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FECUNDITY AND LENGTH-WEIGHT RELATIONSHIP OF THE BROODSTOCK OF BROWN TROUT (*SALMO TRUTTA* M. *FARIO*) FROM CULTIVATED CONDITIONS IN THE BANJA LUKA REGION

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Abstract: Research on the fecundity and length-weight relationship of the broodstock of farmed brown trout (*Salmo trutta* m. *fario*) was carried out in the salmonid hatcheries Klašnik and Šiprage in the Banja Luka region. The aim of the study was to determine the fecundity of females and the length-weight relationship of female and male brown trout from two salmonid hatcheries in the Banja Luka region. Thirty females and thirty males per hatchery were analyzed. The age of the females in the Klašnik hatchery was 3^+ to 4^+ years old, and the males were 1^+ years old, while in the Šiprage hatchery, both the females and males were aged 4^+ to 6^+ years. Egg samples from each female were photographed, and the number and the diameter of eggs in each sample were determined using the "ImageJ" program. A significant correlation ($p < 0.01$) was found between weight, total length, standard length, and body height of females and males from both hatcheries. Total fecundity was significantly lower in females from the Klašnik hatchery (2589±650.85 eggs) than in females from the Šiprage hatchery (4618±1541.54 eggs), which had higher body weight. No significant difference ($p > 0.05$) was found in the relative fecundity, weight and diameter of eggs of females from the Klašnik hatchery (2220±583.71 eggs/kg; 0.097±0.014 g/egg and 5.176±0.232 mm/egg) and the Šiprage hatchery (2343±801.65 eggs/kg; 0.095±0.02 g/egg and 5.267±0.457 mm/egg). Positive allometric growth ($b > 3$) was found in females from the Šiprage hatchery, while negative allometric growth ($b < 3$) was found in other cases.

Key words: fecundity, egg weight, egg diameter, condition factor, brown trout.

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Introduction

Brown trout (*Salmo trutta* m. *fario*) can be found in areas from northern Norway and northeastern Russia to the Atlas mountain range in North Africa, and from Iceland to Afghanistan (Bernatchez 2001; Elliott, 1994). Kottelat and Freyhof (2007) state that brown trout is native to the northwestern part of Europe, from Spain to the Barents Sea in Russia, and has been introduced to other parts of Europe. Brown trout is an autochthonous fish species of Bosnia and Herzegovina. Due to its slower growth, brown trout is less commonly farmed commercially in Bosnia and Herzegovina (Savić, 2023). There are brown trout hatcheries whose main goal is to obtain fry for stocking streams and rivers. To breed the broodstock, it is necessary to provide good conditions for the breeding environment, nutrition, breeding technology, and other factors (Savić et al., 2018).

Brown trout, like other fish species, is characterized by high fecundity. Hoitsy et al. (2012) state that the total fecundity of brown trout ranges from 500 to 8000 eggs per female. Total fecundity increases with increasing body weight and female age (Ojanguren et al., 1996), due to increased body cavity size and available energy (Jonsson and Jonsson, 1997). A number of authors have investigated the fecundity of brown trout (Estay et al., 2004; Şahin et al., 2010; Rasool and Jan, 2013; Kocabas and Bascinar, 2016; Rawat et al., 2017; and others). The relative fecundity of brown trout ranges from 1500 to 3500 eggs/kg of female (Hoitsy et al., 2012), which is higher than that of some other salmonids, such as brook trout and rainbow trout (Hao and Yifeng, 2009; Barylo et al., 2019), but lower than that of huchen (Marić, 2005). As the age of females increases, the relative fecundity of brown trout declines (Estay et al., 2004).

The average diameter of a brown trout egg is about 5 mm, depending on the size of the female's body (Ojanguren et al., 1996). In most salmonids, the egg diameter increases with increasing body weight (Jonsson et al., 1996; Dębowski et al., 2005). There are no significant differences in the size and number of eggs among brown trout of the same age, and the body length of brown trout is the main indicator of the size and number of eggs (Lobon-Cervia et al., 1997).

The condition factor (CF) of the fish is based on the length and weight of the fish body, and these same parameters are used to determine the body growth of the investigated fish population (Jan et al., 2018). When analyzing the length-weight relationship, the regression coefficient (b) is determined, which indicates the growth of the fish (Ricker, 1975; Sangun et al., 2007), and for most fish, it falls within $2.5 < b < 3.5$ (Froese, 2006). The condition factor (CF) indicates the influence of the external environment on fish (Dekić et al., 2016), and within a population, it depends on the genetics and stage of fish development (Treer et al., 2014).

