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THE GROWTH OF BLEAK (*ALBURNUS ALBURNUS* L.) (PISCES, CYPRINIDAE) IN LAKE BALATON AND THE ASSESSMENT OF MORTALITY AND PRODUCTION RATE

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The food, growth, mortality and production of pike-perch population inhabiting Lake Balaton have been studied both in larval and mature stages in details within the period 1965—73 (BIRÓ and ELEK, 1969; BIRÓ, 1969; 1970; 1972; 1973; 1975a, b). From the results obtained it could be established that in the food of pike-perch (*Stizostedio lucioperca* L.), the main predatory fish of Lake Balaton, the bleak played the most important role. In earlier papers (ENTZ, 1949—50; 1951; ENTZ and LUKACSOVICS, 1957; WOYNÁROVICH, 1959), however, the priority of pope (*Gymnocephalus cernua* L.) was noticed, and the bleak was mentioned as secondary prey-fish. The significance of bleak as food fish of pike-perch has increased due to its greater frequency parallel to the strong decrease or even disappearance of several small-sized fish species (BIRÓ, 1971; 1974; PONYI et al., 1972).

ENTZ studied the growth of bleak on material collected in the years 1947—49, and reported a fairly fast growth rate (ENTZ, 1949—50). Changes in quality of food and rate of growth of pike-perch and those of different prey fishes were observed (BIRÓ, 1971; BIRÓ and GARÁDI, 1974). The necessity came up to repeat studies concerning the growth and food of bleak in order to reveal the food-chain of pike-perch. In addition we have obtained data on mortality and production of bleak population, too, because no such data have been published till now as yet.

Material and method

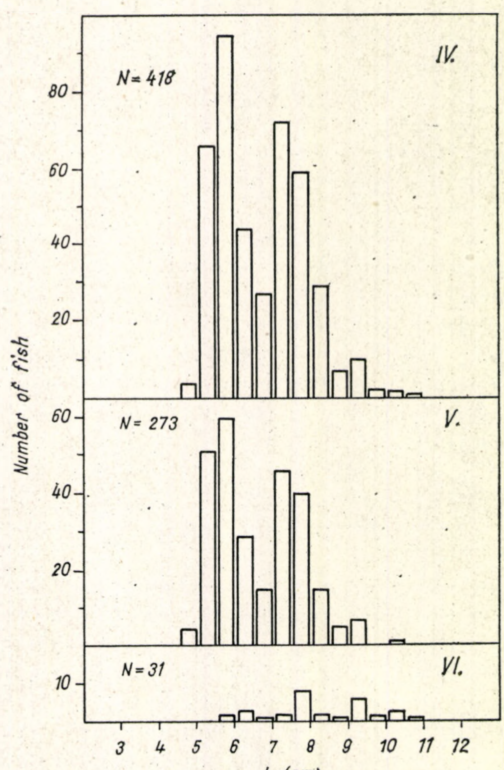
Collections were made in Lake Balaton using a 5 m long and 3 m wide otter-trawl of 5 mm mesh size altogether 47-times during the years 1968—70. For this study 1112 bleaks of different measures have been worked up collected from April to October 1968 *(Table I)*. The specimens caught by net were preserved in 4—5 per cent formaldehyde solution, and their standard and total lengths, as well as their weights were measured. 10—15 scales were detached from the area above the lateral line behind the posterior margin of the left pectoral fin *(Fig. 4)*. After cleaning, the wet scales were placed between slides, and studied with profile projector at a 50-times magnification. The total length of caual radii and the annual ring distances from the focus were measured

TABLE I

Time of samplings, the number of bleaks caught and the limits of measured lengths and weights (1968)

Date of collection	Number of fish	Standard length (cm)	Weight (g)
April	418	4.6—11.0	1.0—21.0
May	273	4.8—10.2	1.5—13.5
June	31	5.5—10.7	2.0—15.0
July	298	5.1—10.0	1.5—14.0
August	12	6.5— 9.9	3.0—13.5
September	71	3.5—11.1	0.5—20.0
October	9	6.7— 7.9	4.5— 7.5
Total	1112		

(Fig. 4). More detailed scale investigations and age-determinations were carried out on 294 specimens. In order to determine the seasonal variances of length-weight relationship (viz. Beverton and Holt, 1957) data of body meas-



Figs 1—2. **Histograms of standard length distribution of bleaks collected during April-October, 1968. N = number of fish investigated, L = standard length**

urements of 1112 specimens were utilized. To define the length structure of the stock, length-data of 1112 bleaks were studied. The relationship between the standard lengths and total caudal radii of scales was determined by the least square method. The intercept of this line on the abscissa was taken into consideration as a correction factor in the back-calculations of fish lengths (FRASER, 1916). The growth of bleak was graphically represented by FORD–WALFORD's method (WALFORD, 1946) with use of the back-calculated standard lengths. For the description of growth in length, BERTALANFFY's (1938; 1957) growth-model was applied. Mortality and production of bleaks belonging to different age-groups were assessed according to RICKER and FOERSTER (1948) and RICKER (1958). The instantaneous coefficients of growth in weight necessary to the assessment of production were calculated after CHAPMAN (1968) and TESCH (1968).

