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GROWTH DYNAMICS OF THE WELS CATFISH POPULATION IN THE CHIRILOAIA LAKE

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Abstract. This paper presents the results of a study on the wels catfish population growth (*Silurus glanis*) from the Chiriloaia lake, Fundu Mare island, Braila county. Scientific fishing was done between 7 and 11 July 2006, in the lake and in the contact channel with the river, using specific commercial fishing tools: gills and cornel tree baskets ('varse' in Romanian). The growth parameters reflect the environmental conditions: the food availability, the ichthyofauna structure, physicochemical parameters of the water, etc. The paper proposes to estimate the growth population parameters of the wels catfish in this ecosystem (L_∞ and k, t_0), the determination of the weight–length relation, the growth rate (the von Bertalanffy growth equation).

Keywords: growth dynamics, wels catfish, the Chiriloaia lake.

AIMS AND BACKGROUND

The growth study involves the determination of the body size as an age function. In the temperate waters the fish age can be determined by reading the annual rings on the scales otoliths, or rays, but there are also methods which permit the conversion of the frequency data on lengths in the structure on ages.

The methods for estimating the growth parameters are considered sub-models of the models which describe the fish population dynamics[1].

The wels catfish (*Silurus glanis*) is valuable species for several reasons: it has a very tasty meat with a high nutritional value, is the freshwater specie which reaches the largest sizes and is a species with a high abundance in the river. The Fundu Mare island is famous for the abundance of this species in the annual captures, as follows: in the 1972–1980 periods the wels catfish catch was 4.25% of the total annual capture, and in the 1980–1986 period, 2.84%, being among the first four species as weight in captures, besides the species crucian carp, carp, roach.

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EXPERIMENTAL

The fishing was done using a fishing unit consisted of: boat, fishing tools (gillnets and cornel tree baskets) and two fishermen. The expedition period was 6 –11 July 2006 and the captured wels catfish specimens number was 60 with a total biomass of 37 716 g. The captured specimens were subjected to biometrical measurements: total length (L_t), height (h), weight (W).

For these specimens were estimated the growth parameters (L_∞, k, t_0), and were determined the length–weight relationship (L–W) and the von Bertalanffy growth equation. To determine these correlations and to estimate the parameters were used the studies of Gulland[2], Holt[3], von Bertalanffy[4], Sparre et al.[5]

Estimation of the growth parameters L_∞ and k by the Gulland–Holt method. The linear regression between the growth of length per year ($\Delta L/\Delta t$) and the average length (L_t) from the corresponding year was determined with the Gulland–Holt relationship of the following form[2,5]:

$$\Delta L/\Delta t = a + b\, L_t \tag{1}$$

$$L_\infty = -a/b;\ k = -b.$$

Estimation of parameters t_0 and k by the von Bertalanffy graphic method. By the linear regression between the average length of the individuals at successive ages, has been determined the von Bertalanffy relationship of the following form[5]:

$$-\ln\,(1 - L_t/\,L_\infty) = -k\, t_0 + k\, t. \tag{2}$$

Accuracy of the estimations by this method depends on the L_∞ value.

The L–W relationship for the wels catfish population (*Silurus glanis*) *of the Chiriloaia lake*. The change in weight of fish can be described by the following relationship:

$$W = q\, L^b, \tag{3}$$

where W is individual weight (g)**;** a and b – regression constant; L_t – total length (cm).

The values of q and b were estimated as follows:

$$\ln W = \ln q + b \ln L \tag{4}$$

(when $b = 3$ isometric growth is directly proportional to the weight, $b > 3$, weight gain is faster than the increase in length if $b < 3$ weight gain is slower than growth in length).

For growth study was used the von Bertalanffy growth equation[5–7]:

$$L_t = L_\infty\,(1 - e^{-k(t - t_0)}) \tag{5}$$

where L_t is the recalculated length at a certain age class; L – the maximum physiological dimension to which tends the population, in the concrete conditions of the habitat; k – the growth constant which shows the growth type of the species; t_0 – the theoretical age at which the length is 0 without biological signification;

RESULTS AND DISCUSSION

Growth analysis. The total length of the specimens caught ranged from 29.5 to 58 cm and the individual biomass – from 190 to 1750 g.

The growth parameters have been estimated using methods based on the length–age correlations, through the Gulland–Holt method and the von Bertalanffy graphic method.

The input date for the L_∞ and k estimation by the Gulland–Holt method, are the pairs: length–age (taken from the existing data from literature) and are given in Table 1.

Table 1 Input data for estimating growth parameters L_∞ and k, the Gulland–Holt method

t	Δt	L_t	ΔL	$(L_{t+1}+L_t)/2$	$\Delta L/\Delta t$
2		12.76			
3	1	40.75	27.99	26.755	26.755
4	1	60.59	19.84	50.67	23.915
5	1	75.98	15.39	68.285	17.615
6	1	88.56	12.58	82.27	13.985
7	1	99.20	10.64	93.88	11.61
8	1	108.41	9.21	103.805	9.925
9	1	116.54	8.13	112.475	8.67
10	1	123.81	7.27	120.175	7.7
		L_∞=151.16 cm; k=0.219			

Linear regression between annual growth in length ($\Delta L/\Delta t$) and the average length (L_t) is determined with relationship (1) and is graphically shown in Fig. 1.

