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SCALE STRUCTURE OF CHUB (*Leuciscus cephalus* L.) FROM HEATED KONIŃSKIE LAKES

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A B S T R A C T. Development and structure of scales of chub from heated Konińskie lakes were studied. First sclerites form on the lateral-oral end of the scales at body length of fry 15-20 mm. Along with scale growth, sclerite arrangement at the caual end of the scales became blurred, while at the oral end – condensed. Annual ring appeared in May. Radius length to sclerite number ratios were similar and did not differ among the lakes.

Key words: CHUB, SCALE STRUCTURE, HEATED LAKES

INTRODUCTION

Studies of fry community size structure of Konińskie lakes showed considerable variation of chub fry size, not only within, but also among the lakes, corresponding to the temperature increase (Wilkońska, Żelepień 1994). Samples collected in 1992-1993 allowed assessing the effect of temperature dynamics on scale development and structure, and time of annual ring formation.

MATERIAL AND METHODS

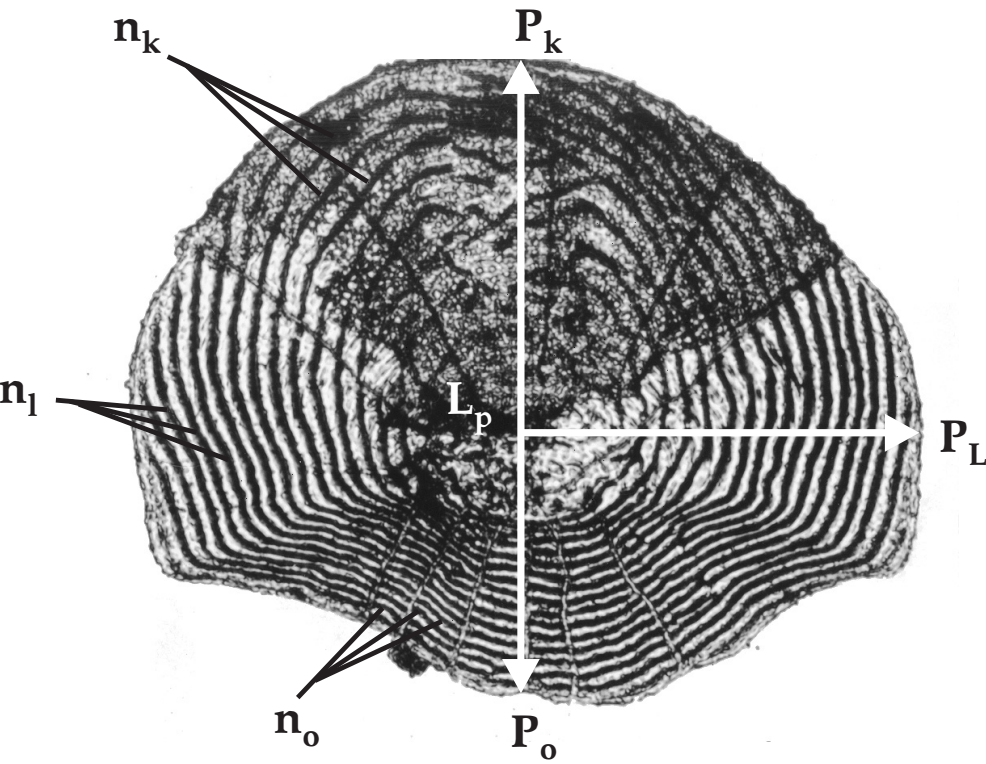
The fish were harvested from Gosławskie, Licheńskie and Ślesieńskie lakes. Total number of 634 chubs was studied. Harvest date, sample numbers, age and body length of fry are shown in tab. 1.

During phase of scale cover formation (in chub of body length under 25 mm), scales were collected at the base of caudal peduncle, and in the individuals over 25 mm – from the first row over the lateral line, under the dorsal fin. For detailed measurements, the most distinct scale was selected, having viewed at least ten scales from each individual. Caudal radius (Pk), oral radius (Po), and both lateral radii (Pl) were measured with 0.001 mm accuracy. Sclerites were also counted, marked nk, no, and nl, respectively (photo 1). For the lateral radii and number of lateral sclerites (Pl and nl), average values from both sides of a scale were assumed. The relationship between

TABLE 1

Age, length (Lc) range, and numbers (n) of chub collected from Konin lakes in 1992-1993

