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Short communication

GROWTH OF THE MUDMINNOW (*UMBRA KRAMERI* WALBAUM) IN RIVER ÉR

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Abstract. Growth characteristics of the mudminnow were studied in river Ér on the basis of length and weight measurements of 252 individuals. Relationship between body length and weight was determined and the expected growth of the length was calculated with the Walford and Bertalanffy methods. Our results were compared with data of Slovakian populations.

Keywords: Bertalanffy model, body length, body weight, Walford method

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Introduction

The mudminnow is an endemic fish species of the rivers Danube and Dniester. It is a typically stagnophyl species and its population has significantly decreased in the last decades, therefore Maitland (1991) considers it a highly endangered species. Bănărescu (1993, 1994) points out that the mudminnow becomes frequent in places where it finds suitable circumstances. The protection of moors, slow, muddy small rivers and brooks with certain vegetation would solve the survival of this species.

The growthof the individuals of the European mudminnow population has been studied by many researchers, but no detailed study suitable for comparison have been published. The first data were published by Geyer (1940) from the territory of Hungary, but he stated that the species could reach only the age of two years. Pavlov (1953) mentioned about the age of 5-6 from the lower reaches of the Danube, and he found larger sizes compared with those of Geyer. Based on these data, Kux and Libosvárský (1957) described two subspecies (*Umbra krameri karmeri* and *U. krameri pavlovi*) in the Lower Danube and Middle Europe, but later this was revised (Baruš and Libosvárský 1983).

Most of the studies about the growth of the mudminnow were published in Slovakia (Libosvárský and Kux 1958, Mišik 1966, Makara and Stráňai 1980), but these consider only the age of two years. Growth studies of the mudminnow population in the Ér Valley (Wilhelm 1984, 1987) showed that this fish can reach the age of six.

Comparative data about the growth of the mudminnow were published by Wanzenböck (1995).

Material and methods

252 mudminnow individuals were gathered between 1973 and 1995 with a scratching net. I measured total length (Lt), standard length (Lc) (without the caudal fin) and body weight (W) of the fishes.

The age of the specimens was determined from the annual rings of the scales previously treated with a solution of 0.2 % NaOCl with a trichinoscope, and later with a stereomicroscope.

In the description of the growth of length I used the values of the standard length, but in some countries the total length is used, so I determined the equation of the transformation of the standard to total length using the following formula:

$$Lt = bLc + a$$

The relationship between the body length and weight was determined with the formula of Tesch (1968):

$$W = aL^b$$

based on the standard and total length too, where "a" is the regression coefficient and "b" has a value of approximately 3.0.

For the mathematical description of the growth I used the Walford (1946) method and the Bertalanffy (1957) model.

Standard length of age group "t+1" was plotted against that of age group "t" and the Walford linear plot was calculated

$L_{t+1} = a + bL_t$.

The X value of the point of the intersection of the Walford plot and the diagonal of 45° is the maximum theoretically achievable (asymptotic) length (Lc_{inf}).

According to the Bertalanffy model, the length achieved at any "t" time can be calculated with the following formula:

$Lc_t = Lc_{inf}[1 - e^{-K(t - t_0)}]$,

where "K" is the growth constant, t_0 is a hypotethical moment when the length is zero, "e" is the basis of the natural logarithm. I plotted $\ln(Lc_{inf} - Lc_t)$ against the age and the value of "K" was determined from

$y = a - Kx$

To calculate the value of t_0, I put on the Y axis the value of $\ln Lc_{inf}$ and draw a parallel with the X axis. The X value of the point of intersection of this parallel with the initial regression line is the t_0. The value of t_0 can be calculated with the formula:

$t_0 = (\ln Lc_{inf} - a) / b$,

where "a" and "b" are the constants of the regression line. The exact value of Lc_{inf} can be calculated using the following formula:

$Lc_{inf} = a / (1 - b)$

The condition of the fish was calculated using the formula:

$CF = W / Lc^b$

where "b" corresponds to the "b" value from the formula of the relationship between the body weight and standard length. I used the average values of the standard lengths of the different age groups in mm and the average weights in g.

