processing was accomplished using the PAST software.

Results and discussion

We found a Danube ruffe population in the upper reaches of the Dnipro (fig. 1).

D XV (XVI) (11) 12–13; A II 6–7; P (13) 14–16 (17); V I 5; l.l. 34–41; sp.br. (6) 7–10; l 11.0 cm.

The differences in the morphology of sympatric populations of the ruffe and Danube ruffe in the Upper Dnipro and populations of the Danube ruffe in the upper and middle reaches of the Dnipro were investigated. Samples of *G. baloni* and *G. cernua* in the Upper Dnipro significantly differed by only one meristic count: the number of unbranched dorsal fin rays. In *G. baloni* this number was significantly larger than that of *G. cernua*, the coefficient of difference (CD) — 1.39, *t* = 6.34. Also they differ significantly by 9 morphometric measurements. Danube ruffe is characterized by larger than ruffe height and width of the body, length of the caudal peduncle, and the dorsal, anal and pelvic fins, height of the anal fin and head, width of the forehead. The coefficients of differences regarding these characteristics ranged from 1.39 to 3.45 and the width of the forehead had the maximum value.

The populations of the two species of ruffes from the middle reaches of the Dnipro significantly differed on 2 of 5 meristic count and 23 out of 29 morphometric measurements listed in the table 1 (Aleksandrova, 1974). More differences in morphological characters of sympatric populations of ruffes from the Middle Dnipro is probably caused by the use of a greater number of specimens (Aleksandrova, 1974). Interestingly, populations of the Danube and common ruffe on the Middle Dnipro on distance P–V significantly different (*t* = 4.45). In contrast, on the Upper Dnipro, the samples of these species are minimally different on this parameter (*t* = 0.28).

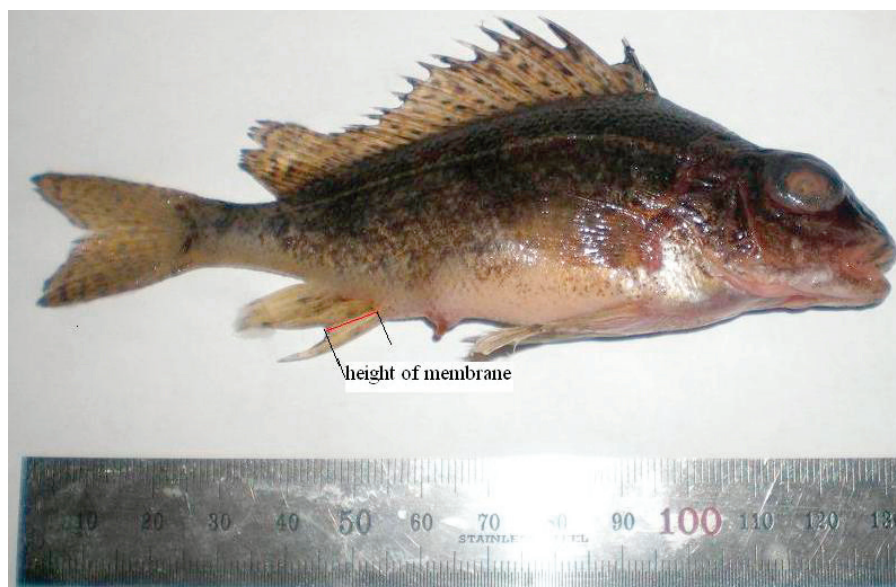


Fig. 1. Photo of *Gymnocephalus baloni* specimen from the upper reaches of the Dnipro.

Samples of the Danube ruffe from the Upper Dnipro differ from the samples from the Middle Dnipro only slightly, meristic counts had no differences, and only 2 morphometric measurements had significant differences. Namely, the caudal peduncle length and the postdorsal distance were larger in specimens from the Upper Dnipro.

The distal edge of the dorsal fin, as proposed by J. Holčík and K. Hensel (1974), is oblique in both the cases according to our data. The angle to caudal peduncle line in the ruffe is sharper, but the magnitude of this angle depends on the degree of straightening of the dorsal fin, and therefore this feature is not very convenient. The second spike on opercle extends beyond the edge of its cover, is not observed in all specimens of the ruffe Danube, what makes it similar to the common ruffe. Number of preopercular spines according to our data coincides with literature data (Specziár, Vida, 1995) and show a great overlapping: *G. baloni* = 9–14, *G. cernuus* = 8–11. Body depth of *G. baloni* lies within 28.90–33.33 and *G. cernuus* — 24.71–29.52, in this characteristic we see minimal overlap. Caudal peduncle length also shows the same minimum overlap: *G. baloni* = 16.82–23.08, *G. cernuus* = 22.47–34.15. These two characteristics are quite reliable and should be used in determining of these fish species.

The most reliable, in our opinion, is the size of the membrane between the first and second rays of the anal fin (fig. 1). The percentage ratio of the height of the membrane to the height of the anal fin is very significant: *G. baloni* M = 52.65 with lim = 44.94–62.50 and *G. cernuus* M = 76.48 with lim = 65.5–88 (at $t = 11.28$), meaning that these indicators do not overlap.

Conclusions

Thus, it can be argued that, population of the Danube ruffe, which is morphologically very close to the population of the Danube ruffe of the middle reaches of the Dnipro River inhabits on the upper reaches of the Dnipro River. 1 meristic count and 9 morphometric measurements distinguish the sympatric populations of *G. baloni* and *G. cernuus*. The relative height of the membrane between the first and second rays of the anal fin is the most visible and convenient characteristic for the reliable separation of the Danube ruffe from the ruffe. We also suggest using one more character in addition to those are already used: caudal peduncle length.

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