

Ecological Characteristics of the Roach (*Rutilus rutilus* L.) and Bream (*Abramis brama* L.) in the Reservoir of the Lake Modrac

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Abstract: A one-year study on the fish population of the Modrac reservoir showed that roach (*Rutilus rutilus* Linnaeus, 1758) and bream (*Abramis brama* Linnaeus, 1758) predominated in the ecosystem, roach being a dominant and bream a subdominant species. That was the very reason for this research aimed at examining their ecological characteristics, gender, age structure and growth. The analysis included 345 samples of roach and 216 samples of bream. It was conducted separately for each gender of both species.

Key words: ecological characteristics, roach, bream, Modrac reservoir

Introduction

Lake Modrac is an artificial lake formed in 1964 for the purpose of supplying the industry of Tuzla with water. At the time of its construction, the length of the reservoir was about 11km, the breadth about 1.6km and the surface area about 17.10km², with the depth of about 18 m and an average depth of about 6m (Mihaljevic *et al.* 1997). Throughout its existence, the lake has been exposed to intensive alluvium covering from shore abrasion and high amounts of coal dust from

two coal separation processes, which inevitably resulted in the reduction of its dimensions. During the time, its purpose changed. In 2006, a water purification plant was installed. It supplied drinking water to several towns and municipalities.

Irrespective of the 40 years of its existence, the Modrac reservoir has been ichthyologically studied only once (Habeković *et al.* 1981).

Ichthyological studies of the reservoir were conducted from March to October 2006 to examine the diversity of the fish population in the observed hydrosystem.

Material and Methods

Field researches were conducted for several days at all four seasons during 2006 to collect data on the fish population in the Modrac reservoir. The intention was to gain an insight into the qualitative and quantitative structure of the fish population. To avoid the selectivity of certain fishing tools, samples were collected by gillnets and barracuda nets of different diameters (mesh sizes ranging from 10mm to 50mm) that were tied in around 200 m sets. The catch in the coastal region of the reservoir was conducted with the help of boats that used the «ELT 61 II» - 300/500 V and 2kV Honda electrical generating unit. Exemplary fishing tools were used for fishing at five locations in the vertical profile of the reservoir.

The fish species were determined according to the Vuković and Ivanović (1971) determination keys, and other available literature was used - Berg (1932) and Simonović (2001).

The distinguished bream and roach species were measured by means of ichthyometers and a pair of compasses. The total and standard lengths of the body and ranges of each were established and the average was calculated. A «Tehtnica ET 1111» digital scale was used to determine the mass of the sampled fish. The acquired values were statistically analyzed according to Petz (1985). Fish age was established by counting scarlet rings on the scales and gender by dissection and examination of the gonads. Based on the obtained data, an analysis was made of the gender and age structure of the population as well as of the linear growth of fish.

Results and discussion

The study on the ecological characteristics of the roach population of the Modrac reservoir included 345 samples of fish, i.e. 103 females, 78 males and 164 sexually immature fish. A separate analysis of relative characteristics of the population was conducted for each gender.

The roach (*Rutilus rutilus*) population

As shown in Figure 1, the gender structure of the roach is characterized by a higher number of females (30.00%) as compared to the males (23%), indicating a growth dynamics and growth tendency of the population. The majority of the population comprised sexually immature individuals (47%). This suggested that the population lived in an ecosystem that provided optimum conditions for existence.

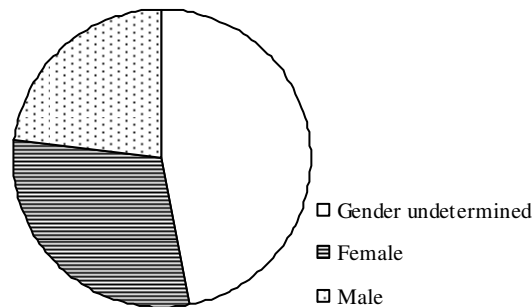


Fig. 1. The roach gender structure (%)

As for the age structure, male fish were aged 0+ to 6+, the evident majority belonging to the younger age category. The categories of fish aged 2+ and 0+ were the most and least dominant, respectively (Figure 2).



Fig. 2. The age structure of roach males

As for the age structure of roach females, the fish were aged 1+ to 6+. The categories of fish aged 2+ and 6+ were the most and least numerous, respectively (Figure 3.).

Two age categories – of 0+ and 1+ - were registered in the gender-classified samples. Most of the fish (73%) were 0+, the rest (27%) being 1+.

Apart from analyzing the gender and age structures of the sampled population, certain body measurements (total and standard body length, fish mass) were also taken for the gender and age categories of fish. Average values were calculated for all body measurements. The results of the analysis are given in Table 1, 2 and 3.