Results

1. Lenght-distribution in different months

The standard lengths of bleaks caught in Lake Balaton varied between 3.5—11.0 cm *(Table I)*. By standard length the population showed a bimoda

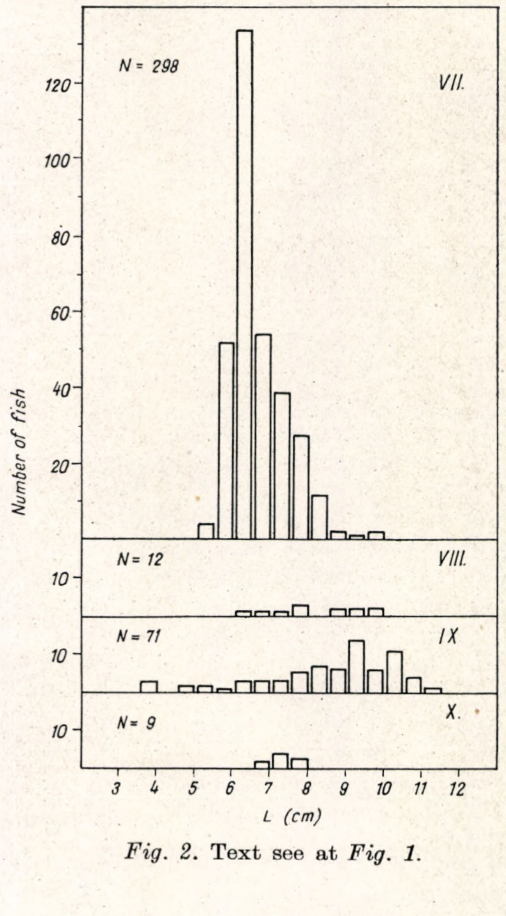


Fig. 2. Text see at *Fig. 1.*

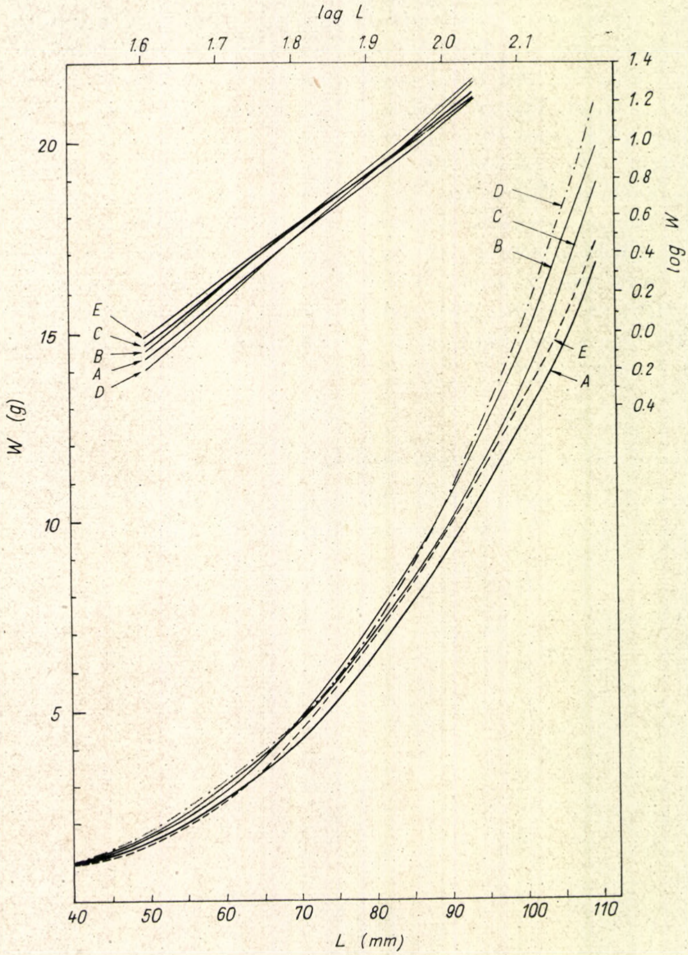


Fig. 3. Seasonal variation in length–weight relationship of bleak of Lake Balaton during consecutive months of 1968. L = standard length, W = weight, A = April, B = May, C = June, D = July, E = August

distribution during spring time (April-May). During summer and autumn (July-September) its distribution was as well asymmetrical, considering the fish material collected in different months *(Figs 1—2)*. In spring months the sample is divided into two dominant leng-groups due to the numerous occurrence of second (1+), third (2+), as well as four-summer-old (3+) specimens. During summer, it was compensated but the asymmetric length distribution remained unchanged. This phenomenon should have been only in a smaller degree the result of growth compensation.

2. *Seasonal variation in length–weight relationship*

The coefficient expressing the growth rate of linear dimensions in proportion to the weight, varied between 2.27—3.43 during the period of studies.

Their deviations experienced during successive months are significant ($P < 0.01$). The relationships were as follows (*Fig. 3*, curves *A–F*):

April	$\log W = -4.9919 + 3.0447 \times \log L$	(A)
May	$\log W = -5.1927 + 3.1788 \times \log L$	(B)
June	$\log W = -4.8398 + 2.9840 \times \log L$	(C)
July	$\log W = -5.6741 + 3.4262 \times \log L$	(D)
August	$\log W = -5.5925 + 3.3749 \times \log L$	(E)
September	$\log W = -4.6139 + 2.8662 \times \log L$	(F)

The average of six months:

$$\log W = -5.1508 + 3.1458 \times \log L$$

where L = standard length in mm; W = weight in grams. As can be seen in *Fig. 3*, there are no great variations in body weights as compared to standard lengths. The seasonal fluctuations are rather significant among specimens of 9–11 cm sizes. The shape of curves calculated for August (*E*) and September (*F*) are uniform covering up each other.