In Bosnia and Herzegovina, there have been no significant studies on the fecundity and length-weight relationship of the broodstock of brown trout, and the results of this study may encourage future research in these areas. This approach can contribute to improving the choice of females for the broodstock (Ihut et al., 2015). The aim of this study was to determine the fecundity and length-weight relationship of female and male brown trout from two salmonid hatcheries in the Banja Luka region.

Material and Methods

The research was conducted at two salmonid hatcheries in the Banja Luka region of Bosnia and Herzegovina, Klašnik (44°43'28.51°N, 17°9'21.07°E, 176 m above sea level) and Šiprage (44°28'26.21°N, 17°35'35.14°E, 620 m above sea level). The Klašnik hatchery is supplied with water from a spring located next to the hatchery facility, and the water temperature on the day of spawning was 10°C. The Šiprage hatchery is supplied with water from the Crkvena River (the source is about 6 km from the hatchery), and the water temperature on the day of spawning was 6°C.

Brown trout (*Salmo trutta* m. *fario*) spawning took place during the 2021/2022 spawning season (end of December – Klašnik and beginning of November – Šiprage). Thirty females and thirty males were analyzed per hatchery, for a total of 120 brown trout (60 females and 60 males) from two hatcheries. In the Klašnik hatchery, females were 3^+ to 4^+ years old and males were 1^+ years old. In the Šiprage hatchery, both females and males were 4^+ to 6^+ years old. An anesthetic (2-phenoxyethanol, 2.5 ml/10 liters of water) was used during spawning in the Klašnik hatchery, while no anesthetic was used in the Šiprage hatchery. Before spawning, the weight (g) of female and male brown trout was determined using a CAS (computing scale) digital scale, with a capacity of 5 kg. Total and standard body length (cm) and body height (cm) were then measured using an ichthyometer.

After determining the mentioned characteristics, the spawning procedure began. After squeezing the eggs of one female into a dry, empty container, the total weight of eggs obtained from each female was measured using a CAS digital scale. A sample of 50–70 eggs was taken from the total weight of eggs of each female, and the sample weight was determined using a Denver DL-501 digital scale with a 0.5 kg capacity and 0.1 g accuracy. The egg samples were photographed, and the images were saved on a computer and used to count the eggs with the "ImageJ" program. The total fecundity of females was determined using the Equation (1).

$$F = \frac{W_t}{W_s} \times N \quad (1)$$

F – fecundity, N – number of eggs in the sample, W_t – total weight of eggs and W_s – weight of eggs in the sample.

The relative fecundity of females was determined by dividing the total number of eggs by the body weight of each female. The average egg weight was determined based on the number and weight of eggs in the sample. After counting the eggs, their diameter was measured using the "ImageJ" program from a sample of 30 eggs per female (900 eggs from 30 females from the Klašnik hatchery and 900 eggs from 30 females from the Šiprage hatchery). The length-weight relationship is determined according to the exponential function in Equation (2).

$$W = aL^b \quad (2)$$

W – weight of fish (g); a – regression constant; b – regression coefficient; L – length (cm).

This relationship is transformed into logarithmic form (Ricker, 1975), as shown in Equation (3).

$$\mathrm{Log}\, W = \mathrm{Log}\, a + b\, \mathrm{Log}\, L \quad (3)$$

$b < 3$ indicates negative allometric growth, $b = 3$ indicates isometric growth, and $b > 3$ indicates positive allometric growth.

The condition factor (CF) is determined by Equation (4).

$$CF = \frac{BW}{L^3} \times 100 \quad (4)$$

CF – condition factor; BW – body weight (g); L – length (cm).

The statistical analysis of the data included descriptive statistics (average, minimum and maximum values, standard deviation, and coefficient of variation), Pearson's correlation coefficient, regression, and significance testing of mean differences (univariate analysis of variance, t-test, and Duncan's test) using the MS Excel program and SPSS16.

Results and Discussion

The age and body weight of female and male brown trout in the Šiprage hatchery were similar, but differed in the Klašnik hatchery. Descriptive statistics for the morphometric characteristics of the analyzed brown trout individuals are presented in Table 1.

