Conformation Features of Three-Year Old Rainbow Trout (*Oncorhynchus mykiss*) Breeding Stock from a Trout Farm

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Abstract

Prior knowledge about correlation coefficients between major somatic characteristics can be used to guide breeding programmes in aquaculture. The purpose of our research was to characterize the Rainbow Trout (*Oncorhynchus mykiss*) breeders from a phenotypical standpoint and to test the existence of correlations that can be used in future research studies. Somatic and gravimetric measurements have been performed on 3-year old females and males, obtained and raised in a regional fishery. Significant difference (646.11 g; $p < 0.05$) was obtained between the mean values of body weight (Bw) in females (2208.38 ± 37.48 g) and in males (1562.27 ± 74.113 g). In terms of total length (TL), significant differences were recorded also between mean values, in favour of females (53.01 ± 0.271 cm) as compared to males (46.65 ± 0.742 cm). The difference between average values of standard length (SL) was (6.86 cm) statistically distinctly significant ($p < 0.01$), in favour of females (42.57 ± 0.682 cm in males; 49.43 ± 0.259 cm in females) and also for the commercial length (CL) in the same sense ($d = 5.92$ cm). For the other conformation features studied (maximum height - MH, minimum height - Mh, body depth - Bd, head length - Hl and caudal peduncle length - Cpl), the recorded differences between males and females were statistically insignificant ($p > 0.05$). The outcome values reflect a higher interdependence between some studied characteristics in males, as compared to females, as indicated by Pearson's correlation coefficients and open the direction in which the real selection can be done.

Keywords: *breeding, rainbow trout, conformation features.*

INTRODUCTION

A native of the Western regions of the United States of America, Rainbow trout is the main salmonid species exploited in Romania due to its plasticity and resistance to environmental changes (Cocan, 2010a). The selection to which the Rainbow trout was subjected in time has improved the timeframes for spawning, alongside with its spectacular growing performance and great variety (Bud *et al.*, 2010). In this sense, sexual maturity is reached at 3 and sometimes even 2 years; this species is best adapted to intense growing conditions, it has the ability to

support warmer waters for short periods of time and is not overparticular to the oxygen content of water (over 6 mg O₂/l) (Păsărin, 2007). Rainbow trout growing systems, such as the intensive recirculating systems, have also been tested; in this case, the rainbow trout reaches the delivery weight in a much shorter time compared to the classical system (Cocan *et al.*, 2012). Apart from the growing system applied, fish production profitability depends also on the biological material used in selection (Cocan *et al.*, 2010 b).

An intensive selection of breeding stocks leads to an increased growth rate, earlier maturity,

increased egg production (Lauren et al., 1957). The aim of this study was to correlate the morpho-productive indices of female and male rainbow Trout (*Oncorhynchus mykiss*) for improvement and selection of future breeding stock.

MATERIALS AND METHODS

The study started in February 2015 in the Valea Bistrişorii fishery, Alba County. The fishery in Valea Bistrişorii is located at an altitude of 630 m and spreads across a 300 m² surface of water, with water supply from the Bistrişorii Valley River, with a discharge rate of 40 litres/sec. These hydro-geographical characteristics ensure optimal conditions, for both growth and reproduction of salmonids on the Valea Bistrişorii fishery. So far, the primary objective of the activity in this farm was to grow rainbow trout for consumption, without the entire technological process, which implies also fish reproduction. Starting in 2015, the most beautiful specimens, both females and males, were retained for reproduction aiming to extend the technological process. In this context, of aiming to obtain the best breeding lots, the following somatic and gravimetric measurements

were performed on a number of 16 females and 11 males, aged 3 years and over: body weight (Bw), total length (TL), standard length (SL), commercial length (Cl), maximum height (MH), minimum height (Mh), body depth (Bd), head length (HL), caudal peduncle length (CpL). Phenotypic correlations between characteristics in both male and female have also been performed with the Pearson correlation. All data were statistically analysed with add - Inul Data analysis from Microsoft Excel.