3. *Relationship between standard body length and total scale radius*

The relationship between average total caudal radii of "key-scales" and standard body lengths was found linear on 294 bleaks. For this the next equations have been calculated (*Fig. 4*):

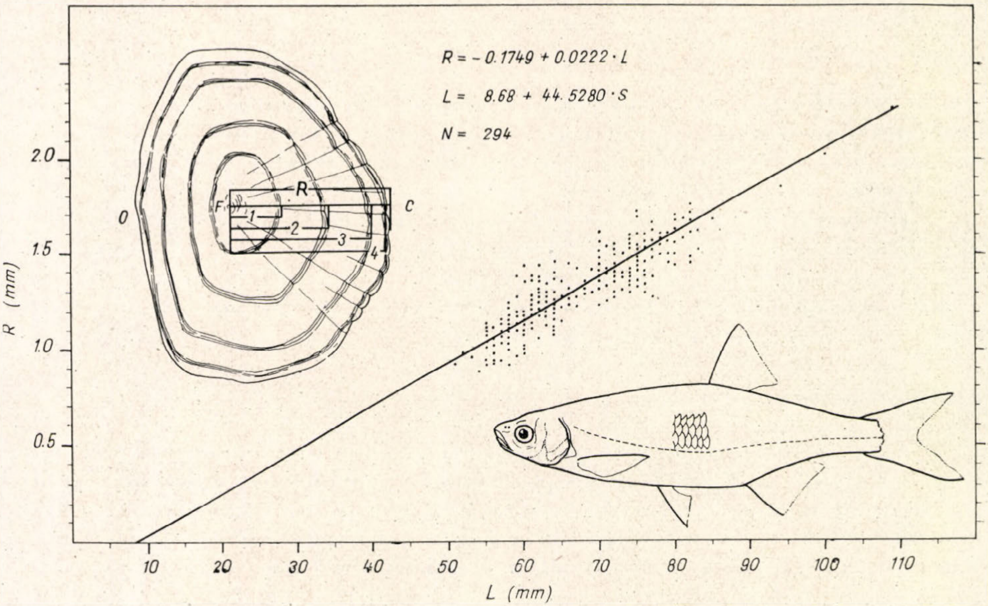


Fig. 4. **Linear regression of average caudal radii of scales (R) in the function of standard lengths (L) established for 294 bleaks caught in Lake Balaton. Its intercept on the abscissa 8.7 mm. Points of measurement indicated on the sketch of scale are: F = focus, R = total caudal radius, O = oral edge of scale, C = caudal edge of scale**

$$R = -0.1749 + 0.0222 \times L$$
$$L = 8.68 + 44.528 \times R$$

where L = standard length in mm; R = total caudal radius of scale in mm.

Average scale radius and standard length calculated by both equations show only small deviations as compared to the measured averages *(Table II)*.

TABLE II

Relationship between the standard lengths (L = mm) and the total caudal radii of scales (R = mm) of bleak

Measured		Calculated	
standard length	caudal radius of scale	standard length*	caudal radius of scale**
55	1.02	54.1	1.05
60	1.17	60.8	1.16
65	1.26	64.8	1.27
70	1.44	72.8	1.38
75	1.51	75.9	1.49
80	1.57	78.6	1.60
85	1.64	81.7	1.71
100	2.03	99.1	2.04
109	2.28	110.2	2.27

* calculated according to the equation of $L = 8.68 + 44.528 \times R$
** calculated according to the equation of $R = -0.1749 + 0.0222 \times L$

About 30—40 per cent of the scales examined showed spots of regeneration after different mechanical damages and irregularly developed marks due to parasitic effects. The year rings on normal scales, developed symmetrically, were usually formed regularly, their radii being just the same.

The larval annuli usually do not separate definitely on the scales. Number of sclerits developing within the first year ring varied between 15—25. A stepped, gently S-shaped relationship seems to exist between the standard lengths and the average year-ring distances established for different age-groups, which reflects the exponential pattern of growth.

4. Growth in standard length

Average standard lengths back-calculated from the distances of the year rings are shown in *Table III*. No positive Lee-phenomenon was observed on the basis of minimal and average standard lengths back-calculated for the five age-groups, but it was found to be positive in the case of maximal values. The growth of bleak in Lake Balaton based on the back-calculated average values *(Table III, C)* seems to be slow, but even smoothed *(Fig. 5)*. Analysing the growth of five different age-groups by year-class strengths, the linearity of average growth in length has changed and preferably a stepped growth could be observed primarily in age-groups 4+ and 5+ *(Fig. 6)*. Based on differences in mean length of age-groups, the annual growth is small. The

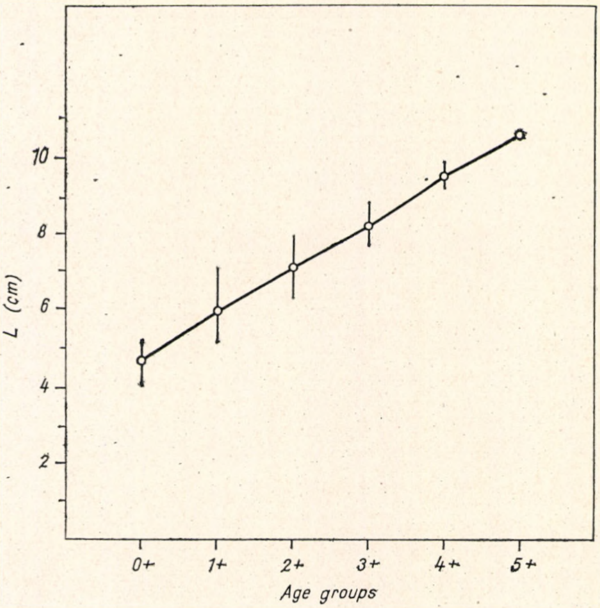


Fig. 5. Average annual growth in standard length of bleak in Lake Balaton from the one-summer (0+) to six-summer-old (5+) age