The analysis of morphometric characteristics (TL, SL, H, and W) of female and male brown trout from the Klašnik and Šiprage hatcheries revealed a strong correlation ($p < 0.01$) among the analyzed parameters. In females from both the Klašnik and Šiprage hatcheries, the highest correlation was found between TL and SL ($r = 0.930$; $r = 0.889$). In the Klašnik hatchery, the lowest correlation was between TL and H ($r = 0.689$), while in the Šiprage hatchery, the lowest was between SL and H ($r = 0.767$). In males from the Klašnik hatchery, the highest correlation was found between W and SL ($r = 0.859$). In the Šiprage hatchery, the highest correlation was between TL and SL ($r = 0.995$). The lowest correlation in the Klašnik hatchery was between TL and H ($r = 0.674$), while in the Šiprage hatchery, the lowest correlation was between W and H ($r = 0.808$).

Table 1. Morphometric characteristics of the broodstock of brown trout from the Klašnik and Šiprage hatcheries.

Hatcheries	n	Sex		W (g)		TL (cm)	SL (cm)	H (cm)
				Before spawning	After spawning			
Klašnik	30	♀	x̄	1449.27	1200.50	48.31	43.18	11.71
			SD	314.37	271.62	4.59	3.97	0.83
			min	950.00	756.00	40.60	36.00	10.00
			max	2235.00	1827.00	57.30	50.70	13.40
			CV	21.69	22.63	9.49	9.20	7.11
	30	♂	x̄	298.27	-	30.08	24.79	6.30
			SD	91.99	-	3.26	3.19	12.25
			min	147.00	-	23.50	19.30	4.90
			max	518.00	-	36.40	31.70	7.80
			CV	30.84	-	10.84	12.85	0.77
Šiprage	30	♀	x̄	2555.27	2100.93	50.98	45.82	13.08
			SD	946.01	773.77	5.71	5.50	2.34
			min	1106.00	868	40.40	36.70	9.50
			max	3912.00	3278	59.90	55.10	18.80
			CV	37.02	36.83	11.21	12.00	17.86
	30	♂	x̄	2661.37	-	50.68	45.84	12.93
			SD	757.11	-	5.85	5.84	1.61
			min	1245.00	-	42.70	37.80	10.30
			max	3751.00	-	58.80	54.20	17.20
			CV	28.45	-	11.54	12.73	12.47

W – body weight of female (g); TL – total length (cm); SL – standard length (cm); H – body height (cm); SD – standard deviation; CV – coefficient of variation.

The difference in the total fecundity of females from the Klašnik and Šiprage hatcheries (Table 2) resulted from the higher age and weight of the females from the Šiprage hatchery. According to Ojanguren et al. (1996), total fecundity increases with increasing body weight and female age. Rasool and Jan (2013) report that the total fecundity of farmed brown trout (weight 517 g) averages 1281 eggs. Rawat et al. (2017) reported that the fecundity of brown trout (weight – 235–1140 g) caught in the river was 454–1052 eggs/female and was positively correlated with weight ($r = 0.653$) and length ($r = 0.859$).

There was no significant difference ($p > 0.05$) in the relative fecundity of females from the Klašnik and Šiprage hatcheries. Rasool and Jan (2013) reported that the relative fecundity of brown trout (weight 517.06 g) averaged 2560 eggs. Sahin et al. (2010) reported that the relative fecundity of brown trout females (3–5 years old) from cultivated conditions in northeastern Turkey was 2259±947 eggs/kg. Jan and Jan (2017) state that the relative fecundity of farmed brown trout (weight – 250–750 g) is 891–1570 eggs/kg of female. The coefficients of variation for total and relative fecundity of females from the Šiprage hatchery were higher (as a result of greater variation in body weight) compared to females from the

Klašnik hatchery. Variations in reproductive characteristics in brown trout are the result of wide distribution and the different conditions of their habitat and breeding environment (Dieterman et al., 2016).

The relative ratio of the total weight of eggs to the weight of brown trout females from the Klašnik hatchery averaged 17.30%:82.70%, and in the Šiprage hatchery, 17.61%:82.39%.

Table 2. Morphometric and reproductive characteristics of brown trout females from the Klašnik and Šiprage hatcheries.

