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GROWTH OF WELS (*SILURUS GLANIS* L.) IN THE VISTULA RIVER AND THE ZEGRZYŃSKI RESERVOIR

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ABSTRACT. The age of wels (*Silurus glanis* L.) and the back calculated length at subsequent ages were estimated using sections of the first pectoral fins. The growth of this species in the Vistula River follows the von Bertallanfy curve. Some fish grew faster in the Zegrzyński Reservoir after its inundation in 1962 than they had before. The two populations exhibited an intermediate growth rate which was between that of wels from the Vag (Slovakia) and Don rivers (Russia).

Key words: WELS (*SILURUS GLANIS*), GROWTH

INTRODUCTION

Preliminary information on the growth of wels *Silurus glanis* L. in Poland was published in 1971 by Horoszewicz and Backiel (see References). The data described below was used only to present length increments and the growth in weight of fish caught in the Vistula River. The materials collected in the Zegrzyński Reservoir were not used, and the data have been waiting proper treatment since their collection. The authors contend that a full account based on the whole collection deserves publication because no other assessment of wels growth in Poland has been attempted.

MATERIAL AND METHODS

The wels were collected from the lower course of the Vistula River (in the vicinity of Włocławek) from 1964 to 1966 and from the Zegrzyński Reservoir from 1964 to 1967. The latter was created in 1962 on the major tributaries of the Vistula (Bug and Narew Rivers) by inundating an area of 3,300 ha.

The collections of fish were comprised of 110 specimens from the Vistula River and 310 from the Zegrzyński Reservoir. The total length (Lt) of the specimens ranged from 42 to 164 cm and from 27.5 to 153 cm and they weighed from 505 to 25,000 g and 130 to 23,700 g, respectively. Wels aged from 95 to 470 days which had been reared in ponds were measured and weighed in order to verify the estimates of the youngest fish.

The first rays of the pectoral fins were used for aging and to perform growth back calculations (cf. Probatov 1929, Probatova 1967, Horoszewicz 1971, Orlova 1987).

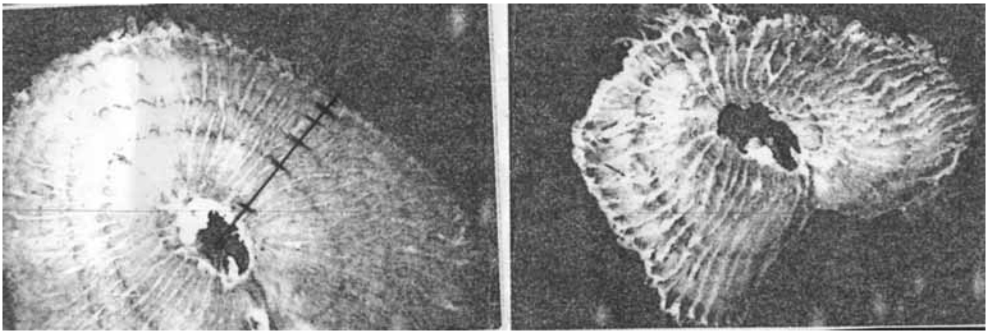

Photo 1. Examples of fin ray sections.

They were cooked then cleaned and dried before cutting sections approximately 0.5 mm thick using a hack saw. These sections were then polished on a whetstone. Clear, dark rings around the center, i.e. the hemal tubule, were usually clearly visible (Photo 1). The dark, continuous rings were considered to be annuli.

Two people determined age and estimated the length at successive ages. Back calculations of length were done by measuring the distance from the center to the successive annuli along the axis perpendicular to the longest edge of the fin ray section (Photo 1). The length of this axis correlated very well with the total length of the fish (r = 0.9101 for n = 179). Hark and Biro (1990) claimed that the best estimates were obtained by measuring the axis ending at the oral peak of the section opposite to the concave edge of the section. However, the present study was conducted prior to this.

RESULTS AND DISCUSSION

The first rings in many fish differ in their appearance and are considered juvenile rings. Although similar rings were noted in wels of a known age reared in carp ponds, no such juvenile rings were noted in a group of juvenile wels reared in cool water trout ponds. Hence, it can be concluded that the juvenile rings may or may not appear. This ring often disappears in old fish due to hemal tubule growth. Thus, no juvenile rings were identified in 63 of 106 samples during estimates of the Vistula collection of fin ray sections (Table 1). In the Zegrzyński collection, where young fish of age 2 and under comprised over 60% of the sample, far more fish displayed juvenile rings (Table 2).