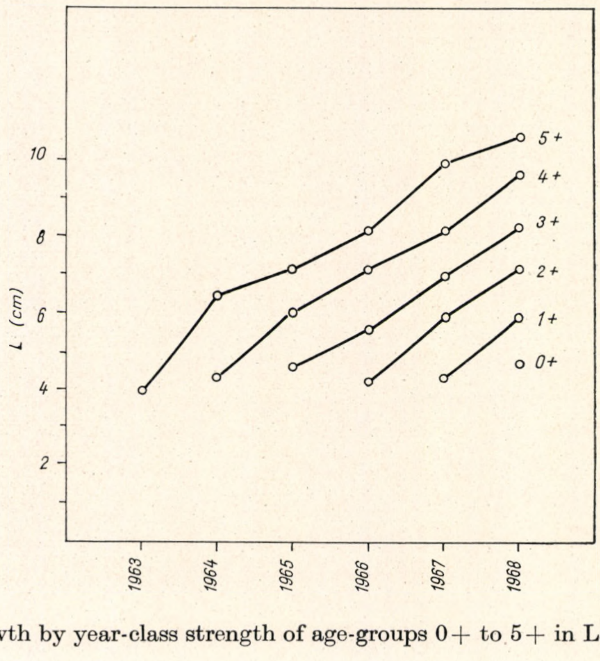


Fig. 6. Growth by year-class strength of age-groups 0+ to 5+ in Lake Balaton

TABLE III

Back-calculated standard lengths (cm) of bleak in Lake Balaton

Standard length		Age-groups						Average	Increase	W* (g)
		0+	1+	2+	3+	4+	5+			
	A	4.1	3.7	3.4	3.9	4.2	—			
L_0	B	5.2	5.2	5.1	5.2	4.5	—			
	C	4.7	4.3	4.2	4.6	4.3	3.9	4.3	4.3	1.0
	A		5.2	4.9	5.1	5.8	—			
L_1	B		7.1	7.0	5.9	6.3	—			
	C		5.9	5.9	5.6	6.0	6.4	6.0	1.7	2.8
	A			6.3	6.7	7.0	—			
L_2	B			8.0	7.4	7.3	—			
	C			7.1	6.9	7.1	7.1	7.1	1.1	4.7
	A				7.7	8.0	—			
L_3	B				8.9	8.2	—			
	C				8.2	8.1	8.1	8.1	1.0	7.1
	A					9.3	—			
L_4	B					9.9	—			
	C					9.6	9.9	9.8	1.7	13.0
L_5	C						10.6	10.6	0.8	16.6

A = minimum; B = maximum; C = average value

* calculated weight according to the average length-weight relationship: $\log W = -5.1508 + 3.1458 \times \log L$

slowest growth period of age-group 5+ coincides in time with the mass fish kill (1965). The back-calculated standard lengths were graphically represented according to FORD-WALFORD'S method. Plotting the lengths in t-time (L_t) in the function of one year later values (L_{t+1}), the dots determine a straight line of which the intercept by the diagonal line passing through the origin at an angle of 45 degrees, gives a theoretically attainable, maximum length, i.e. $L_\infty = 18.8$ cm *(Fig. 7)*. Except the L_0 value, the dots are placed closely along the straight line. From our data the other parameters of BERTALANFFY'S growth-model were also determined, as well as the start point of the exponential curve ($t_0 = -1.25$ year) and the growth coefficient ($K = 0.1142$) *(Fig. 8)*.

TABLE IV

Back-calculated standard lengths of bleak in Lake Balaton

Age groups	Back-calculated standard length (cm)		
	From scales	Ford-Walford's plot	Bertalanffy's model
0+	4.3	3.8	4.3
1+	6.0	5.9	5.8
2+	7.1	7.4	7.3
3+	8.1	8.4	8.5
4+	9.8	9.2	9.6
5+	10.6	10.8	10.6

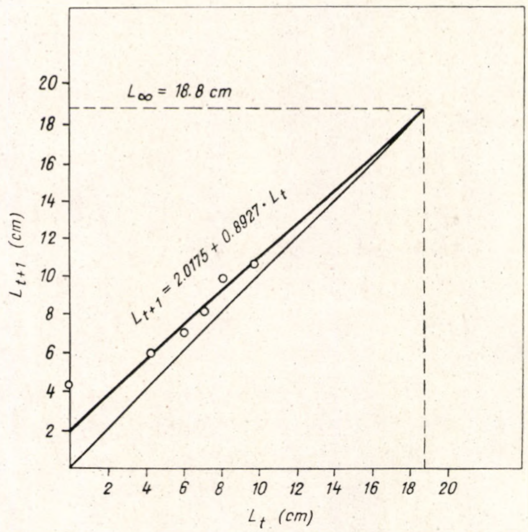


Fig. 7. FORD-WALFORD's plot. L_t = standard length in every t-period of time, if t = 1 year; L_{t+1} = the same one year later; L_∞ = maximum attainable standard length

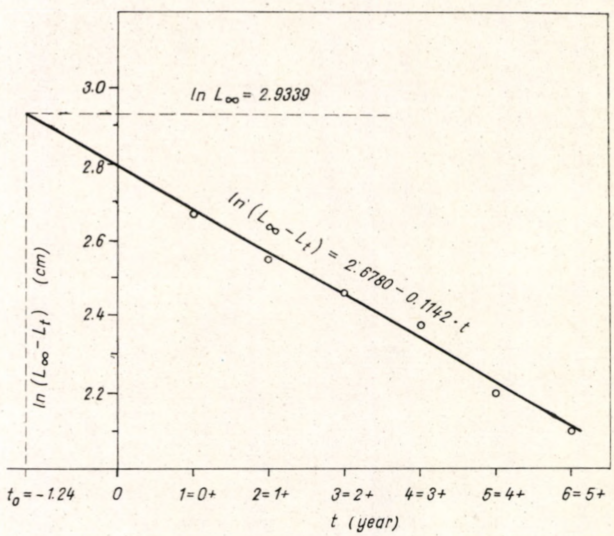


Fig. 8. Estimation of t_0 and K, the parameters of BERTALANFFY's growth model (For explanation see text)

Representing the exponential growth by the parameters obtained, we got a flat-like curve *(Fig. 9)*, the numerical equation being as follows:

$$L_t = 18.8\,(1-\exp-0.1142/t + 1.25/)$$

where L_t = standard length given in cm in every t-period of time, if t = 1 year.