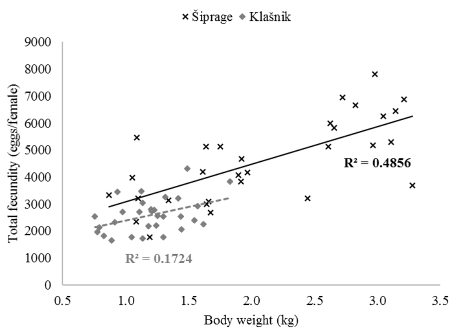
Hatchery		TL (cm)	W (g)	Total fecundity (eggs)	Relative fecundity (eggs/kg of female)	Ratio (%)		Weight of eggs (g/female)	Weight of egg (g/egg)	Diameter of egg (mm)*
						Weight of eggs	Weight of female body			
Klašnik (N = 30)	$\bar{x}$	48.31	1200.50	2589	2220[a]	17.30	82.70	248.77	0.097[a]	5.176[a]
	SD	4.59	271.62	650.85	583.71	2.77	2.77	59.56	0.014	0.232
	min	40.60	756	1654	1363	11.82	76.43	127.00	0.076	4.637
	max	57.30	1827	4321	3688	23.57	88.18	408.00	0.132	5.718
	CV	9.49	22.63	25.14	26.29	16.00	3.35	23.94	14.82	4.48
Šiprage (N = 30)	$\bar{x}$	50.98	2100.93	4618	2343[a]	17.61	82.39	454.33	0.095[a]	5.267[a]
	SD	5.71	773.77	1541.54	801.65	4.33	4.33	200.24	0.020	0.457
	min	40.40	868	1764	1129	8.37	71.24	109.00	0.053	4.414
	max	59.90	3278	7804	5019	28.76	91.63	804.00	0.128	6.236
	CV	11.21	36.83	33.38	34.21	24.56	5.25	44.07	20.81	8.68

TL – total length (cm); W – weight of females after spawning (g); N – number of analyzed females; *900 eggs/hatchery analyzed; [a]the same letter in superscript (observed by columns) indicates no significant difference ($p > 0.05$).

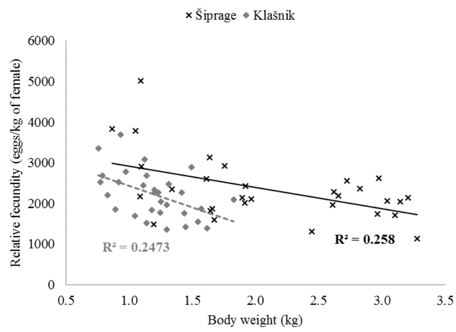
There was no significant difference ($p > 0.05$) in the diameter and weight of eggs from females at the Klašnik and Šiprage hatcheries. Similar results were reported by Sahin et al. (2010), who stated that the diameter of brown trout eggs (3–5 years old) from farming conditions in northeastern Turkey was 5.3±0.40 mm, and the average egg weight was 93.9±19.37 mg. Estay et al. (2004) reported that the diameter of brown trout eggs from farming conditions, aged three, four and five years, was 4.64±0.11 mm, 4.67±0.27 mm and 5.24±0.12 mm, similarly to the results of this research.

The correlation between total fecundity and body weight of brown trout females (Graph 1) from the Klašnik hatchery was positive but low ($R^2 = 0.1724$), while for females from the Šiprage hatchery it was moderately high ($R^2 = 0.4856$). Sahin et al. (2010) reported a highly positive correlation between body weight and total fecundity ($R^2 = 0.8665$, $p < 0.001$) in farmed brown trout females aged 3–5 years. Rasool and Jan (2013) also found a highly positive correlation between fecundity and body weight in female brown trout ($R^2 = 0.9426$).

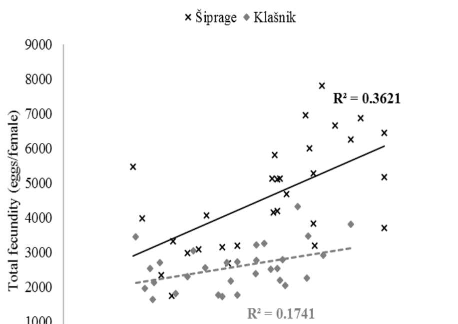
The correlation between relative fecundity and the weight of females from the Klašnik and Šiprage hatcheries (Graph 2) was low and negative ($R^2 = 0.2473$ and $R^2 = 0.258$), which indicates that relative fecundity decreases with increasing body weight, according to Dębowski et al. (2005), Çakmak et al. (2018) and Rinaldo (2020). In contrast to the results of this research, Sahin et al. (2010) report a low positive correlation between body weight and relative fecundity ($R^2 = 0.1632$, $p > 0.10$) in female brown trout aged 3 to 5 years.



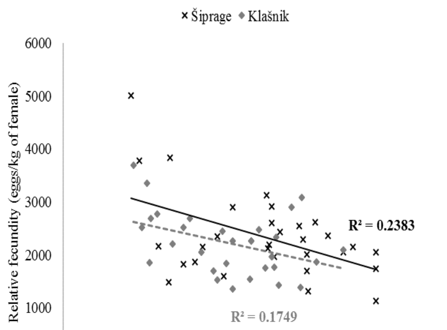
Graph 1. Relationship between total fecundity and body weight of females from the Klašnik and Šiprage hatcheries.



