

SEXUAL DIMORPHISM IN THE HEIGHT OF ANAL FIN OF MARITZA BARBEL (*BARBUS CYCLOLEPIS* HECKEL, 1937) IN THE MARITZA RIVER BASIN

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Abstract

From the middle stretch of Maritza catchment area 229 sexually mature individuals *Barbus cyclolepis* Heckel, 1837 were examined. The height of anal fin in the two sexes was different. The anal fin of the female fishes was higher than that of males. In the ratio (percentage) between the height of the anal fin and standard length of the body there was a strong statistically significant difference between females and males. This ratio had also much higher value in females as compared to males.

Key words: anal fin, *Barbus cyclolepis*, Maritza barbel, sexual dimorphism.

Introduction

The height of anal fin is one of the systematic characteristics used to identify the species of genus *Barbus*. Anal fin is often with different height in the two sexes and is one of the few indicators of sexual dimorphism found in the species of genus *Barbus*. According to Kottelat and Freyhof (2007) in many species of this genus females have higher anal fin than males, probably in connection with excavating the substrate for spawning.

Chichkoff (1935) stated that the height of the anal fin of Maritza barbel vary from 17.3 to 20.0 % of the body length. Drensky (1951) claimed that in Maritza barbel the tip of anal fin reaches back to the base of the caudal fin.

Marinov (1964) examined 86 individuals obtained in catchment areas of the riv-

ers: Mesta, Struma and Maritza. The author found that in all studied rivers female barbels had higher anal fin than males. Marinov (1964) calculated the ratio between anal fin height and standard length of the body and concluded that the difference between the two sexes in this indicator is even larger. Marinov (1964, 1989) found that this difference was statistically significant in each catchment area separately and for the three catchment areas pooled. The author concluded that the height of anal fin of female barbels is over 16.6 % of standard body length (between 16.6 and 23 %, usually more than 17 %), whereas for males it does not exceed 16.6 % (between 12.5 and 16.6 %).

According to Marinov (1989) the height of anal fin of *Barbus barbus* Linnaeus, 1758 is between 13.8 % and 19.8 % of standard length of the body.

The author concluded that in *Barbus meridionalis petenyi* Heckel, 1848 the height of the anal fin of females reaches to caudal origin, whereas for males surpasses this origin.

Sivkov (1991) did morphological characteristic of barbels, distributed in the watershed of the Danube River: Ogosta, Iskar, Vit, Yantra and Kamchia (Sivkov 1991). The author pointed out that the height of the anal fin is significantly greater in females than in males. He considered this as being the only sign of sexual dimorphism in barbels from these rivers.

According to Bianco (2009) the height of the anal fin of Maritza barbel is 23.8 % from the standard length of the body.

According to Kottelat and Freyhof (2007) *B. strumicae* occurs in the rivers Struma and Mesta, while *B. cyclolepis* is endemic to the basin of Maritsa River. The examination of the height of anal fin of barbels in the three streams taken together may lead to inaccuracies. Therefore, this character was examined in *B. cyclolepis* only in the basin of the Maritza River.

Objective and tasks set

The aim of this study was to examine the difference in height of the anal fin in males and females of *B. cyclolepis* in two of the tributaries of Maritsa River.

For achieving this objective the following main tasks were set:

- to determine the variation in the height of anal fin in *B. cyclolepis* in both sexes;
- to calculate the ratio between the height of anal fin and standard length of the body of both sexes.

Study Area

A large share of the runoff of Maritza River on territory of Bulgaria is formed by its tributaries in Sredna Gora Mountains and in Rhodopes Mountains. Therefore, two tributaries were included in the study: Stryama River coming from Sredna gora Mountains and Chepinska River – from the Rhodopes Mountains.

Stryama River rises east of peak Vejen in Zlatishko-Tetevenska Mountains, part of the Sredna Gora Mountains (Figure 1). Stryama is a left tributary of Maritza River, with a length of 110 km and catchment area 1,789 km². Stryama River flows into the Maritza River near the village of Manole.

Chepinska River is a tributary of Maritza River flowing from peak Mala Syutkya in Rhodopes Mountains. The length of this river is 83 km. Its catchment area is 899.6 km² and it flows into Maritza River near the village of Zlokuchane.

Materials and Methods

Fish sampling was undertaken in the spring, summer and autumn of 2010 and 2011 and took place in 6 sampling areas (Table 1).

