GROWTH OF CARP (CYPRINUS CARPIO L.) IN THE KISKÖRE STORAGE LAKE

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Abstract

The present study deals with growth of wild carp in the Kisköre storage lake set up in 1978 at the Tisza river, and compares the results with the data obtained in Orava storage lake (Czechoslovakia), Danube (Yugoslavia) and Körös Backwater reservoir.

The most significant differences were found in comparison with carps from the Körös backwater reservoir. Initially the body mass of carps from the Tisza storage lake is smaller but the growth rate is higher, similar tendency is observed in the longitudinal growth, too. Carps from the storage lake already at the age of five years reach the length of 7 years-old specimens from the Körös backwater reservoir, and except for the first year, their condition is also better. Most probably the rich nurtient supply of the storage lake is of decisive importance for the faster growth and better condition. Positive and negative deviations were observed as compared to the Czechoslovak and Yugoslavian data as well but those were less significant. Growth of carps in the Kisköre storage lake — though essentially more favorable than that in the Körös backwater reservoir — cannot be qualified as outstanding, just as satisfactory for the circumstances.

Introduction

Since 1978 a storage lake has been set up at the Tisza river, which lacking an official name was named initially Tisza—II, afterwards the Kisköre storage lake, and lately the Tisza lake.

Since the area of the lake measuring approximately 100 km² is being covered by water only from spring till autumn, the fish inhabiting it withdraw in the winter season to the deep water of the river and abandoned river beds.

Since 1970 ichtyological studies are being carried on in this region. The aim of these investigations is on the one hand to study the composition as well as the changes occurring in the fish fauna (HARKA 1974, 1985), and on the other hand, to follow the growth of economically important species, such as pike-perch, pike and sheatfish (HARKA 1975a, 1977, 1983, 1984).

The aim of the present study was to investigate the growth of wild carp found in the storage lake, since the data available till now concerned only mirror carp introduced from fish breeding pond (HARKA 1975a). From the economical point of view the importance of carp is comparable to that of the above mentioned species. The average catch of carp from the storage lake in the last seven years exceeded 47 tons. The majority of the specimens belonged to the wild type but due to the regular introduction of cultured forms, the carp stock of the storage lake differs from the original wild form.

Materials and Methods

The data of 220 carps caught between 1983 and 1987 in the north-eastern pool of the storage lake, in the vicinity of the settlements Tiszafüred and Poroszló, were used in the growth studies.The standard lenght of the specimens (measured between the nose and the beginning of the tail-fin) ranged between 300 and 670 mm, whether the body mass varied between 730 and 7410 g.

The relationship between the body length (L) and body mass (W) was calculated according to the formula suggested by Tesch (1971) ($W=aL^b$), respectively in its logarithmic form. The curves were fitted to the measured data by the least squares method (Sváb 1973).

The age of the specimens was determined scalimetrically. The full oral radius of the scales (S) and the distance of the successive winter annuluses from the focus of the scale (S_n) were measured using a Zeiss microfilm reader and a mm scale under 21,5-fold magnification.

The expected length of a specimen (L_n) corresponding to the formation of a given annulus was calculated according to Fraser (1916) and Lee (1920) from the relationship

$$L_n = c + \frac{S_n}{S}(L-c)$$

where L is the measured body length of the caught fish, and c is the correction member originating from the relationship between body length and scale radius.

Growth was described by the Bertalanffy mathematical growth model developed by Beneverton and Holt (1957), and suggested further by Dickie (1971). According to the Bertalanffy equation at the age of t years the body length of fish (L) can be expressed as follows:

$$L_t = L_\infty[1-e^{-k(t-t_0)}].$$

The values of the parameters entering the equation, i.e. the assymptotic body length (L_∞), the growth rate constant (k) and the hypothetical age (t_0) corresponding to L=0, were estimated as suggested by Guland (1963).

The condition factor (CF) was calculated according to Hile (1936) as a ratio of the body mass (measured in g) and the cube of the body length (in mm).

Results and Discussion

Relationship between body mass and body length.

The following relationship was found between the body mass (W) and the standard body length (L_c) in carps on the basis of 220 data pairs:

$$\text{Lg } W = -4{,}1725 + 2{,}8291 \text{ lg } L_c.$$

The body mass and the body length were measured in g and mm, respectively. The correlation coefficient (r) is 0,96. In case the full length (L_t) is used in the calculations, the relationship is as follows:

$$\text{Lg } W = -4{,}6479 + 2{,}9274 \text{ Lg } L_t \qquad (r=0{,}96).$$

Till now in Hungary the growth of wild carp has been investigated by similar methods in the Körös backwater reservoir (Talaat and Oláh, 1986). Comparing the results obtained in the two basins, it can be concluded that although carps from the storage lake initially have a smaller body mass, the rate of mass growth is higher. They catch up already at the end of the first year (the average length at that age being 153 mm) and from that time on their advantage is steadily increasing.

