

BODY LENGTH AND BODY WEIGHT RATIO CHARACTERISTICS OF ONE-SUMMER - OLD WELS (*SILURUS GLANIS* L.)

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Abstract

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In the present research length and weight characteristics of 798 one-summer-old wels were measured, 707 of which with body weight below 50 g and 91 above 50 g respectively. They were reared in earth pond and fed on natural food. To be more demonstrative while tracing the body weight and length rate, besides the summarized data, the specimens were divided according to their body weight into groups within each one of the first two groups. The research proves that the difference in weight and length of the body between the two groups at one-summer-old age is significant ($P < 0.001$). The correlation between weight and length growth of the body can be described by means of an equation of the type $BW = 0.0109SL^{2.8581}$ ($r = 0.9862$) in the group with body weight below 50 g and $BW = 0.0142SL^{2.7809}$ ($r = 0.951$) in the group with body weight above 50 g. For both groups of one-summer old fish studied, the coefficient of Fulton was determined. According to this index, between both groups analyzed there is a difference, which is statistically authentic at $p < 0.001$ ***. The body length and body weight rate characteristics of one-summer old wels, produced from one spawner and grown in identical conditions vary considerably variation as regards body weight (BW, g) and body standard length (SL, cm), 154.33% and 41.49%, respectively. Fish with body weight below 50 g have represented 88.6% and those with body weight above 50 g – 11.4%.

Key words: wels (*Silurus glanis*), body weight, body length, correlation between weight and length growth, Fulton coefficient

Introduction

The variation of body length and body weight of fish, produced at one and the same time and grown in the same environment is a well-known phenomenon (Huss and Persson, 2007), which was reported even for specimen produced by one and the same female fish.

The variation of body length and body weight of

cultivated fish species has a great significance as the percentage of underdeveloped individuals, has a negative effect upon the yields.

The body weight variation of cultivated hydrobionts depends on many external factors: the density, the quantity and quality of food, and the hydro-chemical characteristics, included, are the most important ones, having in mind that the individual potential is also significant for the growth rate of each specimen (Hubeno-

va et al., 2001). It was established that a significant role for the occurrence of body length and body weight differences has of the social hierarchy, specimen ' aggressiveness, striving for territory preservation, cannibalism, etc. (Hecht and Appelbaum, 1988; Smith and Reay, 1991; Hecht and Pienaar, 1993; Keiser et al., 1995 a; Keiser et al., 1995 b; Folkvord, 1997). Concerning predators, the body weight variation could be looked upon as a cause and effect of cannibalism (Hecht and Pienaar, 1993).

The wels (*Silurus glanis* L.) is a predatory fish, which is grown in polyculture or in monoculture, in a different type of production facilities, like: ponds, net cages and recirculation systems (Muller and Varadi, 1980; Filipiak et al., 1993; Duda, 1994; Mares et al., 1995; Filipiak et al., 1997; Pruszynski and Pistelok, 1999; Linhart et al., 2002). Regardless of the way of growing, a characteristic peculiarity of its cultivation is the body length and body weight variations, which are reported very often at the end of the vegetation period. In most cases, some of the fish could reach considerably greater body length and weight, while others could remain underdeveloped. The body length and body weight variations increase also because of the fact that the larger fish could consume prey with varying body length and body weight, which in practice increases their access to a greater food recourse (Folkvord, 1997). At a given moment, the body weight variations become a prerequisite for demonstration of cannibalism and for a lower survivability rate. As far as one-summer old fish are concerned, the wels, which have remained underdeveloped in their growth

rate, have a lower initial growth rate for the next vegetation period, which has negative effect upon the final fish-breeding results.

The purpose of this investigation is to make a body length and body weight characteristics of a one-summer old wels, reared in an earth pond and fed on natural food and to establish the variation of both parameters at the specific conditions.

Materials and Methods

For the purpose of this research, one-summer-old fish, reared during the vegetation period in earth pond, with an area of 0.14 ha, at a number of 600 individuals.ha⁻¹, were used.