The material was collected by electrofishing, conducted with unpuled direct current (DC) and two upstream passes. We used the backpack electrofisher SAMUS 725G – (Samus special electronics, Poland), powered by a 12 V accumulator battery with 75 Ah capacity. The electrofisher converter provides DC impulses with frequency ranged between 5 and 100 Hz, duration 0.03–3 ms and maximum power of 650 W. It is suitable for water resistance

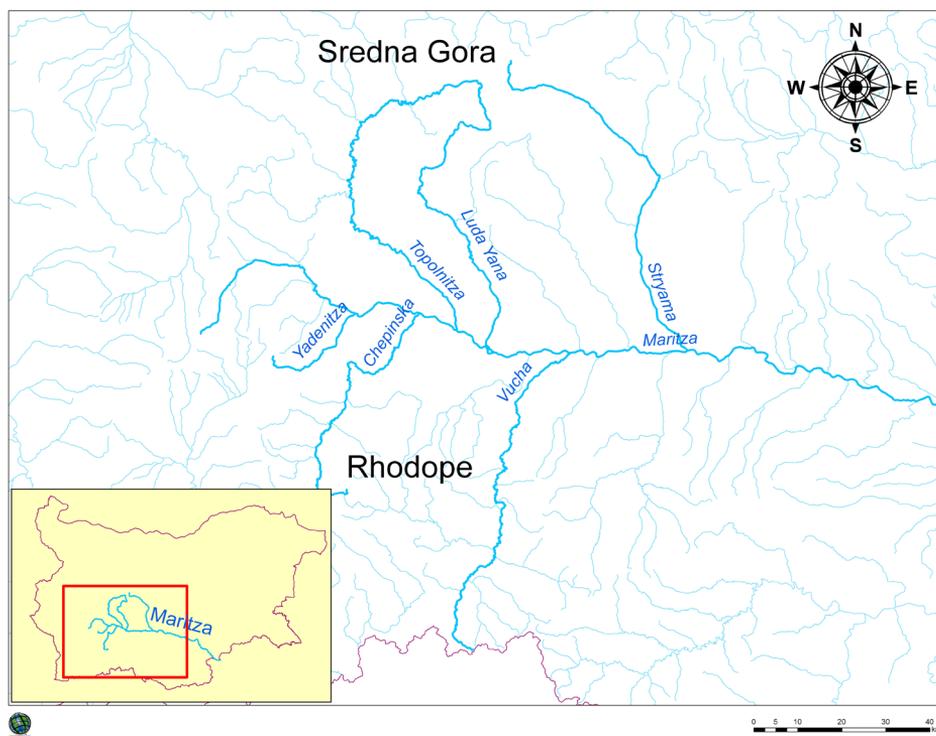


Fig. 1. Location of studied rivers Stryama and Chepinska, Arc Map 10.0 (ESRI).

Table 1. Sampling areas in rivers Stryama and Chepinska.

No	Date	River	North latitude	East longitude	Altitude, m a.s.l.	Location
1	13.06.2010	Chepinska	42°07'42,02"	24°07'24,53"	401	Near the mineral baths of Varvara
2	14.06.2010	Chepinska	42°06'24,78"	24°06'20,11"	465	Neat the railway station M. Nikolov
1	26.07.2010	Chepinska	42°07'42,02"	24°07'24,53"	401	Near the mineral baths of Varvara
3	27.07.2010	Chepinska	42°05'43,81"	24°04'54,82"	523	Near the village of Draginovo
4	19.11.2010	Stryama	42°33'38,45"	24°47'54,11"	302	Near the fish farm of Banya
2	08.04.2011	Chepinska	42°06'24,78"	24°06'20,11"	465	Neat the railway station M. Nikolov
4	09.04.2011	Chepinska	42°05'43,81"	24°04'54,82"	523	Near the village of Draginovo
5	17.04.2011	Stryama	42°32'18,12"	24°49'22,78"	283	Near the town of Banya
4	20.10.2011	Stryama	42°33'38,45"	24°47'54,11"	302	Near the fish farm of Banya
6	18.11.2011	Chepinska	42°11'09,62"	24°09'45,65"	240	Near the village of Lozen
4	20.11.2011	Stryama	42°33'38,45"	24°47'54,11"	302	Near the fish farm of Banya

Table 2. The specimens of *B. cyclolepis* with minimum and maximum values of the height of anal fin and the standard length of their body in the sample of the rivers Stryama and Chepinska.

