

# Study Regarding the Conformation in Four Populations of Reproduction - Female - Rainbow Trout (*Oncorhynchus Mykiss*) From Trout Farm Fiad, County of Bistrita-Nasaud

Daniel Cocan

University of Agricultural Science and Veterinary Medicine, Faculty of Animal Sciences and Biotechnologies,  
3-5 Mănăştur street, 400372 Cluj – Napoca, tel. +40264596348  
e-mail: [cocandaniel@yahoo.com](mailto:cocandaniel@yahoo.com)

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**Abstract.** Rainbow trout (*Oncorhynchus mykiss*) is the main specie exploited in the salmon complexes. The reason is the plasticity and resistance to changes in environmental and disease factors, and due to fast growth rate obtained by the processes of selection and improvement that specie has undergone. In order to achieve the highest production and appropriate quality, a special role has the breeders and their performance. In addition to environmental conditions and nutrition, very important features which contribute to achieving valuable production, are: breeding age, physiological state and morphological indices. In this context, the authors propose to characterize the four populations of breeding females, taking into consideration the following factors: age, body mass index and the main morphological traits. It was followed by dynamic growth and development of breeding females aged three, four, six or eight years. The results obtained, on the reproductive performance of rainbow trout (*Oncorhynchus mykiss*), may help the formation of competitive breeding groups in the context of increasing economic efficiency of trout in Romania. The experiment was conducted in Fiad trout farm, Bistrita-Nasaud County, in June 2009.

**Keywords:** rainbow trout, breeding, physiology of reproduction, different ages

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## 1. Introduction

Originally from Western regions of the North American continent, today rainbow trout has an area of distribution that includes all continents [1], except Antarctica. Bud [2], dates the first imports of rainbow trout on the European continent around 1880, first in Germany, arriving in Romania for the first time in 1902. Pasarin [3] mentions the appearance of rainbow trout in Romania, Moldavia, before the First World War. The aim was the imports of new species populations in mountain rivers and lakes [4] whose native trout populations have declined or disappeared over all because of abuse in fishing or forestry activity

inadequate [5]. Although some European countries it has adapted well [6], the environmental conditions of natural waters in Romania has not managed to reproduce [7], such as rainbow trout that are currently found only in breeders. Breeding fish is the way to remarkable results, both economically and scientifically possible. Reproduction is one of the most important functions of the bodies, after taking birth parents offspring that inherit characteristics [8]. Reproduction of fish is a complex physiological act, which provides training of new generations and perpetuates the species, based on the fertilization process [9]. Return fish production is dependent on the processes of propagation, growth and development of fish in the environment to ensure optimal conditions for enhancement of the biological potential [10.11]. Today, most of

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\* Corresponding author: Daniel Cocan, 0745362621, [cocandaniel@yahoo.com](mailto:cocandaniel@yahoo.com)

Romanian trout breeders prefer trout eggs imported embryos from countries with traditional breeding in salmonids. The few trout that still carried the artificial reproduction of rainbow trout endeavor to preserve and improve the lot of their breeding. In this context, we considered appropriate to perform some studies on conformation traits in three populations of rainbow trout - breeding females of different ages. The results of these studies, in conjunction with other research on the production and quality of semen and environmental factors on reproductive act in rainbow trout, can be used to obtain important breeding performance.

## 2. Materials and methods

The experiment was conducted during the month of June 2009, at the trout farm Fiad, county of Bistrita-Nasaud. Fiad trout farm was founded in 1983 and the main activities are: breeding salmonids and obtain biological material for restocking the waters of the mountain. Cost effectiveness in order to work in this unit and pools are populated with biological material intended for consumption. With an area of 1.7 Hectares, trout Fiad is situated at an altitude of 452 m and the water needs is provided from two sources: River Valley at a rate of 200 Liters/s and Valley Fiad a rate of 100 liters / sec. Water temperature in this salmon unit presents large variations in recent years, with a minimum of 0.5 °C in January and a peak located around 26.5 °C in August. In recent years there has been a growing number of summer days on the water reaches above 20 °C.

