STUDY ON THE EVOLUTION OF SOME MORPHOLOGICAL CHARACTERISTICS OF SILURUS GLANIS SPECIES IN DIFFERENT DEVELOPMENT STAGES, FARMED IN IASI COUNTY

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Abstract

The current study tracked the evolution of some morphological characters of European catfish individuals, at an age of second (L1), third (L2) and respectively four summers (L3), gathered from a fishery in Iasi County. Catfish breed Silurus glanis, was the object of the present study being analysed a number of 30 individuals, 10 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 5.00-5.40 for profile index; 0.90-1.06 for Fulton coefficient; 1,84-1,90 for Kiselev index; 62,81-68,37 for thickness index and 17,28-19,52 for fleshy index which bring out the ratio of the head from the standard body length. Having in view the obtained results we can conclude that the analysed fishes had a good state of maintenance.

Keywords: morphological characters, European catfish, body indices

INTRODUCTION

European catfish *Silurus glanis* (LINNAEUS, 1758) is the most spread representative of *Siluridae* family on European continent, being naturally founded in the fresh waters from Central and Eastern Europe and in South-East Asia [6]. Actual distribution of breed in Europe is the result of combination of three factors: hydrographical, climatic and anthropic. The combined effects of those factors, as well as the anthropic degradation of the environment, leaded to modification of natural spreading area of breed, which succeeded to colonize the majority of territories from Western, South and South-East Europe [16].

From ecologic point of view, European catfish is an euryhaline breed, and its natural area is in great rivers, but also in deep lakes, occasionally could be find in brackish, marine and coastal waters [18]. Prefers those waters which are known in literature as being "area of bream and carp", characterized by deep and calm waters, with a rich macrophyte vegetation and various sub-aquatic structures, as well as deep lakes, where prefer to stay in the areas with a hard substrate [19].

European catfish have a superior growing rhythm compared to other fresh water breeds from Europe, reaching still from the first year of life a weight of 1.2 – 1.5 kg in controlled conditions [9].

Fish biometry represents an important method for breed determination, which consists in direct measurement on individual of different corporal dimensions aiming to eliminate approximations and errors [2].

Effectuation of somatic and gravimetric measurements for each age is realised to determinate, especially, the maintenance state of fishes, as well as their adaptability to the assured growing conditions. Based on the obtained data were calculated the most representative maintenance indexes and coefficients.

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The manuscript was received: 20.05.2014
Accepted for publication: 02.08.2014

MATERIAL AND METHOD

Biological material was represented by a number of 30 European catfish individuals (*Silurus glanis*) of both sexes, reared in one fishery exploitation from Iaşi County. To reach the proposed aims, from biological material which was the subject of research were made three experimental batches L_1, L_2 and L_3, each with 10 individuals per batch, on three age categories, 2nd summer (Sl_{1+}), 3rd summer (Sl_{2+}) and 4th summer (Sl_{3+}). For all studied individuals were realized a series of measurements on the main corporal parameters (figure 1), which served to calculate some ratios between dimensions, of some corporal indexes which serve to evaluate fishes' [13]. Biometry of siluridae supposes determination of character variability on individuals' batches, based on measurements, weightings and statistical processing of obtained data.

Characters determined through biometric studies are represented by metric or dimensional characters (lengths, thicknesses) and by gravimetric characters (weight). Measurements of biological material were realised with some specific instruments (ichtyometers) or other measuring devices (rulers, callipers, centimetre ribbon) [4], [14].

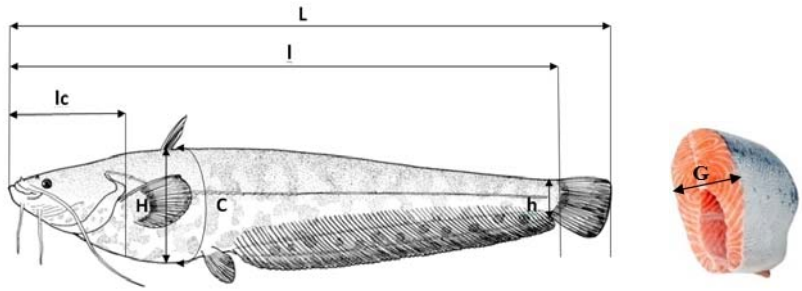

Fig. 1 Biometrical measurements at European catfish

Determined metric and gravimetric characters were:

- corporal mass (m), determined through weighting;
- total length of body (L), which is measured from the top of muzzle to the top of lobs of caudal fin;
- standard length of body (l), measured from top of muzzle to the last row of scales or to the base of caudal fin;
- length of head (lc) represented by the distance from top of muzzle to the posterior edge of opercular 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 dorsal line;
- maximum thickness of body (G), which is measured in the area where the body have the greatest thickness;
- maximum circumference of body (C), is measured at the level of maximum thickness and maximum height.