Since the fish were collected every month between May and November, it was possible to determine when the annual ring had been formed. If the annuli appear in a

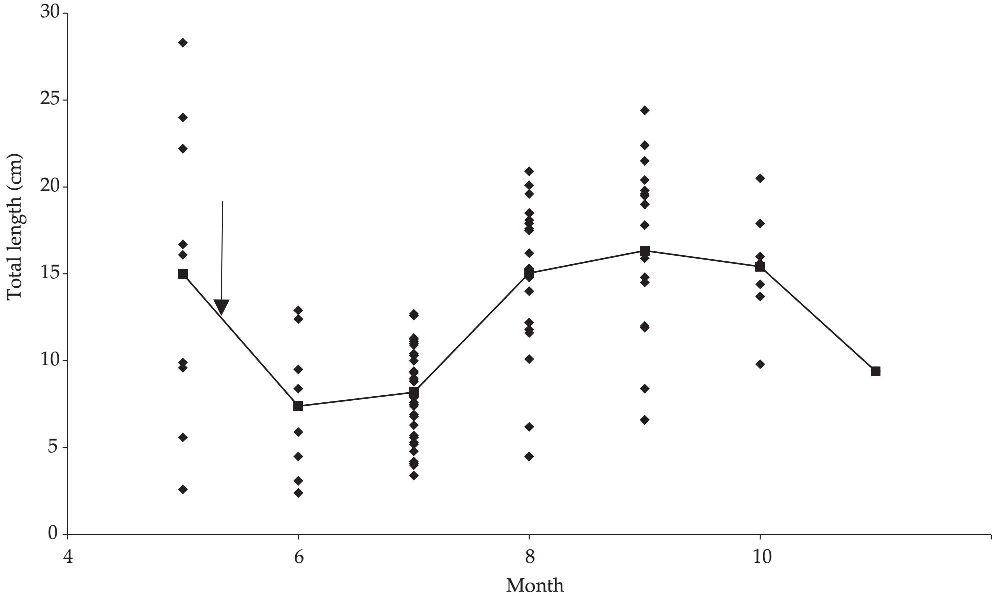

Fig. 1. Marginal growth (mgr) i.e. total length (lt) increments corresponding to the space beynod the last annulus in fin ray slices in 98 fish from the Vistula River. Lines join averages in particular months. The arrow show the mean time of annulus formation.

definite period, then the average marginal growth, i.e. the calculated increments of length corresponding to the distance between the last annulus and the margin of the slide, is the smallest just after that period. This phenomenon was described in Backiel (1962) with respect to fish scales, and a model was constructed. It also obviously applies to fin ray sections. The marginal growth in wels sections was at its minimum in June (Fig. 1). According to the model just mentioned, it can be concluded that the mean time of annulus formation occurred sometime between May and June.

There was some disagreement between the two age determinations mainly because of the growth of the hemal tubule which resulted in partial damage to the first rings. As some other disagreements concerned the largest, oldest fish, four fish from the Vistula collection and eight from the Zegrzyński collection were disregarded (Tables 1 and 2).

With respect to the Vistula River fish collection, the back calculated estimates of length by the two people differed by less than 1%; the exception was with age 1 fish when disagreement was 3.3%. Similarly insignificant differences occurred in the Zegrzyński collection, thus, the average of these two estimates was accepted.

TABLE 1

Length and number (n) of wels collected from the Vistula River and back calculated growth

Age	Measured length			Back calculated length			
	Mean (cm)	Range (cm)	n	Mean (cm)	Range (cm)	n	SD
0	46.8	46.5-48.1	2	**21.1*	11.1-36.1	*63*	*5.66*
1	55.1	42-70	20	38.9	16.6-71.7	106	10.7
2	74.0	51.5-88	14	57.7	29.8-90.8	88	10.9
3	78.2	66-88	17	70.3	41.5-100.2	67	10.6
4	84.9	65-104	15	82.0	53.4-108.2	53	10.54
5	94.0	88-121.5	8	91.9	69.6-115.5	37	9.99
6	107.0	98-112	3	101.0	76.5-125.5	29	10.77
7	113.8	111-115	4	108.6	82.3-130.3	27	10.89
8	125.0	115-130	3	114.9	88.1-138.5	22	12.15
9	130.1	118-144	5	121.5	93.5-146.2	20	13.33
10	139.3	115-1490	4	127.1	96.6-152.9	15	15.7
11	147.0	127-157	6	130.6	99.7-156.3	11	16.92
12	132.5	114-162	3	131.8	106.7-158.8	5	21.79
13	148.5	133-164	2	145.6	127.3-163.0	2	16.59
Total			106				