Fiad trout farm is one of the few units that perform artificial reproduction in trout [12]. Quality of biological material obtained in this unit is often imported from high quality salmon farms worldwide, but may need improvement and upgrading [13].

The main followed indices were: morpho-productive in a number of 40 breeding female rainbow trout (*Oncorhynchus mykiss*), 10 specimens of each population, looking at body

mass indices and the main conformation at different ages. Retention of 10 specimens of each age group is in fact 10% of operated specimens in each pool (100 individuals/pool). Specimens studied were randomly selected in growth pools, the only criteria being represented by withholding an equal number of females in four age categories. The studied traits are: age, body weight, total length, standard length, commercial length, maximum height, minimum height, body thickness, large perimeter, perimeter and length than the head. Statistical processing of data was performed with well known methods.

## 3. Results and discussions

The four populations of female rainbow trout (*Oncorhynchus mykiss*) in trout breeding Fiad farm are exploited in pools and separated by age. Environmental factors are identical for all four pools and nutrition of populations under study is also identical, using the same feed and same frequency of feeding.

Analyzing the mean and variability (table 1) of body mass character of breeding females belonging to four age groups, as expected, the upward trend is in direct proportion to age. Thus, body mass of breeding females aged of three years has an average of  $1.00 \pm 0.04$  kg and a coefficient of variation of 13.55%. At the age of four years they show the accumulation of body mass of 180 g compared to females of three years, where the average value of the character is  $1.18 \pm 0.02$ , with a coefficient of variation of 4.28%, which demonstrates the homogeneity of this group. Largest accumulation is found between body mass of six categories aged of eight years. If the population of breeding females aged six years shows a mean body mass of  $1.82 \pm 0.13$  kg, for individuals aged eight years this character reaches  $2.75 \pm 0.11$  kg, resulting thus an accumulation of body mass of 930 grams. Regarding the value of the coefficient of variation of body mass in populations aged of six or eight years, their values can be considered acceptable (<25%).

**Table 1.** Mean and variability of major phenotypic traits in breeding females of rainbow trout (*Oncorhynchus mykiss*) of different ages

Issue	Females 3 years			Females 4 years			Females 6 years			Females 8 years		
	X ±s <sub>x</sub>	s	V%	X ±s <sub>x</sub>	s	V%	X ±s <sub>x</sub>	s	V%	X ±s <sub>x</sub>	s	V%
Body weight (kg)	1.00±0.04	0.14	13.55	1.18±0.02	0.05	4.28	1.82±0.13	0.42	22.89	2.75±0.11	0.33	12.11
Total length (cm)	40.10±0.62	1.96	4.88	44.15±0.30	0.94	2.14	50.70±1.27	4.03	7.95	56.55±0.44	1.40	2.48
Standard length (cm)	37.25±1.18	3.74	10.03	40.05±0.39	1.23	3.08	47.00±1.17	3.71	7.90	52.75±0.38	1.21	2.29
Commercial length (cm)	31.60±0.69	2.17	6.87	33.95±0.74	2.33	6.85	36.65±1.12	3.54	9.67	44.30±0.65	2.06	4.64
Maxum height (cm)	10.70±0.21	0.67	6.31	11.00±0.21	0.67	0.06	13.50±0.42	1.33	9.88	14.20±0.27	0.86	6.03
Inimum height (cm)	4.25±0.11	0.35	8.32	4.35±0.18	0.58	13.33	5.22±0.20	0.63	12.01	5.55±0.16	0.50	8.96
Body depth (cm)	5.95±0.20	0.64	10.81	5.45±0.20	0.64	11.80	6.20±0.15	0.48	7.79	6.90±0.16	0.52	7.48
Large perimeter (cm)	25.35±0.51	1.60	6.31	26.10±0.30	0.94	3.59	30.45±0.66	2.10	6.90	33.55±0.54	1.72	5.14
Small perimeter (cm)	9.65±0.18	0.58	6.01	10.30±0.24	0.75	7.31	11.50±0.30	0.94	8.20	13.25±0.33	1.03	7.80
Head length (cm)	9.40±0.23	0.74	7.85	9.45±0.17	0.55	5.82	9.60±0.31	0.97	10.06	14.15±0.13	0.41	2.91