Based on somatic determinations could be calculated a series of corporal indexes, which offers information regarding maintenance state and corporal shape of fishes [7], [10].

Profile index (height) – highlight fishes' corporal format and allow framing of population individuals in a certain profile type.

To calculate this index was utilized the following formula:

$$Ip = l/H$$

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

A lower value of that index reflects a pronounced convexity of bodies' superior line. In breeding selection are preferred

catfishes with the lowest profile index, because the bulging aspect of back is correlated with a rich muscular mass [11].

Fulton coefficient (maintenance index) offers information regarding maintenance state of fishes, a higher value of that index could be translated by a very good maintenance state. It is calculated with the following formula:

$$Ii = (m * 100)/l^3$$

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

Quality index (Kiselev) is established based on Kiselev formula and offers information on fish quality. Quality index is calculated as follows:

$$IC = l/C$$

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

The more the values of quality index are lower, with both fish is better developed. Quality index is an important indicator in evaluation of fishes growing. Calculus of Kiselev index helps to determine fish quality, without making any other measurements or weightings [15].

Thickness index (width of back) expresses the width of musculature from back region in rate with maximum body height. Thickness index could be calculated using the formula:

$$Ig = (G * 100)/H$$

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

Carnosity index express the percentage rate of head from the body standard length. To calculate this index the following formula is applied:

$$Ic = (lc * 100)/l$$

where: Ic = carnosity index (%); lc = head length (cm); l = standard length of body (cm). The more the carnosity index had lower values, with both the fishes had a greater carnosity.

Description and calculus way for those indexes was made in according with the information from literature [8], [12].

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 age category of fishes (table 1).

Table 1 Values of main corporal parameters for *Silurus glanis* breed

Specification	*Silurus glanis* (L_1) (Sl_{1+}) (n=10)		*Silurus glanis* (L_2) (Sl_{2+}) (n=10)		*Silurus glanis* (L_3) (Sl_{3+}) (n=10)	
	$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%	$\bar{X} \pm s_{\bar{X}}$	V%
Corporal mass - m (g)	1719.57±271.46	15.79	2964.24±227.11	7.66	4141.22±122.13	5.95
Total length - L (cm)	62.88±3.13	4.97	73.38±0.90	1.23	79.83±2.29	2.87
Standard length - l (cm)	57.53±3.22	5.60	67.10±0.99	1.48	73.08±1.29	1.77
Head length - lc (cm)	11.23±0.78	6.92	12.20±0.73	5.97	12.63±0.60	4.77
Max. height - H (cm)	10.67±0.66	6.19	13.44±0.43	3.23	14.33±0.99	6.88
Maximum thickness of body - G (cm)	6.88±0.44	6.35	8.44±0.43	5.14	9.77±0.25	2.58
Max. circumference (cm)	30.35±1.35	4.45	35.46±1.48	4.18	39.67±1.53	3.85

Analysing the data from table 1 it is observed some differences in evolution of mean values for studied parameters function of age of waist of catfishes. So the mean

values of corporal mass were of 1719.57±271.46g in the case of batch L_1, 2964.24±227.11g at catfishes from batch L_2 respectively 4141.22±122.13g for batch L_3. Corporal mass related to the age of studied individuals represent a positive indicator of fishes adaptability to environmental conditions, reflecting at the same time a well maintenance of biological material [17].

For standard length could be observed an increase, function of age, from 91.49% of total length for batch L_1 (corresponding to age of 2nd summer), reaching at 91.54 % from total length at individuals from batch L_3 (4th summer).

All the studied characters recorded ascendant values function of age, the lowest values were recorded at catfish individuals from batch L_1, and the highest ones at individuals from batch L_3.

For the majority of analysed corporal parameters could be observed a low variability of characters, which justify their possible utilisation for realising comparisons between individuals with different ages, exception making only corporal mass which presented a mean to high variation coefficient especially for individuals from batch L_1, which reflects a non-uniform growing rhythm of mass in the first stages of life.

After corporal measurements were done for *Silurus glanis* individuals from all three batches, were calculated a series of corporal indexes as follows: profile index (Ip), thickness index (Ig), quality index (IC), Fulton index (Ii) and carnosity index (Ic).