Graph 2. Relationship between relative fecundity and body weight of females from the Klašnik and Šiprage hatcheries.



Graph 3. Relationship between total fecundity and total length of females from the Klašnik and Šiprage hatcheries.

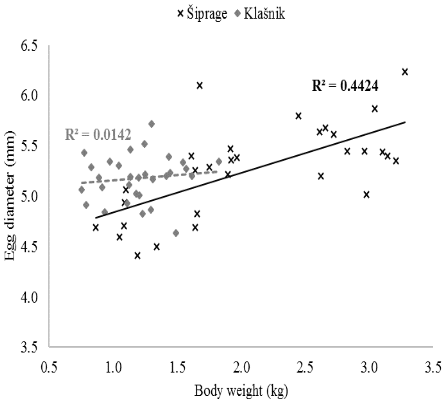


Graph 4. Relationship between relative fecundity and total length of females from the Klašnik and Šiprage hatcheries.

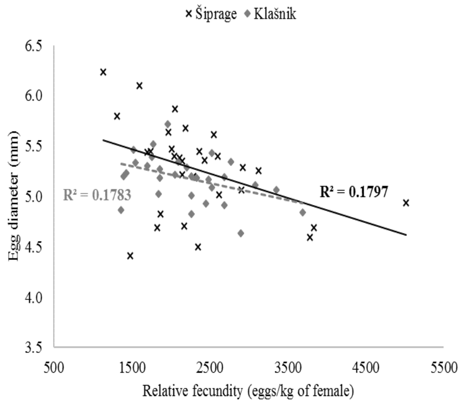
The correlation between total fecundity and total length in females from the Klašnik hatchery (Graph 3) was positive but low ($R^2 = 0.1741$). In females from the Šiprage hatchery, a positive and higher correlation was found ($R^2 = 0.3621$), while Rasool and Jan (2013) have reported that the correlation between fecundity and total length in brown trout females is highly positive ($R^2 = 0.865$).

The correlation between relative fecundity and TL of females from the Klašnik and Šiprage hatcheries (Graph 4) was low and negative ($R^2 = 0.1749$ and $R^2 = 0.2383$); as TL increases, relative fecundity decreases, according to Dębowski et al. (2005) and Rinaldo (2020).

The correlation between egg diameter and body weight of females (Graph 5) from the Klašnik hatchery was positive but low ($R^2 = 0.0142$), while it was higher for females from the Šiprage hatchery ($R^2 = 0.4424$). The diameter of the egg increases with the increase in body weight, as stated by Dębowski et al. (2005). Sahin et al. (2010) report a low negative correlation between egg diameter and body weight ($R^2 = 0.002$, $p > 0.10$) and between egg diameter and total fecundity ($R^2 = 0.0865$, $p > 0.05$). The correlation between the diameter of the egg and the relative fecundity of females (Graph 6) from the Klašnik hatchery was negative and low ($R^2 = 0.1783$), as was the case for females from the Šiprage hatchery ($R^2 = 0.1797$).



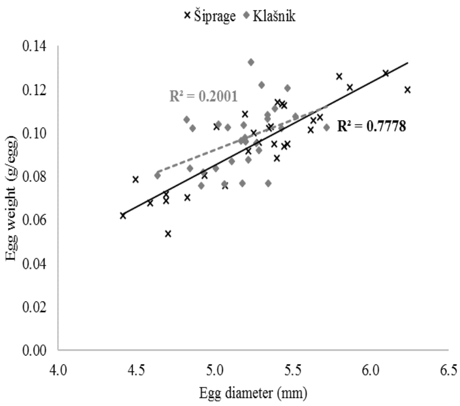
Graph 5. Relationship between egg diameter and body weight of females from the Klašnik and Šiprage hatcheries.

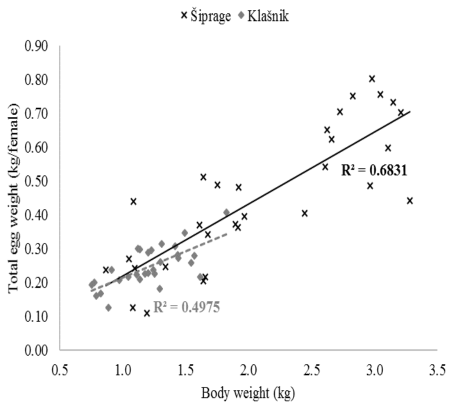


Graph 6. Relationship between egg diameter and relative fecundity of females from the Klašnik and Šiprage hatcheries.

