

AGE, GROWTH RATE AND CONDITION FACTOR OF THE MARITSA BARBEL (*BARBUS CYCLOLEPIS* HECKEL, 1837) IN THE STRYAMA RIVER

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Abstract

A study of the Maritsa barbel in the Stryama River, a tributary of the Maritsa River was carried out. The material was collected in autumn from 2006 to 2011 by electrofishing. A total of 537 specimens of Maritsa barbel were caught. The population was represented by six age groups. The rate composition was simple. In the catch of the barbels in the Stryama River dominated third age groups. The dominating size group in the sample of barbel in the Stryama River was between 61–70 mm long. The relationship between the average values of L (standard length) and S (scale radius) was described by the equation: $L = 13.7486 + 2.8974 \cdot S$; correlation $r = 0.9694$. The barbel in the Stryama River reaches a smaller length than the barbel in the rivers Arda and Doirani. The relation between fish weight (W) and length in the population was represented by the equation: $W = 0.00002 \cdot L^{2.896}$; $r = 0.9996$. The Maritsa barbel in the Stryama River had a lower condition factor than the barbel in the rivers Arda and Maritsa.

Key words: *Barbus cyclolepis*, growth of weight, linear growth, size and age composition.

Introduction

The Maritsa barbel (*Barbus cyclolepis* Heckel, 1837) is an endemic species for the Balkan Peninsula. The fish occurs in the Maritsa River and in its tributaries and also in some water courses of the Aegean watershed and the Black sea watershed on the territory of Turkey (Kottelat and Freihof 2007). The Maritsa barbel is one of the most numerous fishes in the middle zone of the Maritsa River tributaries in Bulgaria and also one of the favorite sport fishes in these water courses. The taxonomy of the species was examined by Marinov (1986). The

author published some data for the length growth of the Maritsa barbel in the Cheinska River, a right tributary of the Maritsa River. The density, biomass, the growth rate and the condition of the Maritsa barbel in the Arda River, another right tributary of the Maritsa River, was studied by Dikov et al. (1994). Vasiliou and Economdis (2005) studied the ecology of the Maritsa barbel in the rivers of the Northern Greece. Raikova-Petrova and Rozdina (2007) and Rozdina (2009) presented data on the population biology of the Maritsa barbel from the Middle Stream of the Maritsa River.

The aim of the study was to compare the growth rate and the condition factor of the Maritsa barbel in the Stryama River with the results obtained for other rivers.

Study Area

The study area includes the Stryama River, a left tributary of the Maritsa River

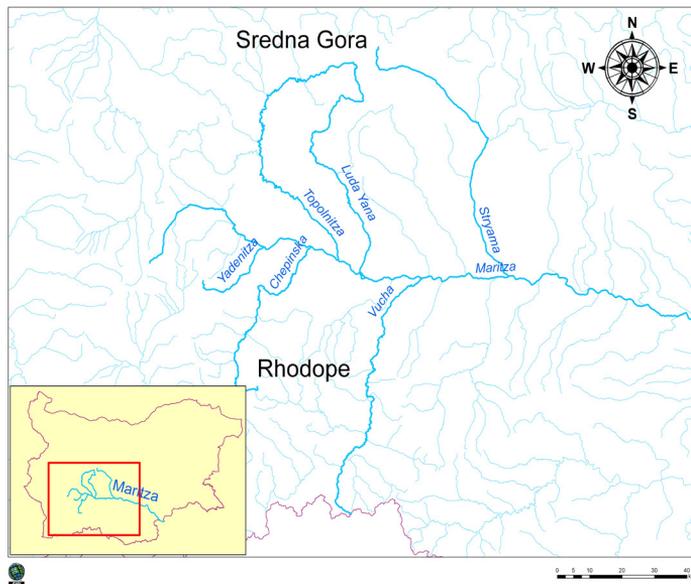


Fig. 1. Location of the Stryama River, Arc Map 10.0 (ESRI – ArcGIS 2013).

coming from the Sredna Gora Mountains (Fig. 1). The Stryama River springs east of peak Vezhen in the Middle Balkan Mountains and flows between the Balkan and the Sredna Gora mountains. Its length is 110 km with a catchment area of 1,789 km². The river flows into Maritsa River near the village of Manole. Most of the Stryama River is in the Upper Thracian Valley and is characterized by small slope, although its average altitude is high.