Similarly, average values of other studied characters, as total length, standard length, head length and length commercial, increased with age. Since breeds are not exploited for consumption, from the characters mentioned above, only the total length presents importance for our study. In this respect, we find females aged of three years with an average length of  $40.10 \pm 0.62$  cm, and value increases gradually with age. Thus, for the average age of four years this value is  $44.15 \pm 0.30$  cm; at the age of six years it is  $50.70 \pm 1.27$  cm and at the age of eight years it reaches the maximum value,  $56.55 \pm 0.44$  cm. Values of the coefficients of variability for the length of the four populations demonstrate their uniformity: 4.88% at the age of three years, 2.14% at the age of four years, 7.95% at the age of six years and 2.48 % age of eight years. The same situation is when the characters are represented by standard length, commercial length and head length, but the other characters studied as maximum height, minimum height or depth of body. In this respect there is an increasing trend in height of specimens with increasing age, being averaged  $10.70 \pm 0.21$  cm at the age of three years,  $11.00 \pm 0.21$  cm at the age of four years,  $13.50 \pm 0.42$  cm at the age of six years and  $14.20 \pm 0.27$  cm at the age of eight years, resulting in an increase of 3.5 cm between the youngest category and the elderly. Also a trend of increasing average value is found for character body depth, but this evolution is less pronounced, recording a difference of only 0.95 cm between the extreme categories in the study,  $5.95 \pm 0.20$  cm at the age of three, that  $6.90 \pm 0.16$  cm at the age of eight years. Values of the coefficients of variation for characters standard length,

commercial length, head length, maximum height, minimum height and depth of the body are reduced in all four age groups studied, which shows homogeneous populations of breeding females.

As expected, the large perimeter achieve dynamic growth in value of  $33.55 \pm 0.54$  cm, with a coefficient of variability of 5.14% of breeding females in the population aged eight years after from the initial average value of  $25.35 \pm 0.51$  cm and a coefficient of variation of 6.31% in the population aged three years. All values obtained are within the range cited by other authors for this species.

Analyzing correlations between body weight and other studied characters, the population of breeding females aged of three years, there is a minimum value of 0.411 between body weight and body depth and a maximum of 0.909 between body weight and maximum height (table 2). We recorded strong correlation between total length and standard length (0.654), total length and length commercial (0.887), total length and maximum height (0.448), total length and minimum height (0.642). Between total length and body depth, and between total length and perimeter is found very weak correlation (0.026 respectively 0.051) which shows an increase in the length of the female body and less in depth, except the egg ripening period preceding reproductive phase. In this respect, weak correlations can be explained by the fact that our experiment was conducted during the summer, when female gonads were less developed.

**Table 2.** Phenotypic correlation coefficient values of the main morphological features of rainbow trout (*Oncorhynchus mykiss*) females aged three years

Specification	Body weight (kg)	Total length (cm)	Standard length (cm)	Commercial length (cm)	Maximum height (cm)	Minimum height (cm)	Body depth (cm)	Great perimeter (cm)	Small perimeter (cm)	Head length (cm)
Body weight (kg)	-	0.738	0.685	0.789	0.909	0.733	0.411	0.866	0.793	0.503
Total length (cm)	0.738	-	0.654	0.887	0.488	0.642	0.026	0.449	0.051	0.469
Standard length (cm)	0.685	0.654	-	0.702	0.649	0.578	0.225	0.541	0.686	0.372
Commercial length (cm)	0.789	0.887	0.702	-	0.591	0.651	0.083	0.556	0.693	0.405
Maximum height (cm)	0.909	0.488	0.649	0.591	-	0.698	0.601	0.931	0.837	0.658
Minimum height (cm)	0.733	0.642	0.578	0.651	0.698	-	0.549	0.614	0.745	0.638
Body depth (cm)	0.411	0.026	0.225	0.083	0.601	0.549	-	0.720	0.394	0.456
Great perimeter (cm)	0.866	0.449	0.541	0.556	0.931	0.614	0.720	-	0.775	0.550
Small perimeter (cm)	0.793	0.051	0.686	0.693	0.837	0.745	0.394	0.775	-	0.753
Head length (cm)	0.503	0.469	0.372	0.405	0.658	0.638	0.456	0.550	0.753	-

