STUDY ON THE EVOLUTION OF SOME MORPHOLOGICAL CHARACTERISTICS OF *ONCORHYNCHUS MYKISS* SPECIES IN DIFFERENT DEVELOPMENT STAGES, FARMED IN NEAMȚ COUNTY

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Abstract

The current study tracked the evolution of some morphological characters of rainbow trout individuals, at an age of second, third and respectively four summers, gathered from a fishery in Neamț County. Trout breed Oncorhynchus mykiss, was the object of the present study being analysed a number of 60 individuals, 20 individuals for each of the third categories of age. Effectuation of corporal measurements and weighting for each age is done to appreciate the maintenance state of them and also their adaptability at the conditions assured by the environment. Based on the obtained and processed data were calculated the most representative indexes and maintenance coefficients. The obtained values were between 3.31-3.55 for profile index; 1.83-1.98 for Fulton coefficient; 1.33-1.44 for Kiselev index; 42.93-48.14 for thickness index; 20.82-21.53 for fleshy index which bring out the ratio of the head from the standard body length and 20.06-21.70 for fleshy index which bring out the ratio of caudal peduncle from the standard length. Having in view the obtained results we can conclude that the analysed fishes had a good state of maintenance.

Key words: morphological characters, rainbow trout, body indices

INTRODUCTION

Oncorhynchus mykiss trout breed (WALBAUM, 1792) is probably the most spread non-native fish breed at world level. This salmon is originally from the affluent of Pacific Ocean both in Asia and also in North America [10]. This breed was introduced all over the world for aquaculture and sport fishing, today being found in almost all the temperate and sub-arctic areas (excepting Antarctica) and at altitudes which overpass 1200 meters in the tropical areas [6]. From ecological point of view, rainbow trout is very flexible, preferring fresh waters and well oxygenated, with a temperature of around 12°C, but also could tolerate a much more ample thermal regime, between 5 and 24°C [7].

Rainbow trout have a growth rate superior to the others salmonids breeds, reaching in the third year of growing a weight of 350-500 g [14]. Fish biometry represents an important method for determination of breeds, which consists in a direct measurement on individual of the different corporal dimensions aiming to eliminate the approximations and errors [2].

Effectuation of somatic and gravimetric measurements for each age is realised to evaluate the maintenance state of the fishes and also their adaptability at the assured growing conditions. Based on the obtained and processed data were calculated the most representative indexes and maintenance coefficients.

MATERIAL AND METHODS

Biological material was represented by 60 individuals of rainbow trout (*Oncorhynchus mykiss*) of both sexes, reared in a salmon fishery from Neamț County. To reach the proposed aims, from the biological material which was the object of the study in period 2010-2011, were established three experimental batches L_1, L_2 and L_3, each of those with 20 individuals per batch, on three age categories, 2nd summer (Pc_{1+}), 3rd summer (Pc_{2+}) and 4th summer (Pc_{3+}). For the studied individuals were realised a series of measurements on the main corporal

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The manuscript was received: 25.05.2012
Accepted for publication: 30.08.2012

parameters (figure 1), which served at calculation of some rates between dimensions, some indexes which allow to evaluate the condition state of the fishes. Salmonids biometry presumes determination of the variability of characters on individuals batches based on measurements, weightings and statistical processing of the obtained data.

Characters determinate through biometric studies are represented by metric characters or dimensional (lengths, thicknesses) and by gravimetric characters (weight). Measurements at salmonids were realised using some special instruments (ichtyometers) or other measuring instruments (ruler, calliper, centimetre ribbon) [3, 13].

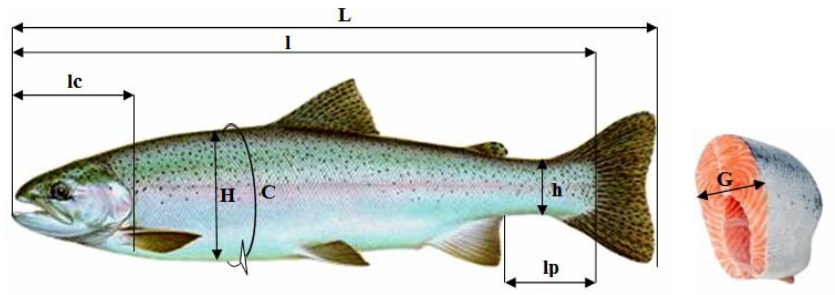

Figure 1 Biometric measurements at rainbow trout

The determinate metric and gravimetric characters were:
- corporal mass (g), determinate through weighting;
- total length of body (L), which is measured from the top of the snout till the top of the lobs of caudal fin;
- standard length of body (l), measured from the top of snout till the last row of scales or till the base of caudal fin [11];
- length of head (lc) represented by the distance from top of snout to the posterior edge of operculum bone;
- length of caudal peduncle (lp), which is measured from the posterior extremity of anal fin to the base of caudal fin;
- maximum height of body (H), which is measured in the highest area of body, from ventral line to the dorsal line;
- maximum thickness of body (G) which is measured in the area were body have the greatest thickness;
- maximum circumference of body (C) is measured at the level of maximum thickness and maximum height.