The correlation (Graph 7) between egg weight (g/egg) and egg diameter (mm) from the Klašnik hatchery was positive and low ($R^2 = 0.2001$), while it was high ($R^2 = 0.7778$) for females from the Šiprage hatchery. The correlation (Graph 8) between total weight of eggs (kg/female) and body weight (kg) of females from the

Klašnik hatchery was $R^2 = 0.4975$, and for females from the Šiprage hatchery it was $R^2 = 0.6831$.





Graph 7. The relationship between egg weight and egg diameter in females from the Klašnik and Šiprage hatcheries.

Graph 8. The relationship between total egg weight and body weight in females from the Klašnik and Šiprage hatcheries.

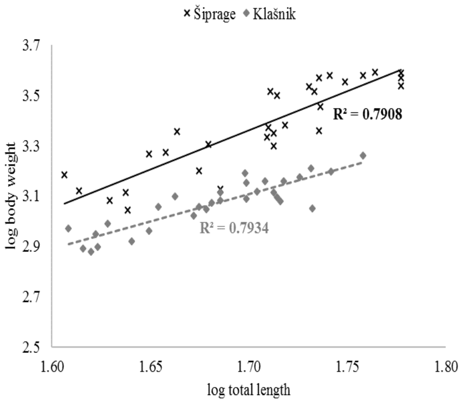
Positive allometric growth was found in females from the Šiprage hatchery, while negative allometric growth was found in males from the Šiprage hatchery, as well as in both females and males from the Klašnik hatchery (Tables 3 and 4). Several factors may contribute to the negative allometric growth of brown trout of the broodstock of males from the Šiprage hatchery, and both females and males from the Klašnik hatchery, such as selection, feed and nutrition, and environmental conditions. Rawat et al. (2014) found a highly positive correlation between length and body weight in brown trout.

Table 3. Descriptive statistics of TL and W logarithmic values, regression parameters, coefficient of correlation and coefficient of determination of brown trout from the Klašnik and Šiprage hatcheries.

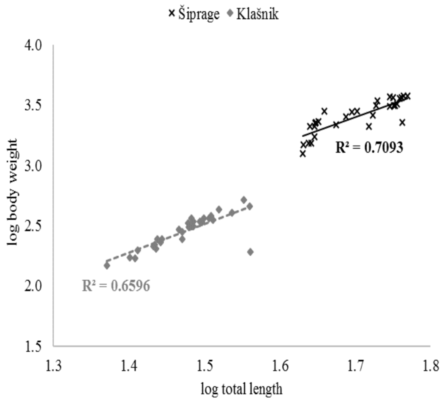
Hatchery	n	Sex	log TL (cm)			log W (g)			Regression parameters		R	R^2
			Min	Max	x̅ ±SD	Min	Max	x̅±SD	a	b		
Klašnik	30	♀	1.61	1.76	1.68±0.04	2.98	3.35	3.15±0.10	-0.334	2.072	0.894	0.798
	30	♂	1.37	1.56	1.48±0.05	2.17	2.71	2.45±0.14	-1.063	2.383	0.812	0.660
Šiprage	30	♀	1.61	1.78	1.70±0.05	3.04	3.59	3.38±0.17	-1.958	3.128	0.889	0.791
	30	♂	1.63	1.77	1.70±0.05	3.10	3.57	3.41±0.14	-0.424	2.250	0.842	0.709

n – number of analyzed fish; TL – total length; W – weight; SD – standard deviation; a – regression constant; b – regression coefficient.

The correlation of the logarithmic values of weight and body length of females (Graph 9) from the Klašnik and Šiprage hatcheries was positive and high (R^2 = 0.7934 and R^2 = 0.7908). For males (Graph 10) from the Klašnik and Šiprage hatcheries, the correlation was also positive and high (R^2 = 0.6596 and R^2 = 0.7093). Jan et al. (2018) report the coefficient of determination (R^2) for the relationship between log length and log weight of female brown trout as R^2 = 0.910, and for males as R^2 = 0.917.



Graph 9. Linear regression of the length-weight relationship of females from the Klašnik and Šiprage hatcheries.



Graph 10. Linear regression of the length-weight relationship of males from the Klašnik and Šiprage hatcheries.

Table 4. Length-weight relationship of brown trout from Klašnik and Šiprage hatcheries.