** juvenile ring; see text for explanation*

TABLE 2

Length and number (n) of wels collected from Zegrzyński Reservoir and back calculated growth before (B) and after (A) inundation

Age	Measured length			Back calculated length							
				Year classes '53-61				Year classes '62-66		Total	
	Means (cm)	Range	n	Before '62		After '62				After '62	
				cm	n	cm	n	cm	n	cm	SD
				B						A	
	37.7	35 - 43	3	*19.3	7			*18.8	273	*18.8	5.09
1	53.1	28 - 70	46	31.8	11	29.0	10	32.6	280	32.6	8.97
2	60.2	43 - 90	139	44.6	8	44.8	13	46.9	242	46.7	9.67
3	72.3	58 -98	73	56.1	6	61.1	13	62.4	104	62.3	10.76
4	85.9	72 - 107	26	65.8	6	74.7	11	76.2	32	75.8	11.65
5	95	76 - 112	8	75.6	6	82.6	9	83.2	7	82.9	10.34
6	102		1	72.4	3	84.8	4			84.8	
7	90		1	73.25	2	95.1	4			95.1	
8				97.6	1	96.6	4			96.6	
9	135		1			107,0	5			107.0	
10						109.2	4			109.2	
11	149		2			115.9	4			115.9	
12	78		1			95.9	2			95.9	
13	125		1			122.1	1			122.1	
Total			302								

** juvenile ring*

The relationship between the weight (W) and total length (lt) of 108 wels was determined after log transformation:

$$W(lt) = 0.00591152\ lt^{3.0183402} \quad (1)$$

The correlation of log(W) versus log(lt) was 0.9873 and the exponent did not differ significantly from 3, thus the following formula also fits the data well:

$$W(lt) = 0.00616107\ lt^{3} \quad (2)$$

Body length was 0.958 times the total length.

The average growth in length (lt, cm) of the Vistula wels (Table 1) appeared to follow a very common convex curve of decreasing increments. Thus, the back calculated data can be represented by the von Bertallanfy equation:

$$lt\ (t) = 173\ \{1 - e^{-0.11757\ (t+1.37)}\} \quad (3)$$

where t is the number of years. Growth in weight (gram) is therefore approximated by the equation:

$$W(t) = 31900.3\ \{1 - e^{-0.11757\ (t+1.37}\ \}^{3} \quad (4)$$

The estimated length using equation 2 deviates little from the average back calculated length except in age 1 fish. The calculated ultimate length (173 cm) corresponding to the weight of 31.9 kg is just an estimate fitting available data, but is not any real maximum. Wels of approximately 50 kg and 2 m in length were seen at the Warsaw market in March 2002. The same was reported by Brylińska (1988) and Berg (1947).

Wels specimens from the Zegrzyński Reservoir were collected from 1964 to 1967. As this water body was created in 1962, fish older than age 2 in 1964 or older than age 5 in 1967 grew before inundation. Their age was 2 to 13 years and they belonged to the 1953 to 1961 year classes. There were only 21 such specimens. The question arises if such a dramatic change in environment affected the growth of these fish. The majority of wels (281 specimens) of up to age 4 belonged to the 1962 to 1966 year classes, hence they grew in the new environment (Table 2). The length the fish reached at ages 3 to 7 was greater in the group growing after inundation than in the one prior to it. However, the significant differences found among age groups 3 to 5 were due only to the very small samples. Thus, it can be concluded that at least some wels grew faster in the new environment of the reservoir.

Probably the earliest report on the growth of wels is that by Probatov (1929). He used very abundant material (721 specimens) from the southern area of the Aral Sea and a small sample (69 fish) from the lower course of the Ural River. He concluded that the Ural wels grew much faster than the former probably due its low abundance and the resulting ample feeding grounds. Other data on the growth of wels concern