Relationship between body length and scale radius

Regression analysis of the standard body length (L_c) and full scale radius (S) led to two relationships presented in Fig. 1. For specimens with body length ranging from 300 to 420 mm

$$L_c = 20{,}13 + 1{,}425\ S \qquad (r = 0{,}98)$$

whether for specimens longer than that

$$L_c = -41{,}2 + 1{,}784\ S \qquad (r = 0{,}96)$$

relationships were obtained.

In the estimation of the actual body length (L_n) the calculations in every case were started using the correction member from the first equation (c=20,13), and only after the calculated actual length reached 420 mm the correction member derived from the second equation was applied (c= −41,2). This length was reached at the age between 4 and 5 years. However no break was observed in the growth curve in this age group either, since in approximately 50% of the cases the first and in the rest-the second correction member was applicable which resulted in a compensatory effect.

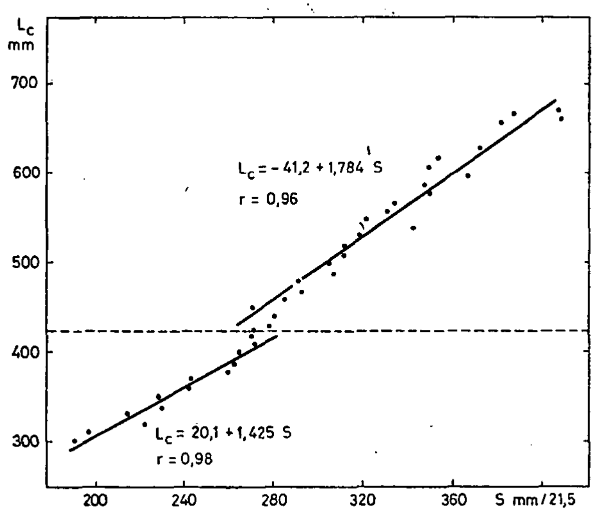

Fig. 1. Relationship between standard body length (L_c) and the full oral scale radius (S)

Time dependence of the longitudinal growth

The age of 216 specimens studied, as determined on the basis of scale examination, ranged from 2 to 9 years. The number of specimens belonging to different age groups (n) is given in Table 1. Since only one 9 years-old fish was found, it was included in the group of 8 years-old specimens, the growth in the 9th year was not evaluated.

Table 1. *Standard body length of carps belonging to different age groups in successive year of their life*
(L_1, L_2, etc. in mm)

Age n		2 12	3 73	4 43	5 27	6 33	7 17	8—9 11	2—9 216	W (g)
	a	90	70	86	90	97	92	108	70	
L_1	b	161	173	143	136	161	134	138	173	
	c	131	113	115	116	123	116	120	119	50
	a	221	163	154	170	151	167	178	151	
L_2	b	312	301	284	287	270	249	246	287	
	c	266	224	206	209	218	207	209	220	285
	a		240	191	229	235	248	243	191	
L_3	b		415	397	375	358	351	348	415	
	c		313	290	309	317	297	294	303	704
	a			318	338	307	320	314	307	
L_4	b			474	463	454	429	428	474	
	c			393	393	405	382	376	390	1438
	a				411	390	399	398	390	
L_5	b				541	543	490	507	543	
	c				461	475	446	438	455	2225
	a					451	453	473	451	
L_6	b					618	587	543	618	
	c					536	520	504	520	3246
	a						498	533	498	
L_7	b						625	586	625	
	c						571	558	565	4105
	a							576	576	
L_8	b							617	617	
	c							594	594	4730

a: minimum, b: maximum, c: average

The calculated standard body lengths reached by the specimens belonging to different age groups during successive years of their life are listed in Table 1. The body mass (W) given in the Table is calculated from the relationship discussed above using the average body length.

A saturation function was fitted to the body length data calculated on the basis of the year marks on the scales. It is described by a BERTALANFFY equation with the following calculated parameters: assymptotic body length (L_∞) 828,1 mm, the growth rate constant (k) 0,1625, the hypothetic age corresponding to zero length (t_0): +0,076 years. From the above follows that at the age of t years the expected standard body length (L_t) of wild carps inhabiting the north-eastern pool of the storage lake can be calculated from the following relationship:

$$L_t = 828,1\,[1 - e^{-0{,}1625\,(t-0{,}076)}].$$

The body lengths calculated on the basis of scale year marks and the BERTALANFFY equation are listed in Table 2. The comparison of the results shows that the function

Table 2. *Standard body length (in mm) reached in successive years by carps from the Kisköre storage lake as determined on the basis of scales and calculations according to the* BERTALANFFY *equation*

Age (year)	Calculated body length on the basis of scales	Bertalanffy's equation
1	119	115
2	220	222
3	303	313
4	390	390
5	455	456
6	520	512
7	565	559
8	594	600

is suitable for growth modelling, since the differences do not exceed 10 mm, which value is comparable with the permissible error limit in measuring of body length. (The positive value of t_0 indicates that the model is not applicable for specimens below one year.)