At studied catfishes, calculated profile index (table 2) recorded a minimal value of 5.00±0.13 at individuals from batch L_2 and a maximal value of 5.40±0.23 at individuals from batch L_1, which indicate a better corporal shape in case of 3rd summer catfishes, even if optimal values are quite similar in the case of 4th summer fishes. Those values show that aging is directly proportional with the development of muscular mass.

Table 2 Profile index at *Silurus glanis* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Silurus glanis SI_{1+}	L_1	10	5.40±0.23	4.20	5.10	5.79
Silurus glanis SI_{2+}	L_2	10	5.00±0.13	2.61	4.79	5.14
Silurus glanis SI_{3+}	L_3	10	5.12±0.46	8.95	4.80	5.64

Calculated Fulton coefficient for studied individuals of European catfish presented an ascendant evolution function of fishes' age, so for individuals from batch L_1 determined value was 0.90±0.08, for batch L_2 was 0.98±0.04, and for batch L_3 determined value was 1.06±0.08. Having in view the fact that a higher value for this index is similar with a superior maintenance state, could be concluded that even all 3 batches had similar conditions regarding environment and feed, elder individuals capitalize better the available resources, this aspect being highlighted also by the obtained results from the current research (table 3).

Table 3 Fulton coefficient at *Silurus glanis* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Silurus glanis SI_{1+}	L_1	10	0.90±0.08	8.68	0.97	1.08
Silurus glanis SI_{2+}	L_2	10	0.98±0.04	4.14	0.94	1.03
Silurus glanis SI_{3+}	L_3	10	1.06±0.08	7.95	0.97	1.13

Values of Kiselev index were between 1.77-1.97, optimal value being recorded at European catfish individuals of 4th summer (L_3), which show that biological material of this batch had the better corporal development (table 4). Studied character presented a low variability at all those three batches, variation coefficient being placed in interval 2.37-5.49.

Table 4 Quality index (Kiselev) at *Silurus glanis* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Silurus glanis Sl_{1+}	L_1	10	1.90±0.04	2.37	1.81	1.97
Silurus glanis Sl_{2+}	L_2	10	1.89±0.05	2.86	1.82	1.96
Silurus glanis Sl_{3+}	L_3	10	1.84±0.10	5.49	1.77	1.96

Analysing the data from table 5 could be observed an increasing evolution of mean values for thickness index, function of development stage of fishes. So, in case of individuals of 2nd summer was recorded a mean value of 64.56±3.38, for individuals of 3rd summer the value was 65.81±2.38, and for the ones of 4th summer the mean value for this index was 68.37±5.24.

The analyzed character was homogenous, calculated values for variation coefficient being in all three cases lower than 10%.

Table 5 Thickness index at *Silurus glanis* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Silurus glanis Sl_{1+}	L_1	10	64.56±3.38	5.24	58.41	69.79
Silurus glanis Sl_{2+}	L_2	10	65.81±2.38	4.51	59.23	66.67
Silurus glanis Sl_{3+}	L_3	10	68.37±0.43	5.24	64.19	74.24

In case of studied batches carnosity index recorded mean values between 17.28±0.55 for batch L_3 respectively 19.52±0.84, value recorded at individuals from batch L_1 (table 6). The studied character was homogenous for all three batches of catfish, aspect enlightened by the value of variation coefficient which oscillated between 3.18-5.18%.

Values of carnosity index which oscillate around the value of 18% certify the fact that studied individuals of European catfishes had a high percent of meat.

Table 6 Carnosity index at *Silurus glanis* breed

Specification	Batch	n	$\bar{X} \pm s_{\bar{X}}$	V%	Min.	Max.
Silurus glanis Sl_{1+}	L_1	10	19.52±0.84	4.31	18.13	21.11
Silurus glanis Sl_{2+}	L_2	10	18.18±0.94	5.18	17.16	19.34
Silurus glanis Sl_{3+}	L_3	10	17.28±0.55	3.18	16.67	17.72

CONCLUSIONS

The obtained values after effectuation of biometric measurements and calculus of corporal indexes and coefficients show that all three batches of European catfish are homogenous, being in the limits cited by literature for this breed [9], [1], [3].

The best values for the analyzed morphological characters were obtained for European catfish individuals of 3rd and 4th summer from batches L_2 and L_3, fact which suggest that with aging *Silurus glanis* breed have a better adaptability at environmental conditions from the studied fishery, fact highlighted also by the values of analyzed coefficients through the current paper.

ACKNOWLEDGMENTS

This paper was *published under the frame of* European Social Fund, *Human Resources Development Operational Programme 2007-2013, project no.* POSDRU/159/1.5/S/132765.