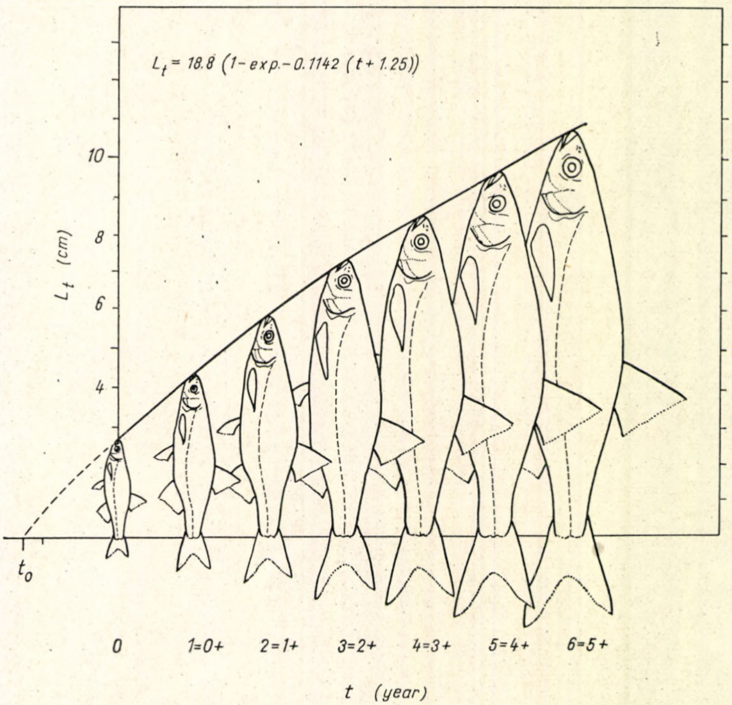


Fig. 9. Growth in length of bleak in Lake Balaton by BERTALANFFY's growth model (For explanation see text).

Comparing the values back-calculated from scales and those represented according to FORD-WALFORD and by BERTALANFFY's model, there is a deviation of 2 to 5 mm in different age-groups *(Table IV)*. This insignificant difference proves the suitability of the model for correct description of growth.

5. *Age-distribution and mortality*

From 1112 bleaks studied, altogether 291 specimens were aged on the basis of the number of completely developed annuli. For the age-distribution we got a typical curve *(Fig. 10)*, where the overwhelming majority consisted of age-groups 1+ and 2+ (46 and 34.7 per cent respectively), but the number of older ones decreased significantly (0.3—4.1 per cent). One-summer-old specimens belonging to age-group 0+ were also represented in a restricted number (13.7 per cent). This fact is evidently in connection with sampling techniques applied. The age-distribution of bleaks examined is asymmetrical. Representing the number of specimens in different age-groups, using their logarithms of natural base when the decrease in number from age-groups 1+ to 5+ was taken to be linear, the instantaneous total mortality coefficient (Z) proved to be 1.33. Survival rate calculated from it was S = 26 per cent and that of the annual mortality was A = 74 per cent *(Fig. 11)*. These rates in different age-groups are greatly variable: between age-groups 1+ and 2+

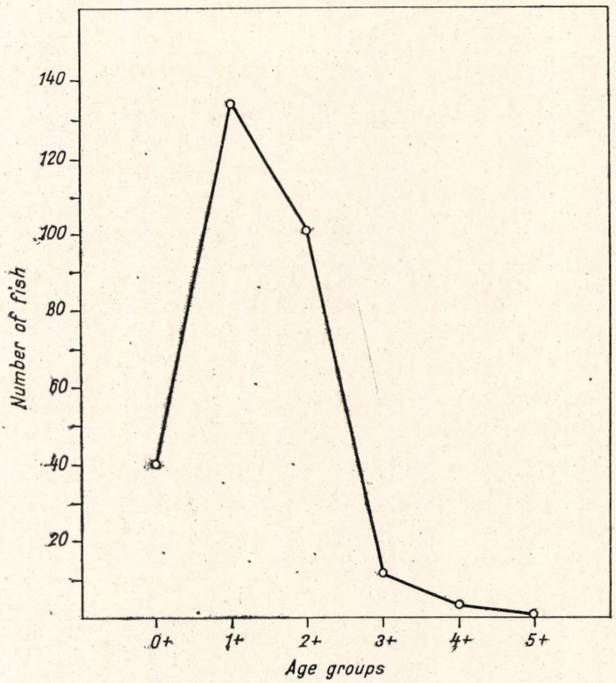


Fig. 10. Age-structure of bleak population in Lake Balaton presented by the sample studied