The growth curve is shown in Fig. 2, together with the calculated average and extreme values. The narrow range of the extreme values at the age of 7—8 years is due to the small number of specimens in this group.

Since in the studies of growth of carp both full (L_t) and standard (L_c) body lengths are being used by different authors, for the sake of comparison a relationship between the two values for carps from the storage lake is presented below:

$$L_t = 17{,}1 + 1{,}444\, L_c \qquad (r = 0{,}99)$$

Fig. 3 shows the results of the present study together with data on growth of carp in the age groups from 1 to 8 years in Czechoslovak (Drava storage lake), Yugoslavian (Danube) and Hungarian (Körös backwater reservoir) basins.

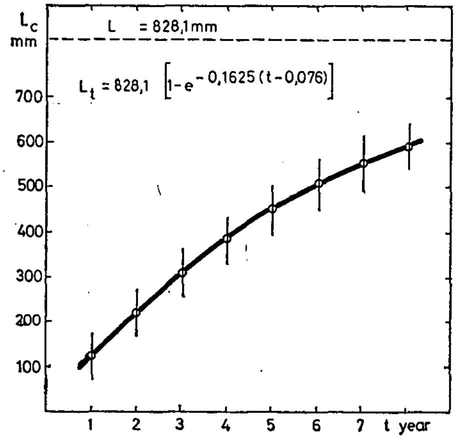

Fig. 2. Growth of carp in the Kisköre storage lake calculated according to the Bertalanffy-equation. Points represent the mean values based on scale marks measurenments, vertical bars show the extreme values

Table 3. *Conditional factors (CF, x10⁵) of carps from the Körös backwater reservoir and the Kisköre storage lake ranging in age from 1 to 8 years*

Age (year)	1	2	3	4	5	6	7	8
Körös backwater	1,55	1,43	1,35	1,31	1,28	1,26	1,24	1,23
Kisköre storage lake	1,39	1,46	1,45	1,44	1,42	1,41	1,40	1,39

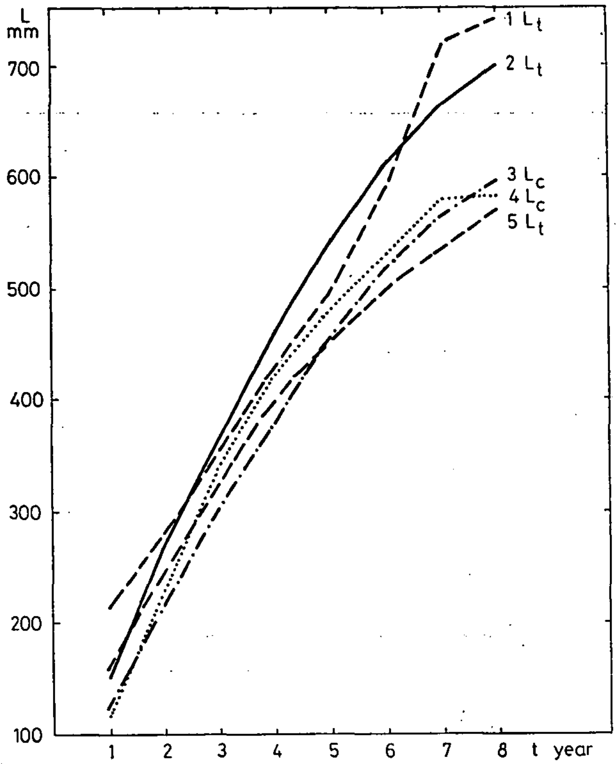

Fig. 3. Growth of full (L_t) and standard body length (L_c) of carps in several neighbouring basins. 1. Yugoslavian Danube-section (Ristić 1971), 2—3. Kisköre storage lake (present study). 4. Orava storage lake (Balon 1967). 5. Körös backwater reservoir (Talaat and Oláh 1986)

The most significant differences were observed in comparison to carps from the Körös backwater reservoir in elder age groups. E.g. carps from the storage lake already at the age of 5 years reached the length of the 7 years-old fish from the backwater reservoir. Further advantage was their better condition, their body mass being bigger by 250 g. On the basis of the conditional factors (CF) listed in Table 3, it can be seen that carps from the storage lake under one year have certain drawbacks, but above that age they catch up and gain advantages over those from the backwaters. Most probably the main role in their faster growth and better condition is played by the richer nutrient supply in the storage lake. The somewhat unexpected drawbacks experienced during the first year could be possibly explained by the protracted reproduction of carps in the storage lake. Although the sprawning starts already in the beginning of April, it still can be observed even in July, thus leading, to the uderdevelopment of the late progeny.