Analyzing correlations between maximum height and other characters studied, and the minimum height and other characters are very strong and positive correlations evident, almost all reached more than 0.5 except the correlation between maximum height and overall length (0.488). Strong positive correlation between perimeter and other characters studied were recorded, but also between small perimeter and body weight (0.793), while between the total length and perimeter, small and very low correlation (0.051) were recorded. Between perimeter and body depth an average correlation

(0.394) was reported. As expected, between head length and studied other characters average to strong correlations were recorded, with a minimum between head length and standard length (0.372) and a maximum between perimeter small and head length (0.753). In population of breeding females aged of four years, we find the same strong positive correlation between body weight and other studied characters, and between total length, standard length, commercial length and the rest of the studied characters, in breeding females aged of three years (table 3).

**Table 3.** Phenotypic correlation coefficient values of the main morphological features of rainbow trout (*Oncorhynchus mykiss*) females aged four years

Specification	Body weight (kg)	Total length (cm)	Standard length (cm)	Commercial length (cm)	Maximum height (cm)	Minimum height (cm)	Body depth (cm)	Great perimeter (cm)	Small perimeter (cm)	Head length (cm)
Body weight (kg)	-	0.747	0.898	0.540	0.417	0.416	0.426	0.626	0.407	0.215
Total length (cm)	0.747	-	0.731	0.357	0.353	0.400	0.425	0.514	0.437	0.229
Standard length (cm)	0.898	0.731	-	0.803	0.573	0.671	0.632	0.763	0.639	0.412
Commercial length (cm)	0.540	0.357	0.803	-	0.555	0.693	0.796	0.601	0.675	0.453
Maximum height (cm)	0.417	0.353	0.573	0.555	-	0.862	0.777	0.889	0.830	0.454
Minimum height (cm)	0.416	0.400	0.671	0.693	0.862	-	0.796	0.848	0.878	0.757
Body depth (cm)	0.426	0.425	0.632	0.796	0.777	0.796	-	0.700	0.837	0.384
Great perimeter (cm)	0.626	0.514	0.763	0.601	0.889	0.848	0.700	-	0.701	0.441
Small perimeter (cm)	0.407	0.437	0.639	0.675	0.830	0.878	0.837	0.701	-	0.643
Head length (cm)	0.215	0.229	0.412	0.453	0.454	0.757	0.384	0.441	0.643	-

A strong correlation was found between: maximum height and minimum height (0.862) and between height and maximum body depth (0.777), maximum height and large perimeter (0.889), lower maximum height and perimeter (0.830), minimum height and perimeter high (0.848) and between lower minimum height and perimeter (0.878). Average correlation within the population of breeding females aged of four years found on the following characters:

maximum height and body weight (0.417), maximum height and overall length (0.353), minimum height and body weight (0.416), minimum height and overall length (0.400). Weak correlations in this population were recorded between: head length and other studied characters, except the correlation between head length and minimum height (0.757) that is very strong (table 4).

**Table 4.** Phenotypic correlation coefficient values of the main morphological features of rainbow trout (*Oncorhynchus mykiss*) females aged six years

Specification	Body weight (kg)	Total length (cm)	Standard length (cm)	Commercial length (cm)	Maximum height (cm)	Minimum height (cm)	Body depth (cm)	Great perimeter (cm)	Small perimeter (cm)	Head length (cm)
Body weight (kg)	-	0.949	0.963	0.974	0.912	0.979	0.516	0.946	0.916	0.878
Total length (cm)	0.949	-	0.997	0.935	0.879	0.937	0.405	0.907	0.943	0.893
Standard length (cm)	0.963	0.997	-	0.950	0.898	0.945	0.449	0.922	0.944	0.898
Commercial length (cm)	0.974	0.935	0.950	-	0.896	0.966	0.483	0.896	0.906	0.806
Maximum height(cm)	0.912	0.879	0.898	0.896	-	0.884	0.560	0.961	0.839	0.948
Minimum height (cm)	0.979	0.937	0.945	0.966	0.884	-	0.425	0.903	0.940	0.858
Body depth (cm)	0.516	0.405	0.449	0.483	0.560	0.425	-	0.585	0.426	0.547
Great perimeter (cm)	0.946	0.907	0.922	0.896	0.961	0.903	0.585	-	0.869	0.960
Small perimeter (cm)	0.916	0.943	0.944	0.906	0.839	0.940	0.426	0.869	-	0.884
Head length (cm)	0.878	0.893	0.898	0.806	0.948	0.858	0.547	0.960	0.884	-