Results

Table 1. The mean standard and total body length and average weight values belonging to the different age groups

Age	Standard length (mm)	Total length (mm)	Weight (g)
0+	38.4 ± 1.4	48.3 ± 2.0	1.05 ± 0.12
1-1+	44.2 ± 2.6	55.4 ± 2.9	1.57 ± 0.27
2-2+	50.6 ± 2.9	63.0 ± 3.5	2.27 ± 0.47
3-3+	57.4 ± 3.9	70.4 ± 2.4	3.35 ± 0.56
4-4+	67.9 ± 5.8	82.0 ± 5.9	5.77 ± 1.52
5-5+	76.9 ± 5.0	91.5 ± 3.1	8.51 ± 1.47
6-6+	88.1 ± 7.6	105.5 ± 9.0	16.49 ± 6.21

The standard length (Lc) of the fishes varied between 38 and 88 mm, the total length was between 48 and 105 mm, and their weight between 1 and 16.5 g (Table 1). The relationship between standard and total length is:

$Lt = 0.8764Lc - 4.3436$ ($R2 = 0.9811$).

The distribution of the collected fish exemplars of different ages according to their standard length is shown in Table 2.

Table 2. Distribution of the collected specimen according to their standard length and age

Age / standard length	0+	1-1+	2-2+	3-3+	4-4+	5-5+	6-6+	7-7+
35.5-40	13	4						
40.5-45	1	47	3					
45.5-50		38	39					
50.5-55			41	7				
55.5-60			6	19	1			
60.5-65				2	3			
65.5-70				1	5			
70.5-75					4	4		
75.5-80					1	5		
80.5-85							2	
85.5-90						1	3	1
90.5-95								
95.5-100								
100.5-105								
105.5-110							1	

I determined the equation of the relationship between (total and standard) length and weight (Figs 1 and 2).

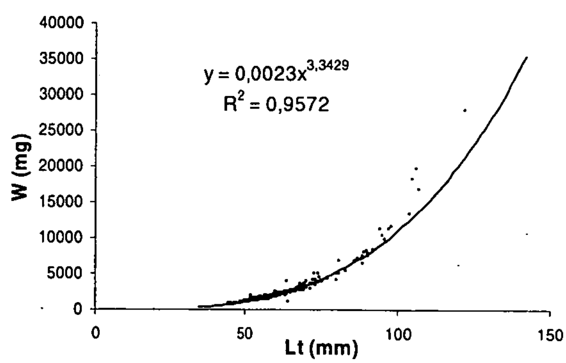

Fig. 1. The exponential relationship between total length and weight

According to the Walford model the maximum achievable (asymptotic) length proved to be 84.20 mm (Fig. 3).

The equation of the regression plot used for the determination of the t_0 and "K" value of the Bertalanffy model was (Fig. 4):

$y = -0.3458x + 4.3927$

$t_0 = -0.1168$

$K = -0.3458$.