Positive and negative deviations were observed as well in comparison to carps from the Danube-section and Drava storage lake but those were less significant. Summing up it can be concluded that growth of carps in the Kisköre storage lake — though essentially more favorable than in the Körös backwater reservoir — cannot be qualified as outstanding, just satisfactory under given climatic and other circumstances.

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A ponty (Cyprinus carpio L.) növekedése a Kiskörei-tározótóban

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Kivonat

A tanulmány ismerteti a Tisza folyón 1978-ban létesített Kiskörei-tározótó vadpontyainak növekedését, majd az eredményeket összeveti a csehszlovákiai Orava-tározótóra, a jugoszláv Dunaszakaszra és a Körös holtágaira vonatkozó adatokkal.

Nagyobb eltérések a Körös-holtágak pontyaival szemben mutatkoztak. A tiszai tározótó

pontyai kisebb testtömeggel startolnak, de tömegnövekedésük üteme gyorsabb, s hasonló a helyzet a hossznövekedésben is. A tározótó pontyai már 5 éves korban elérik azt a hosszt, amelyet a Körös-holtágak pontyai csak 7 éves korban, s az első évet leszámítva kondíciójuk is jobb. A gyorsabb növekedésben és a jobb kondícióban minden bizonnyal a tározótó gazdag táplálékkészlete játssza a főszerepet.

A csehszlovákiai és jugoszláviai adatoktól pozitív és negatív irányú eltérések egyaránt adódnak, de ezek kevésbé jelentősek. A Kiskörei-tározótóban élő pontyok növekedése tehát — bár lényegesen kedvezőbb, mint a Körös-holtágakban — nem kiemelkedő, csupán a körülményeknek megfelelő.

Рост карпа (Cyprinus carpio L.) в водохранилище кишкёре

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Резюме

В статье описан рост дикого типа карпа в водохранилище Кишкёре, построенном на Тисе в 1978 г.; результаты исследований сравниваются с данными, полученными в чехословацком водохранилище Орава, югославском отрезке Дуная и мертвых руслах Кёрёша.

Самые значительные различия наблюдали в сравнении с карпами мертвых русел реки Кёрёш. Начальная масса карпов тисайского водохранилища меньше, но скорость приращения массы больше, аналогичная тенденция наблюдается в отношении продольного роста. В водохранилище карпы уже в возрасте 5 лет достигают длины семилетных особей из мертвых русел реки Кёрёш и, за исключением первого года жизни, их кондиция также лучше. Вероятно, основной причиной быстрого роста и лучшей кондиции является богатый запас питательных веществ в водохранилище.

В сравнении с данными, полученными в Чехословакии и Югославии, наблюдались как положительные, так и отрицательные отклонения, которые, однако, были менее значительными. Рост карпов в водохранилище Кишкёре, будучи более благоприятным в сравнении с мертвыми руслами реки Кёрёш, все же не является выдающимся, а лишь соответствующим условиям окружающей среды.

Prirast šarana (Cyprinus carpio L.) u rezervoaru za vodu Kisköre

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Abstrakt

Rad prikaziva prirast šarana u rezervoaru za vodu na Tisi napravljen 1987. god. kod Kisköre.

Rezultati uspoređeni sa podacima čehoslovačkog rezervoara za vodu „Orava", sa podacima jugoslovenskog otseka Dunava i sa rezultatima mrtvaje Körös. Vidne su veće diferencije sa mrtvajom Körös.

Šarani iz Kisköre u početku su dosta manjeg rasta ali poslije prirast tjelesne težine i dužine je brža.

Šarani iz rezervoara za vodu Kisköre tu tjelesnu dužinu dostižu u petoj godini života što šarani iz mrtvaje Körös u sedmoj godini; isključenjem prvu godinu života dostižu i bolju kondiciju.

Ova činjenica potvrđuje da rezervoar za vodu Kisköre je bogatiji hranom od mrtvaje Körös.

Rezultati u poređenju sa čehoslovačkim i jugoslovenskim podacima su pokazali diferenciju i u pozitivnom i u negativnom pravcu ali te diferencije su bile neznatne.

Prirast šarana-uprkos da su uslovi mnogo bolji- u rezervoaru za vodu Kisköre, nije istaknuta, odgovara se samo okolnostima.