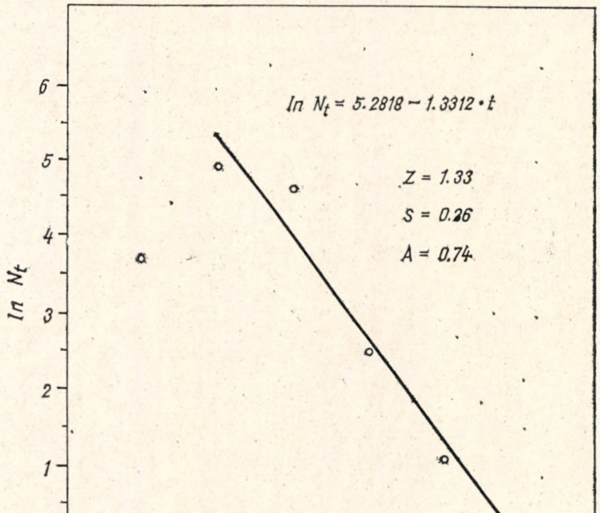


Fig. 11. Mortality of bleak in age-groups 1+ to 5+: the logarithmic decrease of individual number in different age-groups. Z = instantaneous total mortality coefficient; S = survival rate; A = rate of annual mortality

$Z = 0.28$; $S = 76$ per cent, $A = 24$ per cent; in 2+ — 3+ year-old ones $Z = 2.13$; $S = 25$ per cent, $A = 75$ per cent; and finally in 4+ — 5+ year-old specimens $Z = 1.10$; $S = 33$ per cent and $A = 67$ per cent.

6. *Production*

Knowing the initial number of specimens (N_0) and the average weight (W_0) of fish in every age-group and those of the coefficients of mortality (Z) and growth in weight (G), the average biomass ($\bar{B}$) of age-groups 1+ to 5+ have been assessed according to the exponential pattern of growth *(Table V)*. The average biomass proved to be 737 g and its annual increase was 529 g

TABLE V

Average biomass and its annual production in age-groups 1+ to 5+ of bleak in Lake Balaton

Age-groups	N_0 (pc)	W_0 (g)	$N_0W_0 = B_0$ (g)	Z	G	Z—G	$\bar{B}$ (g)	P (g)	$P/\bar{B} \cdot 100 =$ = A. P. (%)
1+	134	2.8	372.5	1.3312	0.9929	0.3383	317.4	315.1	99.3
2+	101	4.7	475.7	1.3312	0.5272	0.8040	325.8	171.8	52.7
3+	12	7.1	85.6	1.3312	0.4146	0.9166	56.2	23.3	41.4
4+	3	13.0	38.9	1.3312	0.6007	0.7305	27.6	16.7	60.5
5+	1	16.6	16.6	1.3312	0.2444	1.0868	10.2	2.5	24.5
Total	251						737.2	529.4	

$$\bar{B} = \frac{B_0(1\text{-exp-}/Z-G/)}{Z-G} \quad \text{if } Z > G \quad \Sigma P/\Sigma\bar{B} \times 100 = \text{A. P.} = 71.8 \text{ per cent}$$

in our sample. The ratio of increased biomass ($\bar{B}G$) per average biomass ($\bar{B}$) gives the annual production (P), which on an average proved to be 71.8 per cent for the given age-groups. The annual production of average biomass was the highest in age-group 1+ (99.3 per cent), while in others it ranged from 24 to 60 per cent.

Discussion

The bimodal or asymmetrical length-distribution of bleak population in Lake Balaton has been previously observed by ENTZ (1949—50) during his studies carried out on winter shoals of bleak. Such pattern of length-distribution was also experienced during our investigations. The seasonal character of the age-structure unanimously shows that in spring the bleak population of Lake Balaton is divided into two dominant age-groups. Thereafter, during the summer months, one predominating size-class is formed. This compensation is evidently due to the relatively high number of two-summer-old fish *(Figs 1—2)*. The same could be observed when analysing the length-distribution of bleak remains found in pike-perch stomachs (BIRÓ, 1973). The length-distribution of bleaks proved to be extremely similar in the pike-perch stomachs and during our present investigations. The spring bimodal and the summer asymmetrical structure have been observed in both cases. It could be concluded that pike-perch selects the most abundant 1—2 year-old specimens of 5.5—7.0 cm being present any time. Since the predatory pike-perch population consumes annually 31—32 kg/ha fish (BIRÓ, 1973; 1975a, b), and its food consists mainly of bleak, it is evident that bleak has a decisive importance in the food-chain as an energy-mediator. To the quantitative estimation of this phenomenon the correct knowledge of real biomass of bleak population expressed in unit of area is wanted. This should be determined by further investigations. In the littoral zone of Lake Balaton the biomass of bleak population present seasonally varies very much because of emigration and immigration. This fluctuation is multiplied by bleak-consumption of different predatory fish (pike-perch, eel, etc.). Bleak can be found along the littoral zone in significant number during the spawning period, when shoals consisting mainly of 1—4 year-old specimens can be observed *(Fig. 12)*.

From the seasonal variation of length-weight relationship it seems to be that the value of its coefficient changes parallel with the periodical spawning and takes place during spring and summer months. More remarkable differences in weight attributed to spawning activities releasing a relatively greater amount of eggs only appeared above 8—9 cm standard length. According to PAPADOPOL (1968), the range of egg number of 1—4 year-old, and of 6.5—11.5 cm sized bleaks originated from Somova (River Danube) was between 592—5700, on an average 1970. The number of ovocytes in different stages of development

Fig. 12. Periodically spawning shoal of bleak consisted of 1—4 year-old specimens at stony littoral zone of Lake Balaton

varied between 898—5814, on an average it was 2437. In the ovary he found in 44.7 per cent ovules and in 55.3 per cent ovocytes. We have no data referring to fecundity of bleaks widespread in Lake Balaton, but the number of their eggs possibly shows the same variation. In seasonal variation of length–weight relationship CHITRAVADIVELU (1974) described very great differences of the coefficients of bleaks caught in ŽOFIN-complex (River Danube) between July and October.