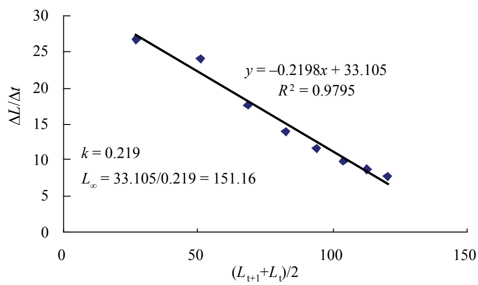

Fig. 1. Linear regression between annual growth in length ($\Delta L/\Delta t$) and average length (L_t)

The input data and the chart estimate of the growth parameters t_o and k using the von Bertalanffy graphic method are given in Table 2 and Fig. 2.

Table 2. Input data to estimate parameters of the von Bertalanffy growth by graphic method

t	L_t	$-\ln(1 - L_t/L_\infty)$
2	12.76	0.088
3	40.75	0.314
4	60.59	0.512
5	75.98	0.698
6	88.56	0.881
7	99.20	1.067
8	108.41	1.262
9	116.54	1.473
10	123.81	1.709
	$k = 0.197$; $t_0 = -1.48$ years	

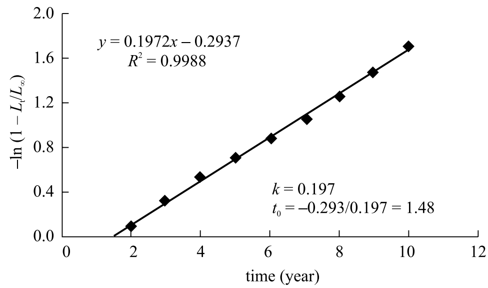

Fig. 2. Estimation of the growth parameters t_0 and k

Using the von Bertalanffy growth equation (3) the relationship between L and W of 60 wels catfish was determined after log transformation:

$$W = 0.021\,L_t^{2.7043}.$$

The value of the coefficient b is a measure of the quality of the environmental conditions, characteristic for each biotope, being a generalised form of the Fulton index[8], expressing the growth character. The value of the coefficient b (2.703) shows an increasing in weight faster than in length.

In Figs 3 and 4 are represented linear and non-linear forms of the length–weight correlation.

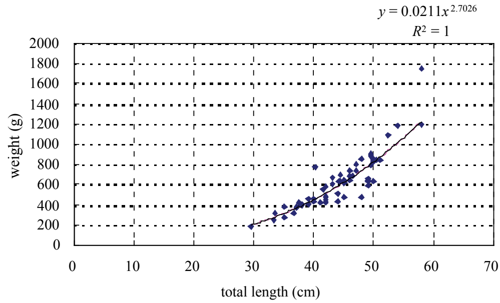

Fig. 3. *L–W* relationship of the wels catfish population (linear form)

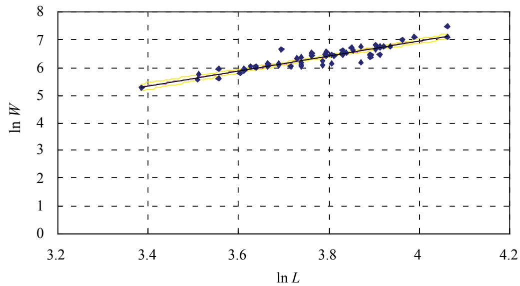

Fig. 4. *L–W* regression of the wels catfish population (non-linear form)

The equation that describes the theoretical growth rate of wels catfish from the Chiriloaia lake is:

$$L_t = 69.007 \ln t - 35.065$$

The theoretical curve of growth of the wels is shown in Fig. 5. Therefore, growth in weight can be approximated by the following equation:

$$W_t = 0.021 \times (69.007 \ln t - 35.065)^{2.704}$$

The growth equation in length using the von Bertalanffy formula (5) is:

$$L_t = 151.6\ (1 - e^{-k(t + 1.48)})$$

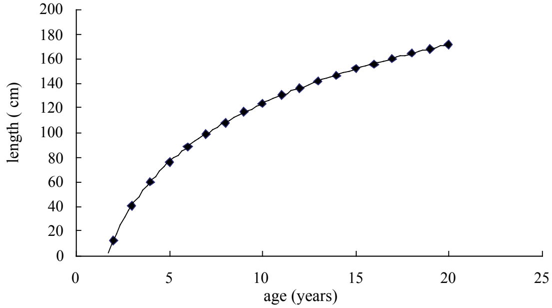

Fig. 5. Theoretical growth curve of the wels catfish population

CONCLUSIONS

The wels catfish is a fish species without scales, the age can be determined by reading in section of the otoliths or of the rays. In general data about the length–age relation or weight–age are rare in the specialised literature.

The growth parameters estimation for the wels catfish population from the Chiriloaia lake are:

$$L_\infty = 151.16, k = 0.197–0.219, t_0 = –1.48.$$

The value of L for the wels catfish population from the Chiriloaia lake is relatively small, observing that in literature we find maximum 500 cm (at an age of maximum 30).

The values of the k constant indicate a relatively good growth.

In this study had been made an estimation of these parameters on a small number of individuals of this species. For accuracy of this study, and in principal of the growth correlation in comparison with the age (hard enough at this species to determine) is needed to continue the research , and the individuals number of the test to be higher.

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