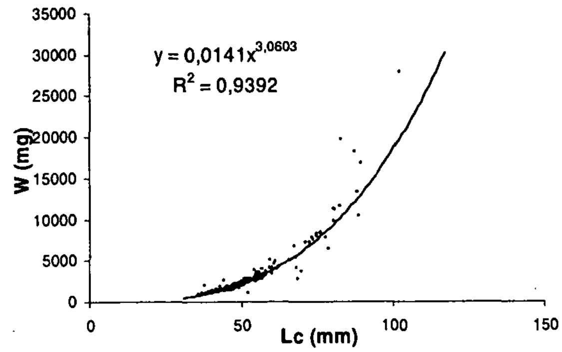

Fig. 2. The exponential relationship between standard length and weight

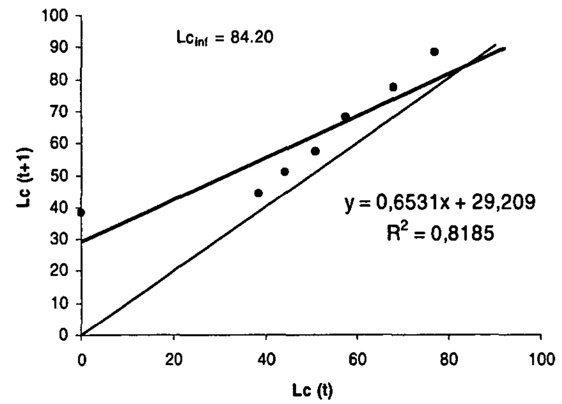

Fig. 3. The growth of the mudminnow according to the Walford model

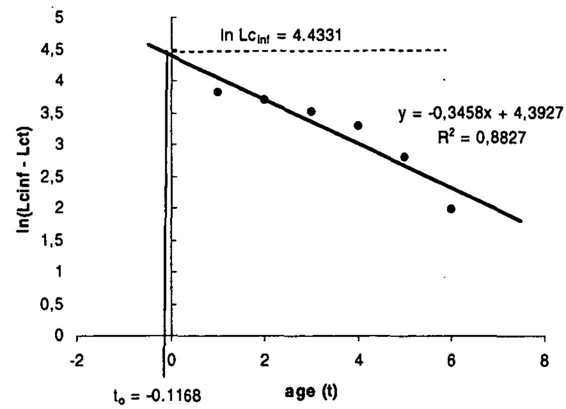

Fig. 4. Determination of the parameters (t_0 and K) of the Bertalanffy equation

The growth of the mudminnow according to the Bertalanffy model is shown in Fig. 5. The equation of the plot is:

$$Lc_t = 84.2[1 - e^{0.3458(t + 0.1168)}]$$

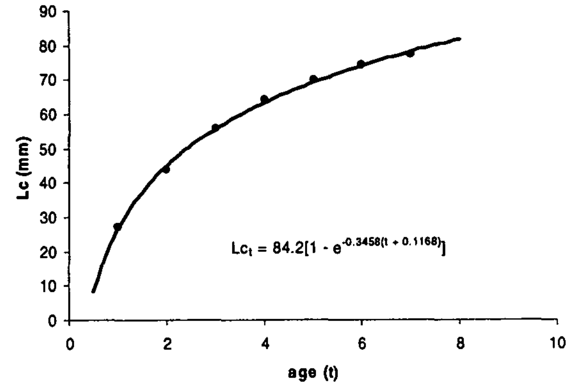

Fig. 5. Growth of the mudminnow according to the Bertalanffy model

The comparison between the measured standard lengths and the calculated lengths according to the Walford and the Bertalanffy model respectively is presented in Table 3.

Table 3. Body length data based on the measurements taken and calculated by the Walford model and the Bertalanffy method

	Standard length (mm)		
Age	Measurement	Walford model	Bertalanffy model
0+	38.4	29.2	26.9
1-1+	44.2	54.3	43.7
2-2+	50.6	58.1	55.5
3-3+	57.4	62.3	63.9
4-4+	67.9	66.7	69.8
5-5+	76.9	73.6	74.0
6-6+	88.1	79.4	77.0

The condition of the different age groups is presented in Table 4.

Table 4. The condition of the different age groups

Age	Condition
0+	0.0000148
1-1+	0.0000144
2-2+	0.0000137
3-3+	0.0000138
4-4+	0.0000142
5-5+	0.0000143
6-6+	0.0000183
Mean	0.0000148

Discussion

The "b" constant of the equation of the standard length—weight relationship is approximately 3 when the growth of the length and weight is uniform ("isometric") (Bíró 1993). In our case this value is 3.0603, which means that the weight grows faster than the length. Mišik (1966) considers that "b" value refers to the feeding conditions of the population. The value above 3 indicates that in the river Ér the nutritional conditions are satisfactory for the mudminnow. My results are similar to the observations of Kux and Libosvárský (1958) and Mišik (1966) from Slovakia, which varied between 2.935 and 3.206.

Comparing the measured data with the values of Walford and Bertalanffy models, note that the measured lengths in the one-year and five-six-year age groups exceed those calculated with the models. The cause of the previous can be the rapid growth of the fish in the first year, and since the collected material comes from different months of the year, there can appear significant differences in the size. The latter one can be explained with the decreased reproduction of the older individuals.

The condition of the fish changes with the age: from the starting values of the first-year individuals it decreases in the case of the reproducing age groups and then increases again in the older age groups less involved in the reproduction.

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