Materials and Methods

In the period 2006–2011 537 pieces of Maritsa barbel were collected from the Stryama River by electrofishing. A SAMUS 725G converter was used, providing up to 640 V direct current (DC), frequency 50 Hz and output power reaching up to 200 W. The catch was performed according to the EN 14011:2004 instruction (Water quality

– Sampling of fish with electricity). Fish for this study were caught mainly in autumn in four sampling areas (Table 1).

The standard length (L) with a precision of 1 mm and weight (W) with a precision of 1 g were measured. The age was determined by measuring the fish scales using an Olympus CX 31 microscope at a 40× magnification.

The identification of the species was made according to Kottelat and Freyhof (2007).

An estimation was made of the growth rate of the Maritsa barbel in different water bodies, comparing the average lengths of equal age specimens (Raikova-Petrova and Zivkov 1993, Zivkov 1999). The weight calculated for the specimens of fixed lengths (50, 100, 150, 200, 250, etc., mm) were used as condition factors of the different populations of the Maritsa barbel (Zivkov 1999).

Survival ($S = e^{-z}$) and annual mortality rate ($A = 1 - S$) were calculated using

Table 1. Sampling areas in the Stryama River.

No	Location	Geographic coordinates		Altitude, m a.s.l.	Date of sampling
		N	E		
1	Near the bridge of the road Plovdiv-Rakovski	42°15'07.29"	24°50'21.05"	174	16.11.2006
2	Near the bridge of the road Plovdiv-Banya	42°32'18.12"	24°49'22.78"	283	17.11.2006 17.04.2011
3	Near the town of Banya next to the fish farm.	42°33'39.11"	24°47'45.81"	302	17.11.2006 19.11.2006 19.10.2011 20.11.2011 16.12.2011
4	Near the village of Rozino next to the bridge on the Stryama River	42°41'29.46"	23°34'00.57"	478	26.10.2008

the equation describing the relationship between the number of fish in the catch and their age (Raikova-Petrova and Zivkov 1993, Zivkov 1999).

Results and Discussion

The relation between the fish length (L) and the scale radius (S) is:

$$L = 13.7486 + 2.8974 \cdot S; r = 0.9694.$$

The decrease of mean logarithmic values of the Maritsa barbel's abundance in the Stryama River is described by the slope regression:

$$\ln N\% = 4.8856 + 0.8184 \cdot t; r = 0.778; n = 537.$$

Age and size composition

The third age group dominates in the catch. The second and the third age groups form over 50 % of the total catch of Maritsa barbel (Fig. 2). Obviously the greatest was the elimination in the fifth and the sixth age groups. The dominant size group in the sample was the group which length between 61–70 mm (Fig. 3). The population is characterized with

a relatively low survival ($S = 44.1\%$) and higher annual mortality rate ($A = 55.9\%$).

The largest specimen is 212 mm long and weights 130 g. The full length of the body of this specimen is 245 mm, the total weight is 146 g and it is five years old (Table 2). The oldest specimen is six years old, 167 mm long and weighs 60 g. Some authors have reported a greater variety of age groups of the Maritsa barbel. Raikova-Petrova (2007) and Rozdina (2009) have found that the maximum age of the barbel in the Maritsa River is 8 years. Vasiliou and Economidis (2005) identify 9 age groups of the Maritsa barbel in the two tributaries of the Vardar (Axios) River – Almopoiios and Doirani, on the territory of Greece. It is normal to find to meet bigger fish in the main river than in its tributaries. The weak interest in fishing in the inland water flows in Greece seems to be the reason for the greater survival of the Maritsa barbel there and its higher life expectancy in comparison with the fish in the Stryama River. The third age group dominates in the catch. The dominant size group is 61–70 mm.

The Marisa barbel in the Stryama River is characterized by high rate of the unpredictable mortality and by short life span.