Based on the somatic measurements could be calculated a series of corporal indexes which offers information regarding fishes' maintenance state and corporal shape of body [8], [11].

Profile index (*height*) – enlightened the corporal shape of fishes and allows the placement of the individuals from a population in a certain profile type [1].

To calculate this index was used the formula:

$$Ip = l/H$$

where: Ip = profile index; l = standard length of body (cm); H = maximum height of body (cm).

A low value of this index reflects a pronounced convexity of the superior body line, trout having a curved dorsum. For selection practice are preferred trout with the lowest profile index because the curved shape of the dorsum is correlated with a rich muscular mass [12].

Fulton coefficient (*maintenance index*) provides information regarding the maintenance state of fishes, a higher value of this index could be translated as a very good maintenance state. The formula used for calculation is the following one:

$$Ii = (m \times 100)/l^3$$

where: Ii = maintenance index (%); m = corporal mass (g); l = standard length of fish (cm).

Quality index (*Kiselev*) is established using Kiselev formula and offers information regarding fish quality. Quality index could be calculated using the formula:

$$IC = l/C$$

where: IC = quality index; l = standard length of body (cm); C = maximum circumference of body (cm).

As the quality index values are lower the fish is much well developed. Quality index is a very important indicator in evaluation of fishes growing rate. Concretion of Kiselev index helps to determinate fish quality without any measurements and weightings [15].

Thickness index (dorsum width) expresses the width of musculature from dorsum area in connection with the maximum height of body. Thickness index could be calculated with the formula:

$$Ig = (G \times 100)/H$$

where: Ig = thickness index (%); G = maximum thickness of body (cm); H = maximum height of body (cm).

Fleshy index express the rate of head or caudal peduncle from the standard length of body. To calculate this index we will apply the following formulas:

$$Ic = (lc \times 100)/l$$

$$Ic = (lp \times 100)/l$$

where: Ic = fleshy index (%); lc = length of head (cm); lp = caudal peduncle length (cm); l = standard length of body (cm). If the fleshy index have lower values the fishes have a greater fleshy.

Description and concretion mode for those indexes was made in according with the information from literature [9].

RESULTS AND DISCUSSIONS

Study of metric and gravimetric characters is an efficient modality to characterize, from morphologic point of view, a fish population [5]. Biometric characters are influenced in a great way by the variations of different external factors and by the age category of fishes (table 1).

Table 1 Values of main corporal parameters at *Oncorhynchus mykiss* breed

Specification	Rainbow trout Pc2+ (n=20)		Rainbow trout Pc3+ (n=20)		Rainbow trout Pc4+ (n=20)	
	$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%
Weight - g (g)	160.28±4.12	11.51	255.55±4.77	8.34	474.83±10.69	10.06
Total length - L (cm)	22.67±0.14	2.69	26.15±0.39	6.69	32.11±0.34	4.78
Standard length - l (cm)	20.59±0.16	3.53	23.75±0.27	5.15	28.90±0.33	5.10
Heads' length - lc (cm)	4.44±0.06	6.22	4.95±0.06	5.39	6.01±0.09	6.61
Length of caudal peduncle - lp (cm)	4.13±0.06	6.54	5.15±0.09	7.71	6.22±0.10	7.01
Maximum height - H (cm)	6.02±0.10	7.42	7.19±0.13	8.28	8.15±0.10	5.25
Maximum thickness of body - G (cm)	2.58±0.04	6.97	3.23±0.04	6.01	3.92±0.03	3.22
Maximum circumference - C (cm)	14.34±0.11	3.45	17.94±0.27	6.82	20.63±0.19	4.11

Analysing the data from table 1 could be observed some differences in the evolution of mean values for the studied parameters function of trout waist. So the mean values of corporal mass were of 160.28±4.12 g in case of batch L_1, 255.55±4.77 g at trout individuals from batch L_2 respectively 474.83±10.69 g for batch L_3.

For standard length could be observed a decrease, function of age, from 90.82 % from the total length for batch L_1 (corresponding to 2nd summer age), reaching at 90% from the total length at individuals from batch L_3 (4th summer).

All the studied characters recorded increasing values function of age category, the lowest ones being recorded at trout individuals from batch L_1, and the highest ones at batch L_3.

For the majority of the analysed corporal parameters could be observed a low variability of the characters, fact which allow their possible utilization to realise comparisons between individuals with different ages, exception being made only corporal mass which presented an average variation coefficient.