Analyzing correlations between the same characters (body mass, total length, standard length, commercial length, height, height, body depth, large perimeter, perimeter and length than the head), in breeding females aged of six years, shows that all are strong and positive, except correlations between body depth and the other studied characters. They frame between 0.405 (body depth and total length) and 0.585 (high perimeter depth and body).

In breeding females aged of eight years, we record the followings: correlations between body weight and length (total length, standard length and length commercial) of body weight and height (maximum and minimum) and between body weight and perimeters (large and small perimeter), are very strong and positive (table 5).

**Table 5.** Phenotypic correlation coefficient values of the main morphological features of rainbow trout (*Oncorhynchus mykiss*) females aged eight years

Specification	Body weight (kg)	Total length (cm)	Standard length (cm)	Commercial length (cm)	Maximum height (cm)	Minimum height (cm)	Body depth (cm)	Great perimeter (cm)	Small perimeter (cm)	Head length (cm)
Body weight (kg)	-	0.921	0.848	0.843	0.790	0.651	0.581	0.724	0.819	-0.133
Total length (cm)	0.921	-	0.712	0.927	0.684	0.832	0.429	0.688	0.698	-0.062
Standard length (cm)	0.848	0.712	-	0.592	0.913	0.485	0.801	0.700	0.923	-0.363
Commercial length (cm)	0.843	0.927	0.592	-	0.498	0.852	0.292	0.543	0.509	0.039
Maximum height(cm)	0.790	0.684	0.913	0.498	-	0.495	0.866	0.858	0.972	-0.252
Minimum height (cm)	0.651	0.832	0.485	0.852	0.495	-	0.238	0.547	0.459	0.095
Body depth (cm)	0.581	0.429	0.801	0.292	0.866	0.238	-	0.817	0.832	-0.182
Great perimeter (cm)	0.724	0.688	0.700	0.543	0.858	0.547	0.817	-	0.849	-0.168
Small perimeter (cm)	0.819	0.698	0.923	0.509	0.972	0.459	0.832	0.849	-	-0.424
Head length (cm)	-0.133	-0.062	-0.363	0.039	-0.252	0.095	-0.182	-0.168	-0.424	-

A good correlation (0.581) is found between body weight and body depth. Between body weight and head length, the correlation is weak and negative (-0.133). Analyzing correlations between length (total, standard and commercial) and other studied characters, the large majority of them have strong values, except the correlation between total length and body depth (0.429) considered below average, correlation between length and commercial body depth (0.292) is weak correlation, as between head

length and the other studied characters, which are mostly weak and negative.

#### 4. Conclusions

Analyzing the average coefficients of variability and correlations between the ten studied populations in the trout breeding females Fiad, Bistrita-Nasaud, results show that they are within the literature cited values. The analysis of correlations between phenotypic studied

characters, shows that most of these correlations are strong and positive, which means homogeneous populations of breeding females and also the concern of specialists in the trout farm Fiad towards selection and breeding for improvement of biological material. Description of the accumulation of body weight indices and indices of body formed by age is emphasized. We will allow in the near future that we can determine in this salmon unit, obtaining the desired traits in reared salmonid individuals: optimal age, body weight and optimal body size that. These traits must be accomplished by breeding females in order to obtain viable and valuable offspring, both qualitatively and quantitatively. Also, the results obtained, the salmonid unit will be valuable is we used the reared individuals as breeding nucleus.

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