The pond was prepared in advance, its bottom being disinfected with 20 kg.ha⁻¹ of quicklime and treated with 20 kg.ha⁻¹ of fertilizer to stimulate the growth of natural food basis. During the experimental period, the ponds overgrown with aquatic vegetation occupied approximately 1/6 of the area.

The fish stocking of ponds was done with 600 pieces.ha⁻¹ larvae of wels, with an initial growth rate of 119.1±37.4 mg. The larvae were produced from one and the same sibling fish and reared up to their 15 days age in tanks, in controlled conditions. Additionally 1500 numbers.ha⁻¹ larvae of carp were added into the pond as food for the wels. Weed fish species have come inside it, as well, Crucian carp (*Carasius auratus gibelio*) and *Pseudorasbora parva*.

During the experimental period, the following hydrochemical parameters were examined: tempera-

Table 1
Average values of basic hydrochemical parameters of the water in the experimental pond during the rearing season

Parameters	$\bar{x} \pm SD$	Cv, %	lim
Temperature, T°C	23.2±2.8	12.2	18.7 - 27.9
Oxygen, mg.l ⁻¹	6.02±1.9	30.9	3.3 - 10
Oxygen, %	72.08±22.3	30.9	42 - 110
pH	7.78±0.32	4.16	7.43 - 8.32
Chemical oxygen demand (COD), mg.l ⁻¹	9.49±0.59	6.17	8.85 - 10

ture ($T^{\circ}\text{C}$), quantity of oxygen dissolved in water (O_2 $\text{mg}\cdot\text{l}^{-1}$), saturation percentage (O_2 , %) and hydrogen's chemical activity index (pH) (Table 1).

In order to trace the body weight and the body length variation of the one-summer-old wels, 798 specimens were measured, in total. The fish were divided in two groups depending on their body weight – below 50 g and above 50 g. The first group consisted of 707 specimens and represented 88.6% of the fish studied, while the second consisted of 91 specimens (11.4%), with body weight of 50 g to 330 g. To be more demonstrative while tracing the body weight and length rate, besides the summarized data, the specimens were divided according to their body weight into groups within each one of the first two groups. For each group the average values (\bar{x}), the standard deviation (SD), the variation coefficient (Cv, %) and the minimum and maximum values of the exterior parameters: body weight (BW, g), body standard length (SL, cm) and body zoological length (TL, cm), were calculated.

Graphics with specimens' rated distribution, according to their body weight was built by means of comparative analysis and by applying Student's criterion (t-test) between the two main groups; the dependence between body weight and body standard length for both groups has been expressed; and meat and fat content rate (according to Fulton) were calculated on the basis of the exponent deduced during statistical processing.

Results and Discussion

The values of the main hydrochemical parameters are shown in Table 1. The lowest temperature reported was 19°C , and the highest 27.9°C . The quantity of dissolved in water oxygen was within the limits of $3.3 - 10 \text{ mg}\cdot\text{l}^{-1}$, and the hydrogen index varied comparatively slightly – $7.43-8.32$. In termination of the experiment, one-summer old carp was not caught, only $0.8 \text{ kg}\cdot\text{ha}^{-1}$, mostly big-sized Crucian carp (above 40 g) and $0.2 \text{ kg}\cdot\text{ha}^{-1}$ of *Pseudorasbora prava*. The total yield of one-summer old wels was 1066 ($76.1 \text{ pieces}\cdot\text{ha}^{-1}$) or $1.76 \text{ kg}\cdot\text{ha}^{-1}$. The recorded surviv-

ability rate was 2.5% at an average body weight of one-summer old small fish $23.16\pm 35.75 \text{ g}$. The lowest body weight reported of the one-summer old wels was barely 1.25 g, and the highest – 329.7 g.