REFERENCES

[1] Arteni, Mihaela: Studies regarding some morphological features of one-summer old catfish (*Silurus glanis* Linnaeus, 1758), AACL Bioflux, 2 (2): 217-222 p., 2009.

[2] Bud, I., Vlădău, V., Nădășan, M.,: Tratat de creştere a peştilor. Editura Texte. Dej, 2010.
[3] Bud, I., Vlădău, V.V., Réka, Șt., Pop, S.N., Ladoşi, Daniela,: Contributions concerning the species and age influence on qualitative index at fish meat, Buletin USAMV -CN, 65 (1-2)/2008 (-) ISSN 1454-2382, p. 288-292, 2008.
[4] Bura, M.,: Acvacultură specială, Editura Orizonturi, Timişoara, 2002.
[5] Cristea, I.T., Contescu, L.,: Cercetări pentru determinarea ritmului de creştere al cleanului (*Leuciscus cephalus* L., 1758). Analele ICAS 47(1):257-273, 2004
[6] Grecu, Iulia,: Contribuții la studiul tehnologiei de reproducere și creștere în perioada larvară a speciei *Silurus glanis L.*, 1758, Teză de doctorat, Universitatea Dunărea de Jos, Galați, 2008.
[7] Grozea, A.,: Acvacultură. Editura Excelsior Art. Timişoara, 2002.
[8] Grozea, A.,: Ciprinicultură. Editura Mirton Timişoara, 2007
[9] Jankowska, Barbara, Zakęś, Z., Zmijewski, T., Ulikowski, D., Kowalska, Agata,: Slaughter value and flesh characteristics of European catfish (*Silurus glanis*) fed natural and formulated feed under different rearing conditions Eur. Food Res. Technol. 224, p. 453–459, 2006.
[10] Macovei, Valerica,: Cercetări cu privire la folosirea vegetației acvatice de către unele specii de pești, Teză de doctorat, Universitatea „Ion Ionescu de la Brad", Iași, 2008.
[11] Mireşan, Vioara, Cocan, D., Constantinescu, R., Răducu, Camelia, Feştilă, Iulia, Sărmas, I.,: Using body size indices for selection of future rainbow trout breeding (*Oncorhynchus mykiss*, Wallbaum 1792), Editura Bulletin UASVM Animal Science and Biotehnologies, 2010.
[12] Önsoy, B., Serhan, A., Filiz, H., Bilge, G.,: Determination of the best length measurement of fish, North-Western Journal of Zoology 7 (1): 178-180, Oradea, Romania, 2011.
[13] Pagu, B.I.,: Contribuții la stabilirea vârstei și greutății corporale optime de valorificare a speciei de păstrăv *Oncorhynchus mykiss*, Teză de doctorat, Universitatea de Științe Agricole și Medicină Veterinară Ion Ionescu de la Brad, Iași, 2013.
[14] Păsărin, B., Stan, Tr.,: Acvacultură. Îndrumător practic. Editura Karro, Iași, 2003.
[15] Simeanu, Cristina, Păsărin, B., Simeanu, D.,: The study of some morphological characteristics of the sturgeon species of *Polyodon spathula* in different development stages. Lucrări Științifice, seria Zootehnie, vol. 54(15), USAMV Iași, Editura "Ion Ionescu de la Brad" Iași, pag 244-247, ISSN 1454-7368, 2010.
[16] Schlumberger, O., Sagliocco, M., Proteau, J.P.,: Biogéographie Du Silure Glane (*Silurus Glanis*): Causes Hydrographiques, Climatiques et Anthropiques, CEMAGREF, U.R. Ressources Ichtyologiques en Plans d'Eau, BP 5095, 34033, Montpellier cedex, France, 2000.
[17] Ünlü, E., Değer, D., Çiçek, T.,: Comparison of morphological and anatomical characters in two catfish species, *Silurus triostegus* Heckel, 1843 and *Silurus glanis* L., 1758 (Siluridae, Siluriformes), North-Western Journal of Zoology 8 (1): 119-124, Oradea, Romania, 2012.
[18] Valadou, B., Changeux, T., Proteau, J.P., Belliard, J., Ledouble, O.,: Le silure glane (*Silirus glanis*, L.) en France. Evolution de son aire de repartition et prediction de son extintion, IRD, CEMAGREF, Paris, 2007.
19.[4] Wolter, C., Bischoff, A.,: Seasonal changes of fish diversity in the main channel of the large lowland river Oder, Regulated rivers 17(4-5), p 595-608, 2001.