At the end of the measurements realised on individuals of *Oncorhynchus mykiss* from the three batches, were calculated a series of corporal indexes such as: profile index (Ip), thickness index (Ig), quality index (IC), Fulton index (Ii) and fleshy index (Ic).

At the studied trout, calculated *profile index* (table 2) recorded a minimum value of 3.31±0.04 at individuals from batch L_2 and a maximum value of 3.55±0.04 at individuals from batch L_3, fact which enlightened a much good corporal format in the case of trout of 3rd summer.

Table 2 Profile index at *Oncorhynchus mykiss* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Oncorhynchus mykiss Pc_{2+}	L_1	20	3.43±0.05	6.86	3.10	3.79
Oncorhynchus mykiss Pc_{3+}	L_2	20	3.31±0.04	5.33	2.97	3.58
Oncorhynchus mykiss Pc_{4+}	L_3	20	3.55±0.04	5.35	3.14	3.97

Fulton coefficient calculated for the studied individuals of rainbow trout presented an ascendant evolution function of fish age, so at individuals from batch L_1 the value was of 1.83±0.03, for batch L_2 of 1.92±0.04, and for batch L_3 the value was of 1.98±0.05.

The studied character presented a medium variability for batch L_3 (V%=11.21) and low for batches L_1 and L_2 (table 3).

Table 3 Fulton coefficient at *Oncorhynchus mykiss* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Oncorhynchus mykiss Pc_{2+}	L_1	20	1.83±0.03	7.64	1.59	2.08
Oncorhynchus mykiss Pc_{3+}	L_2	20	1.92±0.04	8.84	1.60	2.20
Oncorhynchus mykiss Pc_{4+}	L_3	20	1.98±0.05	11.21	1.68	2.65

Values of Kiselev index were placed between 1.33-1.44, the better value was recorded at rainbow trout individuals of 3rd summer (L_2), fact which shows that trout from this batch had the better corporal development and are the most indicated ones for consumption (table 4). The studied character presented a low variability for all the three batches, variation coefficient being placed in interval 3.21-4.84 %.

Table 4 Quality index (Kiselev) at *Oncorhynchus mykiss* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Oncorhynchus mykiss Pc_{2+}	L_1	20	1.44±0.02	4.84	1.33	1.59
Oncorhynchus mykiss Pc_{3+}	L_2	20	1.33±0.01	3.21	1.25	1.44
Oncorhynchus mykiss Pc_{4+}	L_3	20	1.40±0.01	4.59	1.23	1.50

Analysing the data from table 5 it is observed an increasing evolution of the mean values *for thickness index*, function of trout waist. So in the case of individuals from 2nd summer was recorded a mean value of 42.93±0.38, for individuals of 3rd summer was 44.99±0.54, and for the ones of 4th summer the mean value of this index was 48.14±0.43.

Table 5 Thickness index at *Oncorhynchus mykiss* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Oncorhynchus mykiss Pc_{2+}	L_1	20	42.93±0.38	4.01	38.87	46.40
Oncorhynchus mykiss Pc_{3+}	L_2	20	44.99±0.54	5.31	41.51	49.18
Oncorhynchus mykiss Pc_{4+}	L_3	20	48.14±0.43	3.99	44.38	52.58

The analysed character was homogenous the calculated values for variation coefficient were in all three cases lower than 10 %.

At the studied batches *fleshy index I* recorded values between 20.82±0.24 in case of batch L_3 respectively 21.53±0.18, value recorded at individuals from batch L_1, comparing with *fleshy index II* which recorded the lowest value at individuals from 2rd summer (table 6). The studied character was homogenous for all the three batches of rainbow trout aspect enlightened by the value of variation coefficient which oscillated in interval 3.67-6.19%.

The values of fleshy index which oscillates around the value of 20 certify that the studied trout have a high percentage of meat.

Table 6 Fleshy index at *Oncorhynchus mykiss* breed

Specification	Batch	n	Ic	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Oncorhynchus mykiss Pc_{2+}	L_1	20	I	21.53±0.18	3.67	20.16	23.06
			II	20.06±0.20	4.35	18.08	21.72
Oncorhynchus mykiss Pc_{3+}	L_2	20	I	20.87±0.24	5.13	19.31	22.91
			II	21.70±0.29	5.94	18.72	23.57
Oncorhynchus mykiss Pc_{4+}	L_3	20	I	20.82±0.30	6.19	19.11	24.18
			II	21.54±0.28	5.97	18.04	24.25

Values of calculated indexes and coefficients for all three experimental batches correspond with the ones from the literature for these breed of fishes [4], [12].

CONCLUSIONS

The obtained values after realising biometrical measurements and concretion of corporal indexes and coefficients show that all three batches of rainbow trout are homogenous and are between the limits cited in literature for these breed.

The best values for the analysed morphological characters were obtained at individuals of rainbow trout of 3rd and 4th summer from batches L_2 and L_3, which enlightened a good maintenance state and corporal development.

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