Studies on cycloid scales of characteristic shape showed a linear regression between standard lengths and caudal radii of scales. By this relationship 8.7 cm was calculated for standard length, which gives the size measurable in time of "key-scale" formation *(Fig. 4)*. This is about a half of that CHITRAVADIVELU (1971) has observed on bleaks (16 mm) inhabiting the Labe river system. This difference may be due to the measuring of diagonal radius applied by him. The size of 8.7 mm obtained during our investigations seems to be smaller than the real one, and equals with the length of one-two week-old fry.

Standard lengths back-calculated from annual radii of scales showed a slow growth of bleak in Lake Balaton. Its primary reason might be due to qualitative and quantitative features of food. This is supported by analysis of the gut content of a number of specimens, the food mainly consisting of diatoms (G. TAMÁS, oral information) and in smaller amount of animal food (crustacean-plankton, insects) (ENTZ and LUKACSOVICS, 1957). The monotony of gut contents can reflect the insufficiency of available food for bleak in the littoral zone, but on the other hand, it can be the results of its competition with eel (*Anguilla anguilla* L.) for food (BIRÓ, 1974). Based on these assumptions, the difference experienced in growth rate of bleak as compared to data published by ENTZ (1949—50) can be explained. From this fact, however, we drew the conclusion that the slow and uneven growth of pike-perch (BIRÓ, 1970; 1972) must be in causal connection with the slow rate of growth of bleak recently observed. Decrease recorded in the growth rate of bleak was also described in other prey fishes of pike-perch (BIRÓ, 1971; 1972; PONYI et al., 1972). These signs should be considered if the food chains of different fish species, e.g. pike-perch should be explained quantitatively as related to environmental changes of the lake. Environmental change, toxic effect, etc. concerning the growth by year-class strengths mostly seems from the length increase of bleaks of age-group 5+, where the fish kill taken place in 1965 coincides with the slower growth-period of this age-group. The causal connection of this coincidence in time, however, can not be demonstrated unanimously.

The maximal standard length in the model describing the growth of bleak in Lake Balaton, $L_\infty = 188$ mm, hardly differs from the theoretical size of 192 mm described by CHITRAVADIVELU (1974). According to his findings, this is attained by 13—15 year-old bleaks. In Lake Balaton such old specimens could not be detected. The age of the oldest ones supposed to be present may reach probably 8—9 years. The number of such old specimens, however, may be very small in the lake, because not a single such old specimen was caught during our 47 collections. Mortality of the population is strongly affected by death immediately after spawning, when primarily males die (ENTZ, oral information). The instantaneous mortality coefficient $Z = 1.33$ is higher than that observed in the Danube, which was $Z = 0.82$ (CHITRAVADIVELU, 1974). The assessed value of mortality in Lake Balaton is strongly influenced by significant loss during spawning, too. Besides mature bleaks a great amoun of eggs laid down dies before hatching of larvae; in consequence of that the eggs become entirely covered by muddy sediment and colloids floated by rough water. This observation refers to other fish species, as well as to bream (*Abramis brama* L.), which spawns on the same stony grounds (Biró and Garádi, 1974).

Because of insufficient knowledge of population number and biomass expressed for unit area, the production could be given only in unit of average biomass. Despite of low survival rate, the production of average biomass is high, it may be estimated about 72 per cent in which the portion of one-summer-old fish is excluded. It is highly probable that because of the great

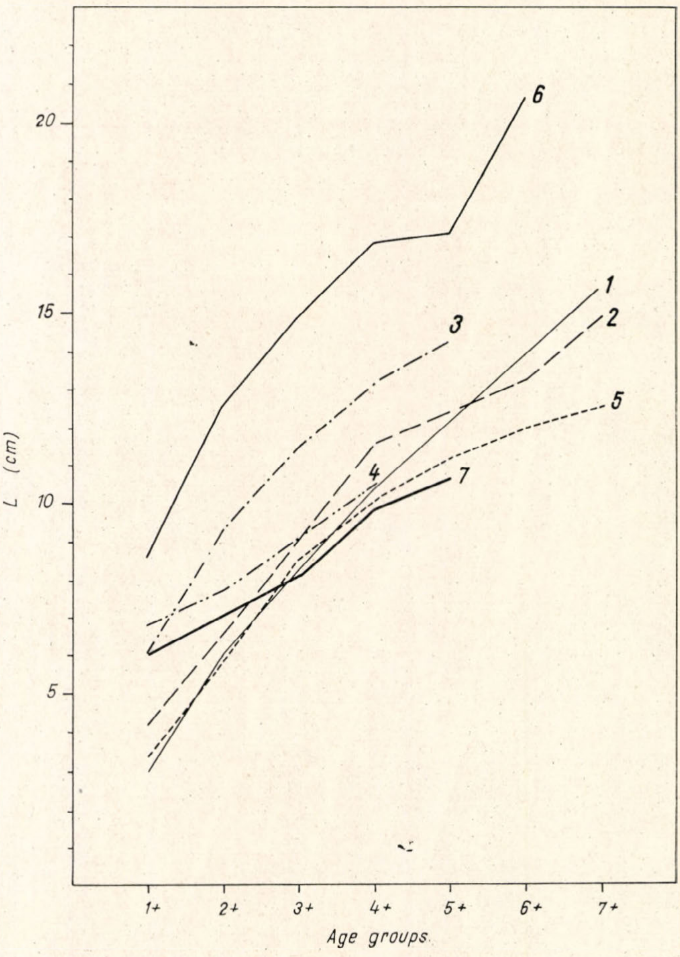


Fig. 13. Growth in length of bleak in different European waters: 1. Lake Langelmaresi (Finland) (Broefeldt, 1917, cit. Berg, 1933), 2. Average of 20 N-German lakes (Bauch, 1955), 3. Lake Ilmen (Soviet Union) (Domracev, 1926, cit. Berg, 1933), 4. Somova (Danube Delta, Roumania) (Papadopol, 1970), 5. Thames (England) (Williams, 1963), 6. Average of Slapy and Lipno Reservoirs (Czechoslovakia) (Vostradovský, 1963), 7. Lake Balaton (Hungary), present investigations

number of one-summer-old fish the ratio of P/B is higher. During his three-year studies CHITRAVADIVELU (1974) found the population density of bleak inhabiting the ŽOFIN-complex (River Danube) to be varying between 158—9675, their biomass ranging from 11 to 170 kg/ha and with a gross production from 5.2 to 91.0 kg/ha. Presumably we have to reckon with similarly significant, but more balanced variability in bleaks of Lake Balaton, because its shallow water gives more stabilized living possibilities as compared to the habitat in lotic environment.