Hatchery	n	Sex	Growth type: $W = aL^b$	Growth type: Log W = Log a + b Log L	
Klašnik	30	♀	$W = 0.4634L^{2.072}$	LogW = -0.334+2.072LogL	Allometric (-)
	30	♂	$W = 0.0865L^{2.383}$	LogW = -1.063+2.383LogL	Allometric (-)
Šiprage	30	♀	$W = 0.01102L^{3.128}$	LogW = -1.958+3.128LogL	Allometric (+)
	30	♂	$W = 0.376704L^{2.250}$	LogW = -0.424+2.250LogL	Allometric (-)

n – number of analyzed fish.

In the Klašnik hatchery, the regression coefficient was higher for males (b = 2.383) compared to females (b = 2.072), while in the Šiprage hatchery, the regression coefficient for females (b = 3.128) was higher than for males (b = 2.250). This partially agrees with the findings of Jan et al. (2018), who have stated that the regression coefficient (b) of brown trout from cultured conditions is slightly higher in females than in males. Rawat et al. (2014) reported that the regression coefficient (b) of male brown trout (W = 20.61–1180 g) was 3.096 and that of females (W = 24.37–1280 g) was 3.040, and the total regression coefficient (males and females) was 3.073. Tanir and Fakioğlu (2017) reported that the length-weight relationship of brown trout (W = 4.02–264.31 g) caught from multiple locations in a river in northeastern Turkey ranged from 3.0672 to 3.3158. Arslan et al. (2004) found that the growth of brown trout caught from the rivers of northeastern Turkey was isometric in spring, summer and autumn, while negative allometric growth occurred in the winter period. The observed differences in length and body weight growth of female and male brown trout broodstock from the Klašnik and Šiprage hatcheries may result from different influences. In addition to the age structure, the differences in growth could be influenced by the spawning season, nutrition, conditions of the breeding environment, lack of selection when choosing broodstock individuals, cultivation technology, and other factors.

Analysis of condition factors (Table 5) revealed significant differences (Duncan test; $p < 0.05$) between males and females. The lowest CF (1.08) was found in males from the Klašnik hatchery, while the highest CF was found in males (2.03) and females (1.85) from the Šiprage hatchery.

Table 5. Descriptive statistics of W, TL and CF of brown trout from the Klašnik and Šiprage hatcheries.

Hatchery	n	Sex	W (g)	CV	TL (cm)	CV	CF			
							x̄±SD	min	max	CV
Klašnik	30	♀	1449.27±314.37	21.69	48.31±4.59	9.49	1.28±0.18[a]	0.91	1.83	13.72
	30	♂	298.27±91.99	30.84	30.08±3.26	10.84	1.08±0.15[b]	0.40	1.29	13.88
	60	♀+♂	873.77±624.14	71.43	39.20±10.00	25.51	1.18±0.19[a, b]	0.40	1.83	16.29
Šiprage	30	♀	2555.27±946.01	37.02	50.98±5.71	11.21	1.85±0.33[c]	1.18	2.42	17.91
	30	♂	2661.37±757.11	28.45	50.68±5.85	11.54	2.03±0.38[d]	1.17	2.98	18.61
	60	♀+♂	2608.32±851.17	32.63	50.83±5.73	11.28	1.94±0.36[c, d]	1.17	2.98	18.72

n – number of analyzed fish; W – body weight before spawning; CV – coefficient of variation; TL – total length; CF – condition factor; SD – standard deviation; [a, b, c and d] different superscript letters (per column) indicate a significant difference ($p < 0.05$).

The condition factor (CF) ranged from 1.08±0.15 in males from the Klašnik hatchery to 2.03±0.38 in males from the Šiprage hatchery, according to research by Jan et al. (2018), who state that the CF of brown trout (W = 250–750 g) was above 1, which indicates a good status of farmed brown trout. The high condition factor of females and males from the Šiprage hatchery was accompanied by higher coefficients of variation, which were more pronounced compared to females and males from the Klašnik hatchery. Jan et al. (2018) stated that the highest CF of female brown trout was found in November (1.87 ± 0.08; W = 124–840 g) and the lowest in January (0.99 ± 0.10; W = 104–760. 3 g). In male brown trout, the highest CF was also determined in November (1.177 ± 0.40; W = 305–672 g) and the lowest in January (0.98 ± 0.12; W = 160–915.7 g). Rozdina et al. (2019) reported that the CF of brown trout (aged 1–5 years) caught in the river averaged 1.84, indicating a good condition of the brown trout. Ishtiyaq and Imtiaz (2019) state that the CF of rainbow trout from cultured conditions (W = 198–450 g) varies significantly by month throughout the year, ranging from 0.98 to 1.58. The pronounced variation in CF can be attributed to different factors (breeding environment, nutrition, health status, etc.). Piria et al. (2020) stated that the CF of brown trout caught in streams in Croatia ranged from 0.94 to 1.06 (TL = 7.1–32 cm). Kheyrandish et al. (2010) reported that the CF of 4^{+} year-old brown trout harvested from six Caspian basin rivers was 1.24 (W = 209.5 g) and 1.37 (W = 390 g). The CF of female and male brown trout from the Šiprage hatchery was favorable and high. In females and males from the Klašnik hatchery, the CF was above 1, but significantly lower compared to individuals from the Šiprage hatchery. A significant difference in CF ($p < 0.05$) was found between female and male brown trout from the two hatcheries.