RESULTS AND DISCUSSION

All studied characteristics presented mean values favourable to females (table 1), thus proving that although males reach sexual maturity earlier than females (2-3 years in males as compared to 3-4 years in females), females grow faster from a morphological standpoint, the same observation was remarked and from (Özgür and Bayir, 2013). Mean body weight (Bw) was of 2208.38±37.48 g in females, and of 1562.27±74.113 g in males, resulting in a statistically significant difference of 646.11 g.0 between these two categories (p<0.05). The mean value of total length (TL) for females

Tab. 1 The main phenotypic characteristics of reproduction females and males of rainbow trout (*Oncorhynchus mykiss*)

Specif.	Males (n = 11)			Females (n = 16)			Diff.	Sem.
	X ±sx	V%	s	X ±sx	V%	s		
Bw	1562.27±74.113	47.44	741.132	2208.38±37.48	16.97	374.795	-646.11 *	p<0.05
TL	46.65±0.742	15.90	7.415	53.01±0.271	5.10	2.706	- 6.36 *	p<0.05
SL	42.57±0.682	16.02	6.822	49.43±0.259	5.25	2.594	- 6.86 **	p<0.01
Cl	33.44±0.544	16.27	5.441	39.36±0.202	5.12	2.016	- 5.92 **	p<0.01
MH	13.01±0.235	18.04	2.347	14.33±0.116	8.09	1.160	- 1.32 ns	p>0.05
Mh	4.59±0.06	13.15	0.603	4.92±0.041	8.26	0.406	- 0.33 ns	p>0.05
Bd	6.96±0.1	14.34	0.998	7.69±0.092	12.00	0.923	- 0.73 ns	p>0.05
HL	9.07±0.185	20.35	1.845	9.31±0.09	9.66	0.899	- 0.24 ns	p>0.05
CpL	6.42±0.133	20.67	1.327	7.27±0.081	11.16	0.811	-0.85 ns	p>0.05

(Bw) body weight, (TL) total length, (SL) standard length, (Cl) commercial length, (MH) maximum height, (Mh) minimum height, (Bd) body depth, (HL) head length, (CpL) caudal peduncle length, *-significant, **-significantly distinct, ns-insignificant.

was 53.01 ± 0.271 cm and 46.65 ± 0.742 cm for males, resulting also in a statistically significant difference ($p < 0.05$) of 6.36 cm for this phenotypic characteristic, favouring females.

Kayam (2004) also noted that females presented higher growth rate than males and hence, from the economic standpoint, fish farmers generally prefer to raise female fish; and as a solution to increase the percentage of female fish, he recommends to utilize young broodfish.

Statistically distinctly significant differences ($p < 0.01$) were recorded for the following characteristics: standard length (SL) (in males = 42.57 ± 0.682 cm; in females = 49.43 ± 0.259 cm; $d = -6.86$ cm) and commercial length (CL) (in males = 33.44 ± 0.544 cm; in females = 39.36 ± 0.202 ; $d = 5.92$ cm), both favouring the female fish.

For the other phenotypic characteristics studied (maximum height-MH), minimum height - Mh, body depth - Bd, head length - HL and caudal peduncle length CpL, the differences recorded between males and females proved statistically insignificant ($p > 0.05$). Body characteristics improvement in selection work is necessary for both males and females. These values are within the values cited in the scientific literature (Mireşan *et al.*, 2009).

Phenotypic correlations between the studied characteristics have been calculated for both males (table 2) and females (table 3). The values recorded reflect a greater interdependence between the studied traits in males than in females.

Also Sylven and Elvingson (1992) shows that growth traits are strongly influenced by sex and maturity being correlated with production ability.