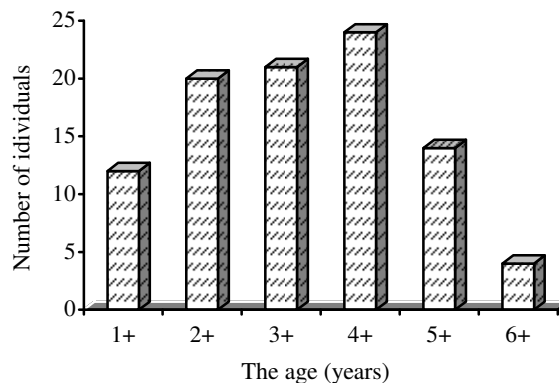


Fig. 3. The age structure of roach females

The data presented in the tables show that the range of basic body measurements and their average values were within the range that had been previously established and documented in literature and no significant deviations were recorded.

The results of the present study were compared to those of Marković *et al.* (1996) obtained for the roach population in the Zapadna Morava River (Serbia). The authors reported data on the linear growth of roaches, analyzing 124 samples of fish aged 1+ to 7+. The growth was calculated by backward counting, suggesting that the total body length ranged from 61 mm in the fish aged 1+ to 211 mm in those aged 7+. The obtained results were similar to the results of the present study.

The average values of the total body length were used to analyze the length growth of the roaches, and the growth of body mass was measured from the body mass average. Both parameters were given for each age category separately, and an analysis was conducted separately for each gender (Figure 5 and 6).

Tab. 1. The range of body measurements and mass of roach males

Age	TBL (cm)	SBL (cm)		Fish mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	$\bar{x}$
0+		11,5		9,4	15,0
1+	10.30 - 12.20	11.29	8.10 - 10.00	9.19	15.15
2+	11.50 - 15.00	13.80	9.30 - 12.20	10.63	25.98
3+	12.50 - 18.00	15.83	10.00 - 14.51	12.81	45.96
4+	16.20-18.70	17.56	13.40-15.70	16.38	93.90
5+	18.00-21.50	19.80	14.80-17.20	16.38	93.90
6+	18.90-19.50	19.20	15.50-16.20	15.85	83.0

Tab. 2. The range of body measurements and mass of roach females

Age	TBL (cm)		SBL (cm)		Fish mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$
1+	10.40 -11.80	11.18	8.40 – 9.70	9.10	10.90 – 18.10	13.82
2+	10.70 -16.60	13.19	8.50 - 13.50	10.65	13.80 – 54.00	25.71
3+	11.80 -17.80	15.67	9.50 – 14.50	12.96	20.10 - 75.20	44.93
4+	16.20-21.20	18.50	10.50-17.80	15.14	54.90-134.60	81.85
5+	17.80-22.20	19.40	14.30-18.50	16.00	72.90-162.10	97.54
6+	18.80-20.40	19.50	15.30-17.00	16.05	76.80-112.20	93.83

Tab. 3. Body measurements and fish mass of sexually immature roach

Age	TBL (cm)		SBL (cm)		Fish mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$
0+	5.0 - 11.0	7.67	4.1 - 9.0	6.18	0.7 – 15.3	5.15
1+	9.1 - 11.2	10.2	7.4 - 9.3	8.25	6.9 - 16.8	11.2

The analysis of the roach length growth showed that the fish of both genders intensively grew in the period from 0+ to 3+, following which the males grew slower. Similarly, the females manifested a lower growth rate at the age of 4+. The results of the roach growth are presented in Figure 5.