Conclusion

A significant correlation ($p < 0.01$) was found between the examined morphometric characteristics (W, TL, SL, H) of female and male broodstock of brown trout from the Klašnik and Šiprage hatcheries. The total fecundity of females from the Klašnik hatchery was lower than that of the females from the Šiprage hatchery, which is due to the greater age and body weight of the female brown trout from the Šiprage hatchery. No significant difference ($p > 0.05$) was found in the relative fecundity of females from the Klašnik and Šiprage hatcheries. The correlation between total fecundity, weight, and body length of females from the Klašnik and Šiprage hatcheries was positive; with an increase in body length and weight, total fecundity also increased. The correlation between relative fecundity, weight, and body length of females from the Klašnik and Šiprage hatcheries was negative, indicating that relative fecundity decreased with increasing body length and weight. The ratio (%) of egg weight to body weight of brown trout females from the two hatcheries was similar. There was no significant difference ($p > 0.05$) in the average weight or diameter of the eggs from females at the Klašnik and Šiprage hatcheries. As body weight increased, egg diameter also increased, while higher relative fecundity in females was associated with smaller egg diameter.

Length-weight relationships were characterized by different allometric growth patterns. Positive allometric growth ($b > 3$) was found in females from the Šiprage hatchery, while negative allometric growth ($b < 3$) was observed in males from the Šiprage hatchery, as well as in both females and males from the Klašnik hatchery. The condition factor of females and males from both hatcheries differed significantly ($p < 0.05$) in all combinations of male and female brown trout.

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PLODNOST I DUŽINSKO-MASENI ODNOS MATIČNOG JATA POTOČNE PASTRMKE (*SALMO TRUTTA* M. *FARIO*) IZ GAJENIH USLOVA REGIJE BANJA LUKA

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R e z i m e

Istraživanje plodnosti i dužinsko-masenog odnosa matičnog jata gajene potočne pastrmke (*Salmo trutta* m. *fario*) realizovano je u salmonidnim mrestilištima Klašnik i Šiprage, region Banja Luka. Cilj rada bio je da se utvrdi plodnost ženki i dužinsko-maseni odnos ženki i mužjaka potočne pastrmke iz dva salmonidna mrestilišta u regiji Banja Luka. Analizirano je 30 ženki i 30 mužjaka po mrestilištu. Starost ženki u mrestilištu Klašnik bila je 3^+ do 4^+, a mužjaka 1^+ godinu, dok su u mrestilištu Šiprage ženke i mužjaci bili starosti 4^+ do 6^+ godina. Uzorci ikre od svake ženke fotografisani su i korišćenjem programa „ImageJ" utvrđen je broj i dijametar ikre u uzorku. Utvrđena je značajna korelacija ($p < 0,01$) mase, totalne dužine, standardne dužine i visine tijela ženki i mužjaka iz dva mrestilišta. Apsolutna plodnost značajno je niža kod ženki iz mrestilišta Klašnik (2589±650,85 ikre) nego kod ženki iz mrestilišta Šiprage (4618±1541,54 ikre) koje su bile veće mase tijela. Nije utvrđena značajna razlika ($p > 0,05$) u pogledu relativne plodnosti, mase i dijametra ikre ženki iz mrestilišta Klašnik (2220±583,71 ikre/kg; 0,097±0,014 g/ikra i 5,176±0,232 mm/ikra) i Šiprage (2343±801,65 ikre/kg; 0,095±0,02 g/ikra i 5,267±0,457 mm/ikra). Kod ženki iz mrestilišta Šiprage utvrđen je pozitivan alometrijski rast ($b > 3$), a u ostalim slučajevima negativan alometrijski rast ($b < 3$).

Ključne reči: plodnost, masa i dijametar ikre, faktor kondicije, potočna pastrmka.

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