The analysis of the hydrochemical parameters shows that during the experimental period water temperature, the quantity of oxygen dissolved in it, oxidability, as well as pH index were close to the optimum, with some insignificant deviations. Lower quantity of oxygen dissolved in water was observed in August $3.3-4.4 \text{ mg}\cdot\text{l}^{-1}$. During the experimental period no risk values for the fish survivability rate were registered. Overall, the hydrochemical characteristics were favorable for fish growing.

The average body weight value, in total, for all one-summer old wels studied was $23.16\pm 35.75 \text{ g}$ (at $n=798$, $\text{lim } 1.25\div 329.7 \text{ g}$). This index indicates a very high degree of variation – above 154%, which was imposed during the results analysis, to divide the fish in two groups, as regards their body weight – below 50 g (Group A) and above 50 g (Group B).

The body weight characteristics of the two studied groups stated above are presented in Figures 1 and 2. It was established that the specimens with body weight below 10 g are the predominant ones and represent 56% of all specimens investigated with body

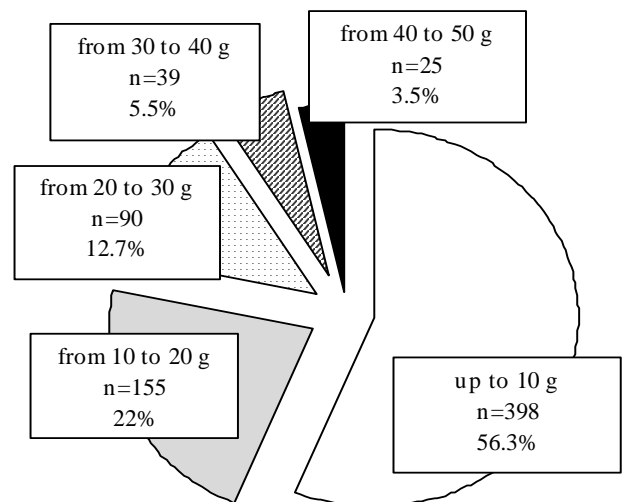


Fig. 1. Distribution of the one-summer old wels (in %) in regard to the feature body weight (body weight, up to 50 g)

weight below 50 g, or 50% of all fish analyzed. The wels with body weight of 10 to 20 g are 22% of all investigated specimens, with body weight below 50 g, those with body weight 20 to 30 g are 12.7%, and those with body weight between 30 g and 50 g represent 9% of the specimens with body weight below 50 g (Figure 1).

As to the second group (B), wels investigated is concerned, with body weight above 50 g, the highest percentage is that of fish with body weight below 100 g – 61.5%. 20.9% are fish with body weight 100 g to 150 g, and those with body weight 150 g to 200 g and above 200 g are 8.8% (Figure 2).

Within Group A (BW < 50 g) the specimens were divided according to body weight groups, every other

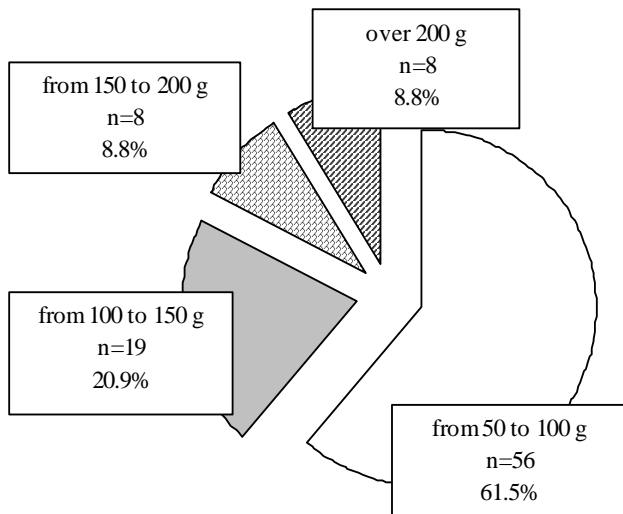


Fig. 2. Distribution of the one-summer old wels (in %) in regard to the feature body weight (body weight, over 50 g)

10 g. The body weight varies within a wide range from 1.25g to 49.6 g (Cv, 6.75÷34.25%), and the body length from 5.8 cm to 19 cm (Cv, 2.77÷12.09%). By increasing the average body weight values for the separate body weight groups, the variation coefficients of these indices decreases (Table 2).