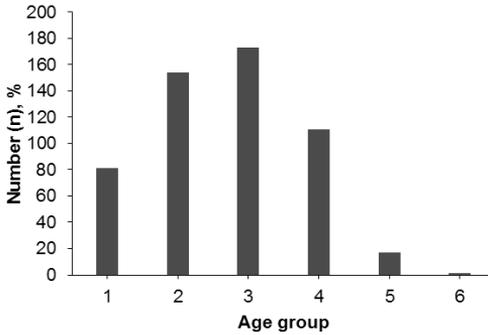


Fig. 2. Age structure of the population of Maritsa barbel in the Stryama River.

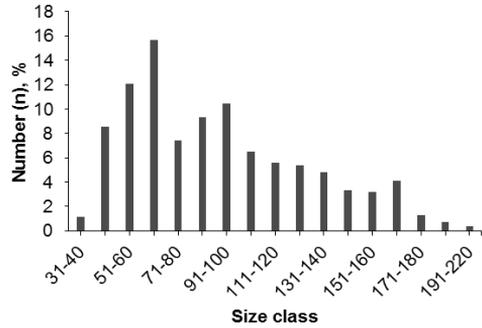


Fig. 3. Size class of the population of Maritsa barbel in the Stryama River.

Similar results for this species in the Doirani River has been reported by Vasiliou and Economidis (2005).

Growth rate

The length Linear and the weight growth are shown in Tables 2 and 3. The Maritza barbel has the greatest length growth in the first year of its life. This is due to the fact that one year old fish are not yet sexually

mature and use their reserves only for growth (Nikolsky 1965). In subsequent years, length growth is gradually increasing until the fifth year of the life of the fish. In the sixth year the length growth of the barbel slows down. This trend in length growth has been observed for the barbel from the Maritza River too (Table 4) (Rozdina 2009). This is probably a sign of the start of the aging period (Nikolsky 1965).

The weight growth is characterized by a gradual increase to the fifth year

Table 2. Back calculated body length of the Maritsa barbel in the Stryama River.

Generation	Age group	Back calculated body length (L , mm) of Maritsa barbel at the end of each year of the life, calculated from scales radius (S)						Number
		L_1	L_2	L_3	L_4	L_5	L_6	
2011	I	51						1
2009	III	55	67	83				66
2008	IV	56	67	94	110			135
2007	V	63	76	99	131	152		7
2006	VI	50	78	86	109	135	156	58
2004	III	45	53	66				184
2003	IV	54	74	99	122			50
2002	V	57	67	93	122	153		36
Average body length (L_{av}), mm		54	69	89	122	147	156	
Real length (L_r), mm		45	n.d.	69	112	159	165	
Growth length (l'), mm		54	15	20	33	25	9	

Legend: n.d. – no data.

Table 3. Back calculated body weight of the Maritsa barbel in the Stryama River.

Generation	Age group	Back calculated body weight (W , mm) of the Maritsa barbel at the end of each year of the life, calculated from body length (L , mm)						Number
		W_1	W_2	W_3	W_4	W_5	W_6	
2011	I	1.8						1
2009	III	2.2	3.9	7.3				66
2008	IV	2.3	3.8	10.3	16.2			135
2007	V	3.3	5.5	11.9	27.3	41.6		7
2006	VI	1.7	5.9	8.1	16.1	29.8	44.7	58
2004	III	1.2	2.0	3.7				184
2003	IV	2.1	5.1	11.9	21.9			50
2002	V	2.5	3.8	10.1	22.1	42.5		36
Average body weight (W_{av}). g		2.1	2.1	4.3	9.0	22.0	38.0	
Real weight (W_r). g		1.4	1.4	n.d.	5	19.6	56.4	
Growth weight – (t'). g		2.1	2.2	4.7	13.0	16.0	6.7	

Legend: n.d. – no data.

of the life of the fish. The weight growth during the first year is the smallest. For the first year the length growth of the fish is greater than the weight growth. In the sixth year of the life of the Maritsa barbel the weight growth rate also decreases (Table 2 and 3). The data shows that the most rapid growth in length and weight of the Maritsa barbel has the 2007 generation. The next three generations of barbel

in the Stryama River have a slower rate of growth in length and weight.