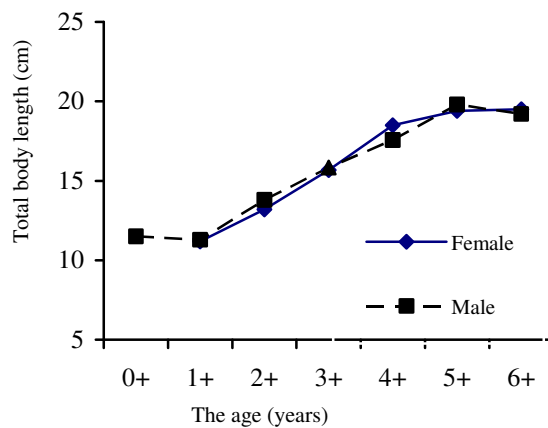


Fig. 4. Length growth of roach

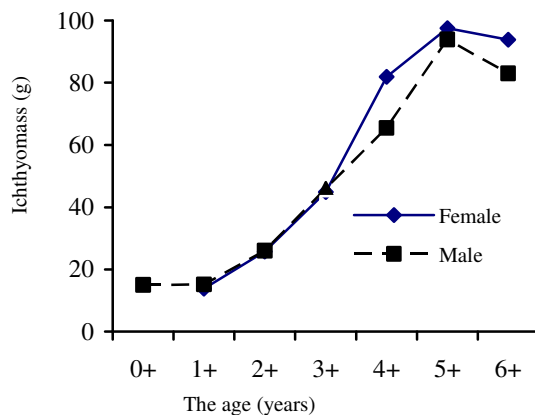


Fig. 5. Body mass growth of roach

Figure 6 shows that the length growth coincided with the body mass growth. The body mass of roach of both genders showed a low growth rate at the age 0+ to 1+, but an intensive rate at the age of 1+ to 5+, followed by slight stagnation at the age of 5+.

The bream (*Abramis brama*) population

The analysis of the structure of the bream population included 216 fish samples, of which 111 (51.39%) were male, 92 (42.59%) female and 13 (6.02%) could not be classified in terms of gender. Although the males dominated, the difference was not large and could have been random. This was evidenced by the fact that a dense population of bream was found in the Modrac Lake, being due, among other things, to favourable gender distribution in its population.

The female bream gender structure included fish aged 1+ to 7+ and one fish aged 10+. The category of fish aged 5+ and those of fish aged 3+ and 10+ were the most and least numerous, respectively.

The male bream gender structure was characterized by fish aged 0+ to 7+ and one fish aged 9+. The category of fish aged 4+ was the most predominant, followed by categories of fish aged 5+ and 6+ and by that of fish aged 0+ and 9+.

The results on the range of basic body measurements and body mass of bream are presented in Table 4, 5 and 6.

Tab. 4. The range of body measurements and body mass of bream males

Age	TBL (cm)		SBL (cm)		Fish mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$
1+	10.3-16.5	13.39	8.4-12.8	10.44	11.6-35.3	21.57
2+	16.2-19.5	17.53	12.4-15.3	13.48	35.3-70.2	50.18
3+	13.5-27.2	18.72	11.0-21.2	14.69	26.7-174	66.6
4+	17.5-29.0	23.96	13.4-21.8	18.73	53.6-182.5	133.04
5+	22.6-27.6	24.61	18.2-21.5	18.51	122-193.3	150.76
6+	21.3-298.8	24.77	19.0-22.8	20.42	147.0-216.5	178.3
7+	24.2-28.1	26.5	18.5-22.4	20.82	127.5-217.9	186.7
9+		27.4		21.8		182.0

Tab. 5. The range of body measurements and body mass of bream females

Age	TBL (cm)		SBL (cm)		Body mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$
1+	11.8-13.5	12.75	9.2-10.4	9.67	15.8-18.1	17.32
2+	14.4-24.5	17.35	10.7-19.4	13.41	21.7-127.2	49.1
3+		25.8		20.6		165.5
4+	22.1-28.8	25.18	17.8-23.2	19.61	114.2-209.1	156.98
5+	23.4-32.0	25.83	18.5-25.0	20.15	132.1-254.0	169.46
6+	23.2-29.0	26.18	18.5-23.5	20.34	128.1-230.0	169.87
7+	25.5-28.4	26.46	19.5-24.0	20.71	150.4-247.0	180.3
10+		40		32.5		625.0

Tab. 6. The range of body measurements and body mass of sexually immature bream

Age	TBL (cm)		SBL (cm)		Fish mass	
Years	Range	$\bar{x}$	Range	$\bar{x}$	Range	$\bar{x}$
0+	9.1 - 10.0	9.65	7.0 - 8.0	7.6	8 - 9.4	8.64
1+	8.2 - 11.2	10.02	6.2 - 8.7	7.56	5.6 - 13.4	9.02

The tables show that the obtained ranges of basic measurements (total and standard body lengths and body mass) were within ranges obtained previously. The average values were also previously obtained and documented in literature.

The average values of total body length were used in the length growth analysis, and those of body mass in the growth analysis.