As far as the second group of specimens with body weight above 50 g (Group B) is concerned, the fish were divided according to body weight groups, every other 50 g. The body weight also varies within a wide range from 50.29 g to 329.7 g (Cv,

Table 2

Average values of the features body weight (BW, g), total body length (TL, cm) and standard length (SL, cm) in one-summer-old wels (*Silurus glanis* L.) reared under pond condition

One-summer-old wels (<i>Silurus glanis</i> L.)			
Features	BW, g	TL, cm	SL, cm
up to 10 g, n=398			
x±SD	5.47±1.87	9.93±1.18	8.73±1.06
Cv, %	34.25	11.9	12.09
lim	1.25-9.9	6.6-13.4	5.8-11.2
from 10 to 20 g, n=155			
x±SD	14.47±3.18	13.82±1.19	12.3±1.14
Cv, %	21.95	8.58	9.29
lim	10-19.8	8.7-16.5	7.7-14.5
from 20 to 30 g, n=90			
x±SD	23.62±2.42	16.37±0.87	14.67±0.79
Cv, %	10.25	5.29	5.4
lim	20-29.9	14.5-20.5	12.9-17.2
from 30 to 40 g, n=39			
x±SD	34.54±2.97	18.44±0.58	16.54±0.56
Cv, %	8.6	3.16	3.41
lim	30-39.4	17.4-19.5	15.4-17.5
from 40 to 50 g, n=25			
x±SD	44.89±3.03	20.2±0.58	18.23±0.51
Cv, %	6.75	2.86	2.77
lim	40.3-49.6	19.3-21.5	17-19
up to 50 g, total, n=707			
x±SD	12.75±10.68	12.43±3.36	11.03±3.09
Cv, %	83.77	27.01	28.03
lim	1.25-49.6	6.6-21.5	8/5/2019

7.04÷19.09%). The body length of the wels studied is from 18.5 cm to 34.5 cm and varies at a low rate (Cv, 2.55÷7.21%). By increasing the average values of body weight for the separate body weight groups, the variation coefficient of body weight decreases, with the exception of the last body weight group. Eight fish were included in it, having body weight 200 g to 329.7 g, which also explains the higher value of the variation coefficient - 18.88% for this index (Table 3).

Table 3
Average values of the features body weight (BW, g), total body length (TL, cm) and standard length (SL, cm) in one-summer-old wels (*Silurus glanis* L.) reared under pond condition

One-summer-old wels (<i>Silurus glanis</i> L.)			
Features	BW, g	TL, cm	SL, cm
from 50 to 100 g			
x±SD	69.29±13.23	23.24±1.44	21.28±1.54
Cv, %	19.09	6.22	7.21
lim	50.29-98.05	21-27	18.5-25.5
from 100 to 150 g			
x±SD	126.27±11.79	28.29±1.25	26.37±1.15
Cv, %	9.34	4.42	4.37
lim	108.8-143.95	5/26/1930	5/24/2028
from 150 to 200 g			
x±SD	166.38±11.71	31.26±0.92	29.13±0.74
Cv, %	7.04	2.95	2.55
lim	152.01-186.9	30-32.5	28-30
over 200 g			
x±SD	232.18±43.83	34.94±1.76	31.13±2.6
Cv, %	18.88	5.03	8.36
lim	200-329.7	33-38	25.5-34.5
over 50 g, total, n=91			
x±SD	104.04±54.36	26.03±4.16	23.9±3.86
Cv, %	52.25	15.98	16.16
lim	50.29-329.7	21-38	18.5-34.5

Authentic differences between body weight and body length ($p < 0.001^{***}$) were established between the two groups investigated – A and B.