Comparing the data published on growth of bleak in different European waters (BERG, 1933; BAUCH, 1955; OLIVA and FRANK, 1959; ČIHAR, 1961; VOSTRADOVSKÝ, 1963; WILLIAMS, 1963; MANN, 1964; BALON, 1967; KIECKHÄFER, 1967; PAPADOPOL, 1970; CHITRAVADIVELU, 1971; 1974) we found their growth in Lake Balaton to be relatively slow in spite of the fact tha the mean-size of one-year-old specimens is comparatively large *(Fig. 13)*

Summary

Length- and age-distribution of 1112 bleaks, as well as the growth of 294 specimens collected during consecutive months of 1968 have been studied. The seasonal variations in length-weight relationship, the mortality, average biomass and production of the population were studied. It was established that:

1. The population showed in spring a bimodal distribution by standard length, which was transformed to asymmetrical.

2. The length-weight relationship showed significant seasonal variation, which is evidently in connection with ripening cycle of gonads, with spawning as well as changes in condition.

3. Regression between the total caudal radii of scales and standard lengths was linear. The straight line cuts 8.7 mm from the abscissa. On the basis of standard lengths calculated from the annuli of scales, the growth of bleak is usually slow in Lake Balaton, its annual increase in length is small. Exponential growth in standard length could be well represented by BERTALANFFY's model. The observed stunted growth of bleak as compared to previous data may be probably the consequence of food scarcity of the littoral zone and the result of food competition with other fish species.

4. Age-structure of the stock is asymmetrical and its overwhelming majority consisted of age-groups 1+ and 2+ in 46 and 34.7 per cent, respectively. One-summer-old (0+) fishes were present only in 13.7 per cent, and the ratios of older ones, belonging to age-groups 3+ — 5+, were between 0.3—4.1 per cent. Based on decrease in logarithmic number of specimens, the instantaneous total mortality coefficient proved to be $Z = 1.33$, the rate of survival was $S = 26$ per cent and that of annual mortality $A = 74$ per cent. These values have changed in different age-groups. The ratio of average biomass and production on an average was $\bar{P}/\bar{B} = 71.8$ per cent. It was found to be highest in age-group 1+ (99.3 per cent), while in others (2+ to 5+) it varied between 24—60 per cent.

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A KÜSZ (*ALBURNUS ALBURNUS* L.) NÖVEKEDÉSE A BALATONBAN, MORTALITÁSÁNAK ÉS PRODUKCIÓJANAK BECSLÉSE

Bíró Péter

Összefoglalás

Vizsgáltuk 1968 különböző hónapjai során gyűjtött 1112 db küsz méret- és kormegoszlását és scalimetrikus mérések alapján összesen 294 példány növekedését. Tanulmányoztuk a testhossz-testsúly viszonyának szezonális variációját, az állomány mortalitását, átlagos biomasszájának produkcióját. Megállapítható volt:

1. Tavasszal az állomány a törzshosszak alapján bimodális megoszlást mutatott, amely a nyári kompenzálódás után aszimmetrikussá vált.

2. A testhossz-testsúly viszonya szezonálisan szignifikáns különbségeket mutatott, ami nyilvánvalóan kapcsolatos a gonádok fejlődési ciklusával, az ívással, valamint a kondícióbeli változásokkal.

3. A pikkelyek teljes kaudális rádiusza és a törzshossz regressziója gyakorlatilag lineáris volt. A „kulcs"-pikkelyek képződésekor mérhető törzshosszra 8,7 mm-t kaptunk. A pikkelygyűrűkből visszaszámított törzshosszak alapján a küsz növekedése a Balatonban általánosan lassú, évenkénti növekedése kismértékű. A törzshossz exponenciális növekedése a BERTALANFFY-féle modellel pontosan leírható. A küsz állományra vonatkozó korábbi adatokhoz képest lassúbb növekedése valószínűleg a tó parti öve táplálékbeli elszegényedésének következménye, illetve más halfajokkal szembeni kompetíció eredménye lehet.

4. Az állomány kor szerinti struktúrája aszimmetrikus, a döntő többséget 1+ és 2+ korcsoportok alkották 46 illetve 34,7%-ban. Csak 13,7%-ban szerepeltek egynyaras (0+) halak, s az idősebb, 3+ — 5+ korcsoportúak részaránya 0,3—4,1% volt. Az egyedszámok logaritmikus csökkenése alapján a totális mortalitás pillanatnyi együtthatója $Z = 1{,}33$ volt, a túlélés rátája $S = 26\%$-nak, az éves mortalitás $A = 74\%$-nak adódott. Ezek az értékek a különböző korcsoportokban változtak. Az átlagos biomassza és produció aránya $P/\bar{B} = 71{,}8\%$ volt, legmagasabbnak az 1+ korúaknál találtuk (99,3%), míg a többi korcsoportban 24—60% között változott (2+ — 5+ korúaknál).