Sex/individuals	♀/n = 98		♂/n = 131	
River	min h, mm/ l, mm	max h, mm/ l, mm	min h, mm/ l, mm	max h, mm/ l, mm
Chepinska	17/134	45/204	12/77	20/104
Stryama	16/97	44/163	9/70	29/143

Legend: ♀ – females, ♂ – males, *h* – height of anal fin, *l* – standard body length in that specimen.

from 25 to 1000 Ω. The amperage in load condition was from 5 to 65 A. Besides in the present study, the material collected was used also for studying the fecundity of the species.

Identification of the species was done according to Kottelat and Freyhof (2007) and Stefanov (2007). Sexual determination was done by examining the gonads by eye and under binocular microscope Carl Zeiss Jena with zoom 20–60 X. Measurement of the standard body length and height of the fins were performed by millimeter line with accuracy to nearest 1 mm.

The ratio between height of anal fin and standard length of the body was calculated using the formula (1).

$$R = 100 \cdot h \cdot l^{-1}, \quad (1)$$

where:

R is the ratio between height of anal fin and standard length of the body, %;

h is the height of anal fin, the distance from the base to the top of the spines of the anal fin, mm;

l is the standard length of the body, i.e. the distance from the top of the head to the end of scaly cover, mm.

Statistical data processing consisted of comparison among means using t-test and was done by using the software

PAST (Hammer et al. 2001).

Results

Total 229 sexually mature individuals of *B. cyclolepis* were caught in the studied rivers. The maximum value of the anal fin height of Maritza barbels in

rivers of Stryama and Chepinska pooled was 45 mm for the females and 21 mm for males, respectively (Table 2). The lowest value of the anal fin height for females in the two studied rivers was 16 mm, while in the males it was 9 mm.

The results showed that the mean ratio between height of the anal fin and the standard body length of *B. cyclolepis* in the two studied rivers was 22.33 % for females and 16.34 % for males (Table 3). In females this ratio varied between 12.68 % and 26.99 %, and only in 5 females it was lower than 20 %. In the male Maritza barbels the ratio ranged from 11.2 % to 21.35 %. Only in three males this ratio was 20 % and more.

Discussion

The results of the present study confirm the statement of Marinov (1964) that in females anal fin usually reaches the caudal origin, while in males often it does not reach it. The author's results support the assumption of Kottelat and Freyhof (2007) about the role of the anal fin in female barbels during the spawning period.

Table 3. Ratio between height of anal fin and standard length of the body to the *B. cyclolepis* Heckel, from the rivers Stryama and Chepinska.

Sex/individuals and statistical index	♀/n=98	♂/n=131	df	CI	p	S ²
Ratio between the height of anal fin from standard length of the body	22.33 %	16.34 %	227	95 %	0,00	4.07

Legend: ♀ – female, ♂ – males, *df* – degrees of freedom, *CI* – confidence limits, *p* – *p*-value, *S*² – pooled variance.

There was strong statistically significant difference between the two sexes in the ratio height of the anal fin: standard body length in Maritza barbel in two studied rivers (Table 3).

However, the percentage better indicates the difference in height of anal fin in both sexes than direct height comparison. The ratio height of the anal fin: standard body length better expressed the difference between the two sexes, than direct comparison of average heights anal fins.

The ratio of the height of the anal fin and the standard body length of *B. cyclolepis* reported by Bianco (2009) is similar to our data concerning the females.

In contrast to the results of Marinov (1964) present study included larger sample only from Maritza River Basin. The results showed that the ratio of the height of the anal fin and standard body length of *B. cyclolepis* varied widely in both sexes. However, there was a clear difference in the upper limit of this ratio, reaching up to 27 % in females, while in males it was no more than 21 %. In most cases, the ratio in males did not exceed 20 %, while in females it was more than 20 %. The obtained values of the studied ratio are greater than these in Marinov (1964), but confirmed the established sexual dimorphism in the height of the anal fin in *B. cyclolepis*. This difference could likely be due to the larger sample collected from only one catchment area.

Conclusions

The height of anal fin in female individuals of *Barbus cyclolepis* from Maritza River was significantly greater than that of males.

The ratio of the anal fin to standard body length in female barbels was average 22 %, whereas in males the average value was 16 %.

Most often, the ratio between the height of the anal fin and the standard length of the body of males did not exceed 20 %, and for females was more than 20 %.

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