Tab. 2 Phenotypic correlation coefficient values of the body characteristics of rainbow trout males. (*Oncorhynchus mykiss*)

Specif.	Bw	Tl	Sl	Cl	MH	Mh	Bd	HL	CpL
Bw	-	0.915	0.947	0.902	0.897	0.906	0.674	0.854	0.818
Tl	0.915	-	0.994	0.966	0.949	0.929	0.671	0.848	0.864
Sl	0.947	0.994	-	0.963	0.952	0.942	0.682	0.863	0.868
Cl	0.902	0.966	0.963	-	0.911	0.922	0.633	0.771	0.759
MH	0.897	0.949	0.952	0.911	-	0.959	0.743	0.788	0.933
Mh	0.906	0.929	0.942	0.922	0.959	-	0.780	0.718	0.832
Bd	0.674	0.671	0.682	0.633	0.743	0.780	-	0.507	0.648
HL	0.854	0.848	0.863	0.771	0.788	0.718	0.507	-	0.823
CpL	0.818	0.864	0.868	0.759	0.933	0.832	0.648	0.823	-

(Bw) body weight, (Tl) total length, (Sl) standard length, (Cl) commercial length, (MH) maximum height, (Mh) minimum height, (Bd) body depth, (HL) head length, (CpL) caudal peduncle length.

Tab. 3 Phenotypic correlation coefficient values of the body characteristics of rainbow trout (*Oncorhynchus mykiss*) in females.

Specif.	Bw	Tl	Sl	Cl	MH	Mh	Bd	HL	CpL
Bw	-	0.284	0.347	0.392	0.817	0.505	0.684	0.360	0.002
Tl	0.284	-	0.974	0.905	0.404	0.502	-0.021	0.381	0.396
Sl	0.347	0.974	-	0.905	0.508	0.462	-0.010	0.441	0.462
Cl	0.392	0.905	0.905	-	0.526	0.501	0.102	0.291	0.077
MH	0.817	0.404	0.508	0.526	-	0.410	0.549	0.269	0.185
Mh	0.505	0.502	0.462	0.501	0.410	-	0.501	0.563	-0.132
Bd	0.684	-0.021	-0.010	0.102	0.549	0.501	-	0.221	-0.223
HL	0.360	0.381	0.441	0.291	0.269	0.563	0.221	-	0.232
CpL	0.002	0.396	0.462	0.077	0.185	-0.132	-0.223	0.232	-

(Bw) body weight, (Tl) total length, (Sl) standard length, (Cl) commercial length, (MH) maximum height, (Mh) minimum height, (Bd) body depth, (HL) head length, (CpL) caudal peduncle length.

Very strong and positive correlations have been obtained for males, especially between total length (TL) and standard length (SL) ($r = 0.994$), between commercial length (CL) and total length (TL) ($r = 0.966$), and also between maximum height (Mh) and standard length (SL) ($r = 0.952$).

For males, the lowest correlation value obtained was 0.633, between the commercial length (CL) and body depth (Bd).

Strong and positive correlations were obtained also for breeding females ($r = 0.974$) between total length (TL) and standard length (SL), between standard length (SL) and commercial length (CL) ($r = 0.905$), and also between maximum height (Mh) and body weight (Bw) ($r = 0.817$).

For females negative correlations were also recorded, such as the correlation between body depth (Bd) and caudal peduncle length (CpL) ($r = -0.223$) and the correlation between body depth (Bd) and total length (TL) ($r = -0.021$).

CONCLUSION

All characteristics studied presented values favourable to females, thus proving that although males reach sexual maturity earlier than females (2-3 years for males, as compared to 3-4 years for females), females grow faster and are preferred by fish farmers for economic reasons.

However, due to the higher variability of the variation coefficients obtained especially for body weight for males (Bw) $V\% = 47.44$ and $V\% = 16.97$ also for females, further studies, on a larger number of breeders, are needed to establish with high accuracy the valuable results applicable in selection.

Regarding correlation coefficients, strong and positive values have been obtained for males, especially between total length (TL) and standard length (SL) ($r = 0.994$). These values reflect a greater interdependence between the two studied traits in males than in females.

For females, strong and positive correlations have been obtained for total length (TL) and standard length (SL) ($r = 0.974$), but negative correlations were for phenotypic characteristics such as body depth (Bd) and caudal peduncle length (CpL).

The existence of correlations between morpho-productive characteristics in rainbow trout leads to the conclusion that within the Valea Bistrișorii fishery, improvement of production

and reproduction performance of rainbow trout is necessary. The outcome of this study, alongside with other research can be used for improvement of production and reproduction performance of rainbow trout (*Oncorhynchus mykiss*).

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