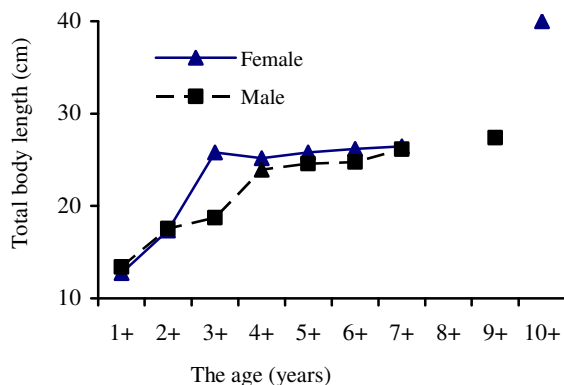


Fig. 6. Length growth of bream

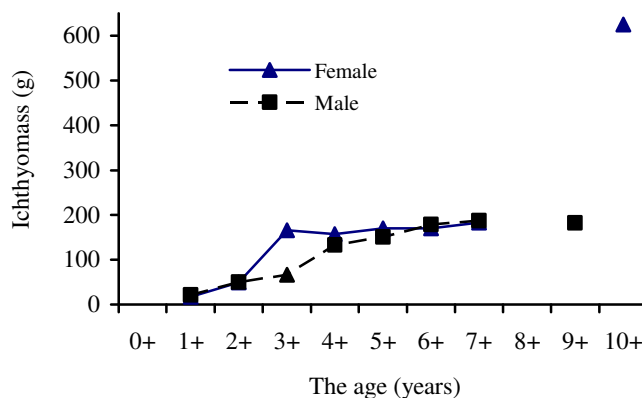


Fig. 7. Body mass growth of bream

Figure 6 shows the growth of bream sampled from the Modrac reservoir. Both males and females exhibited an intensive and identical growth at the age of 1+ to 2+. Subsequently, a higher growth rate until the age of 3+ was detected in the females, followed by a lower rate until the age of 7+.

The body mass growth coincided with the body length growth, being intensive and identical at the age of 3+ (Figure 7). Then, a lower growth rate until the age of 4+ was exhibited by the males, followed by a higher uniform rate until the age of 7+. The body mass growth of females was more intensified compared to the male growth, particularly at the age of 3+ and 4+, following which it declined.

Marković *et al.* (1997) studied some ecological characteristics of the bream population in the Međuvrške reservoir (Serbia). With respect to age structure, they reported data on fish aged 0+ and 7+, with the dominant participation of fish aged 3+. The category of fish aged 1+, 4+ and 5+ was numerous. The growth of bream in the

ecosystem was analyzed separately by gender. The obtained values were similar to those of the present study.

The longitudinal growth of roach and bream in the Tisa backwaters (Čurug - Biserno Ostrvo) was explored by Maletin and Kostić (1998). The authors suggested that both roach and bream of this ecosystem showed a constant and uniform rate of body length and body mass growth.

The growth of roach in the Odra estuary was explored by Więsk and Załachowski (2000). They showed that the lowest rate of longitudinal growth of roach was found in Lake Dąbie, followed by Laguna Szczecin and, finally, Pomeranian Bay, where the rate was highest. Studies on the rate of roach growth in Lake Dąbie (Włodzimierz and Krzykowska 1995) reported a higher rate of body length and mass growth as compared to other Polish lakes.

Załachowski and Więski (1998) studied the growth and longitudinal - weight correlations in bream in Lake Dąbie. Their study showed a faster, but non-uniform rate of growth which differed over the years of observation. The growth almost coincided with the average growth of the species, being confirmed by the average absolute length increments during the first ten years.

Conclusion

Given the ecological value of the observed species, which are also recreational fishing species, particularly the bream, more important attention should be given to studying their ecological and other characteristics.

Roach and bream of Modrac reservoir have never been studied before and the results given in this study are the first scientifically confirmed facts on the ecological characteristics of the explored species. These species, especially the bream, should be given more attention in further studies due to their ecological and other characteristics. To obtain accurate facts and information, further research should be done involving a larger sample of fish and focusing on morphology, nutrition, growth, health condition and genetics. It is also known that these species cross breed and that a great population of their hybrids in Bosnia and Herzegovina was first registered in Lake Modrac (Adrović *et al.* 2009). Therefore, this phenomena should be given special attention.

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EKOLOŠKE KARAKTERISTIKE BODORKE I DEVERIKE IZ HIDROAKUMULACIJE MODRAC

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Rezime

Tokom jednogodišnjih istraživanja ihtiopopulacija hidroakumulacije Modrac, utvrđeno je da su bodorka (*Rutilus rutilus* Linnaeus, 1758) i deverika (*Abramis brama* Linnaeus, 1758) vrste sa najvećom pojedinačnom brojnošću u istraživanom ekosistemu. Bodorka ima dominantno, a deverika subdominantno učešće. Dominantna brojnost njihovih populacija je bio razlog istraživanja osnovnih ekoloških obilježja ovih vrsta, polne i dobne strukture i dužinskog rasta. Analiza je provedena na uzorku koji se sastojao od 345 jedinki bodorka i 216 jedinki deverike, a provedena je odvojeno po polovima za obje riblje vrste.