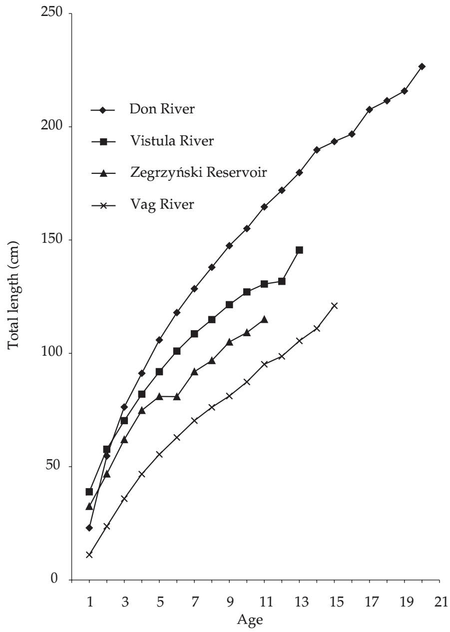

Fig. 2. Linear growth of wels in the Don River (the fastest), next in the Vistula River, in Zegrzyński Reservoir and in the Vag River (the slowest). Data of Bizajaev (1952), Sedlar and Geczo (1973) and this paper.

several other rivers, such as the Don in Russia (Bizjaev 1952), the Vag in Slovakia (Sedlar and Geczo 1973), the Danube in Yugoslavia, the Tisza in Hungary (after Harka 1984), two reservoirs - the Orlice in the Czech Republic and the Kakhovsk on the lower Dnepr river (Probatova 1967) as well as Rumanian waters (after Harka 1984). The fastest growth rate was recorded in the Don and the slowest in the Vag River. The current data from the Vistula River and Zegrzyński Reservoir show an intermediate growth rate between these two extremes (Fig. 2).

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REFERENCES

Backiel T. 1962 - Determination of time of annulus formation on fish scales - Acta Hydrobiol. 4: 292-411.

Backiel T. 1971 - Production and food consumption of predatory fish in the Vistula River - J. Fish Biol. 3: 369-405.

Berg L.S. 1949 - Ryby presnykh vod SSSR i sopredelnykh stran - Izd. AK. Nauk SSSR. Moskva-Leningrad.

Bizjaev F.N. 1952 - K metodike opredelenja vozrasta i rosta soma, *Silurus glanis* - Zool. Zhurn. 31 (5): 696-699

Brylińska M. (ed.) 1998 - Polish Freshwater Fish - PWN, Warszawa, 429 pp. (in Polish).

Harka A. 1984 - Studies on the growth of sheatfish (*Silurus glanis* L.) in River Tisza - Aquacult. Hungarica 4: 135-144.

Harka A., Biro P. 1990 - Probable sources of biased estimates of growth in wels *(Silurus glanis* L) using fin rays - Aquacult. Hungarica 6: 35-39.

Horoszewicz L. 1971 – Wels - PWRiL, Warszawa, 190 pp. (in Polish).

Orlova E.L. 1987 - Osobennosti rosta i sozrevaniya soma *Silurus glanis*, v delte Volgi. Pri zaregulirivannom stoke - Vopr. Ikhtyol. 27(6): 945-955.

Probatov A.N. 1929 - O wozraste aralskogo soma - Izv. Otd. Proklad. Ikhtyol. 9 (2): 213-224.

Probatova I.W. 1967 - Wozrostnyj sostaw soma i perspektivy ego promysla w Kachovskom vodochraniliszcze - Rybnoe Choz. Kijev 4: 20-22.

Sedlar J., Geczo V. 1973 - Beitrag zur Kentniss des Alters und Wachstum des Welses, *Silurus glanis* L. aus einigen Gewassern der Sudslowakei - Vest. Cesk. Spol. Zool. 37(3): 195-211.

STRESZCZENIE

WZROST SUMA (*SILURUS GLANIS* L.) W WIŚLE I ZBIORNIKU ZEGRZYŃSKIM

Materiały do oceny wieku i wzrostu suma (*Silurus glanis* L.) w Wiśle i w Zbiorniku Zegrzyńskim w postaci pomiarów długości ciała i promieni płetw piersiowych zebrano w latach 1964-1967. Z promieni tych wykonano szlify. Zmiany przyrostów krawędziowych pomiędzy majem a listopadem pozwoliły na stwierdzenie, że średni okres zakładania pierścieni rocznych przypadał na przełom maja i czerwca. Wzrost długości sumów w Wiśle przebiegał zgodnie z równaniem von Bertallanfy'ego (równanie 3). Stwierdzono, że przynajmniej niektóre sumy z Zbiornika Zegrzyńskiego, utworzonego w 1962 roku, rosły szybciej po tym roku. Ich wzrost był jednak nieco wolniejszy niż wzrost sumów w Wiśle. Sumy obu tych populacji rosły szybciej niż ryby te w rzece Vag (Słowacja), lecz wolniej niż w rzece Don w Rosji.

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