Figures 3 and 4 present the relation between body weight and linear (length) growth rate. The dependence concerning the group with body weight below 50 g is described by an exponential equation, as follows: $BW = 0.0109 \cdot SL^{2.8581}$ ($r = 0.9862$) and concerning the second group it is, as follows:

$$BW = 0.0142 \cdot SL^{2.7809} \quad (r = 0.951).$$

For both groups of one-summer old fish studied, the coefficient of Fulton was determined. Its value for the group with body weight below 50 g is 1.1 ± 0.15 ,

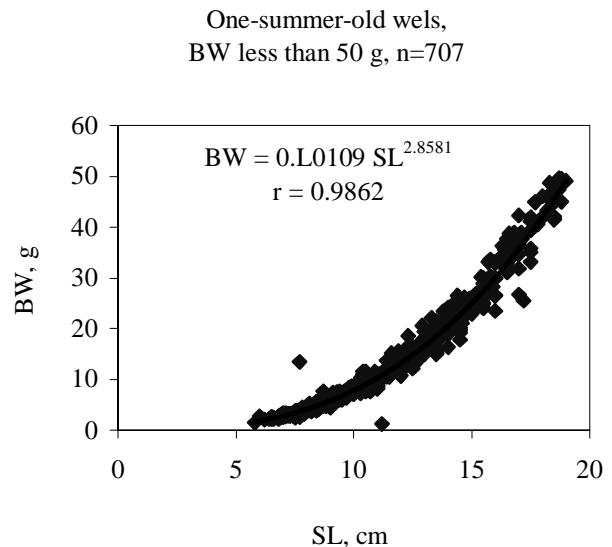


Fig. 3. Relationship between body weight (BW, g) and standard body length (SL, cm) in one-summer-old wels (*Silurus glanis* L.) with body weight less than 50 g

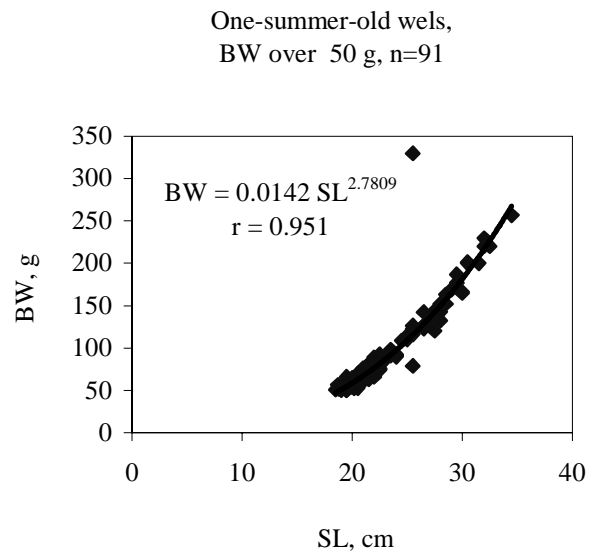


Fig. 4. Relationship between body weight (BW, g) and standard body length (SL, cm) in one-summer-old wels (*Silurus glanis* L.) with bodyweight over 50 g

and for the fish with body weight above 50 g it is 1.43 ± 0.3 . According to this index, between both groups analyzed there is a difference, which is statistically authentic at $p < 0.001^{***}$.

Conclusions

The body length and body weight rate characteristics of one-summer old fish stocking material of wels, produced from one spawner fish and grown in identical conditions show a considerable variation as regards body weight (BW, g) and body standard length (SL, cm), 154.33% and 41.49%, respectively. Fish with body weight below 50 g represented 88.6% and those with body weight above 50 g – 11.4%. A considerable part of the one-summer old fish (50%) are below 10 g, which decreases their chance to reach a consumer growth rate for the next year. It can be supposed that the body weight and body length variation reported of one-summer old wels is the effect either from the different growth rate potential of each specimen within the limits of its species, which is a factor with great importance, and is typical for the predatory fish, as well as from the specific growing conditions.

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