In the Stryama River Maritsa barbel reaches a shorter length in comparison with the two south – flowing rivers Arda and Doirani (Dikov et al. 1994, Vassiliou and Economidis 2005). This is probably due to a longer growing season, warmer winters and better growth conditions in the Arda and Doirani Rivers. In comparison with the

Table 4. Comparison of average lengths of equal age Maritsa barbel in five rivers area from its habitat.

Author/s and year	River	Body length (L), mm								
		L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9
Rozdina 2009	Maritsa	35	62	91	116	140	152	171	204	
Our data 2015	Stryma	54	69	89	122	147	156			
Vasiliou & Economidis 2005	Doirani	68.2	97.5	121.2	144	166	188	213.2	226.1	236.3
Dikov et al. 1994	Arda	64	106	140	182					
Marinov 1986	Chepinska	115	139	148						

growth of the barbel in other rivers (Table 4) in the Stryama River the length growth of the Maritsa barbel is closest to this in the rivers Doirani, Arda and Chepinska. Barbel in Stryama River grows faster in length but slower in weight compared with barbel in the Maritsa River (Rozdina 2009).

The condition factor

The condition factor is shown in Table 5. The populations of Maritsa barbel in the rivers Arda, Maritsa and Stryama are arranged according to their weight for 250 mm. The weight of the Maritsa barbel from the rivers Arda and Maritsa is greater than the weight of the barbel in the Stryama River for equal rounded lengths. The difference in the weight of the Maritsa barbel in the rivers Maritsa and Stryama increases proportionally with the lengths. While the differences in weight for the 50–100 mm long Maritsa barbel in the two rivers are only a few grams, the differences in weight for the 250 mm ones are about 100 grams. The Maritsa River has a low average altitude, its average slope is smaller, its average water temperatures are higher and its capacity is much higher compared to the Stryama River.

Perhaps this has an effect on the growth conditions, the abundance of food and the availability of a better habitat. This fact is confirmed by a comparison with the data of Rozdina (2009). This is also shown in the study on the food components of the Maritsa barbel (Rozdina et al. 2008). The better conditions for the Maritsa barbel in the main course of the Maritsa River in comparison with those of the Stryama River are in accordance with the concept of the river continuum – in the lower part of the watercourse nutritional conditions are favorable, the number of fish is larger and they grow more rapidly (Uzunov and Kovatchev 2002). In terms of the Arda River, its watershed is much more to the south, and falling under the strong Mediterranean influence of the climate. It is likely that the warmer climate and the longer growing season lead to the better conditions of the barbel there.

The condition factor of the barbel from the Stryama River is lower than that of the barbel in the rivers Maritsa and Arda.

Conclusions

Considering our data on the population of the Maritsa barbel in the Stryama

Table 5. Condition factor of the Maritsa barbel in different rivers.

River	Author/s and year	Equation of the whole population	Average weights (W_L , g) calculated with the same rounded lengths (L , mm)				
			W_{50}	W_{100}	W_{150}	W_{200}	W_{250}
Stryama	Our data 2015	$W = 0.00002L^{2.896}$	1.7	12.4	40.1	92.2	176.0
Arda	Dikovet al. 1994	$W = 0.00002L^{2.9401}$	2.0	15.2	50.0	116.5	224.5
Maritsa	Rozdina 2009	$W = 0.0144L^{3.0588}$	2.0	16.5	56.7	137.4	271.9

Legend: W_L – weight of the fish with rounded values of the body length (50 to 250 mm).

River we reached to the following conclusions:

1. The third age group dominates in the catch of barbel from the Stryama River;

2. The dominant size group in the sample of barbel from the Stryama River is the group with a length between 61–70 mm;

3. The population of the Maritsa barbel in the Stryama River is characteristic with a relatively low survival and short life span;

4. The barbel in the Stryama River has its greatest length growth in its first year of life;

5. The barbel from the Stryama River reaches a smaller length than the barbel in the rivers Arda and Doirani;

6. The condition factor of the barbel from the Stryama River is lower than that of the barbel in the rivers Maritsa and Arda.

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