Lake	Licheńskie		Gosławskie		Ślesieńskie							
Age	0+		0+		0+		1+		2+		3+	
Date	Lc (mm)	n	Lc (mm)	n	Lc (mm)	n	Lc (mm)	n	Lc (mm)	n	Lc (mm)	n
26.05.92	15-35	20	11-40	92	-	-	21-65	93	-			
03.09.92	31-35	4	25-105	18	26-65	98	83	1	-			
10.05.93	23	1			-	-	46-71	8	81-120	10		
29.07.93	21-60	33	41-80	16	21-50	199	71-105	35	106-115	3	180-210	3
Razem	15-60	58	11-105	126	21-65	297	21-105	137	81-120	13	180-210	3



Phot. 1. Scheme of chub scale. P_k - caudal radius, P_o - oral radius, P_l - lateral radius, n_k - caudal sclerites, n_o - oral sclerites, n_l - lateral sclerites

TABLE 2

Linear regression coefficients for the relationship between body length and lateral sclerite numbers
($nl=a+Lc*b$)

Regression coefficients	a	b	r
Licheńskie	-8.664	0.654	0.982
Gosławskie	-8.653	0.66	0.992
Ślesieńskie	-8.66	0.643	0.997

TABLE 3

Average values of: Pl/Pk; Pl/Po; nl/nk; nl/no; Pl/nl for chub scales in Konin lakes
(n - number of measurements)

	Pl/Pk	Pl/Po	nl/nk	nl/no	Pl/nl(mm)
Licheńskie n=174					
Mean	0.98	1.92	1.47	1.00	0.041
SD	0.10	0.19	0.18	0.11	0.008
Gosławskie n=378					
Mean	0.98	1.98	1.51	0.99	0.040
SD	0.09	0.17	0.16	0.13	0.005
Ślesieńskie n=1350					
Mean	0.98	1.97	1.46	1.00	0.039
SD	0.11	0.16	0.12	0.10	0.009

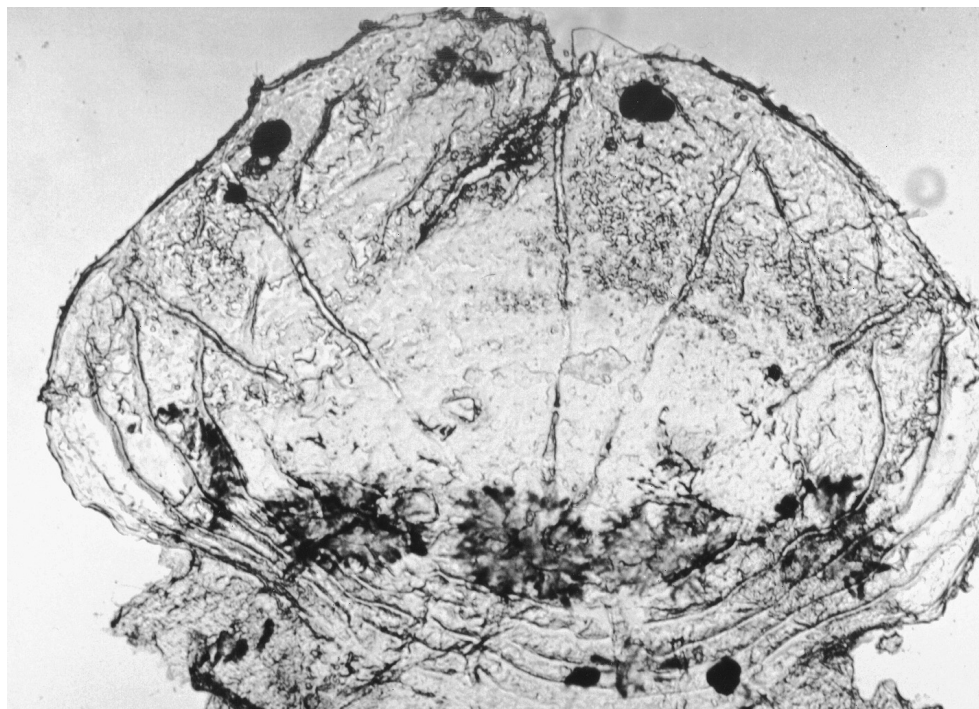
body length (Lc cm) and number of lateral sclerites was described by the equation $nl=a+Lc*b$. Values of a , b and r coefficients are presented in tab. 2.

Scale structure was described by the relationship between radius and number of lateral sclerites (Pl , nl), and other measures of scale (tab. 3).

RESULTS

SCALE STRUCTURE

Formation of scales and sclerites was observed in chub larvae from Licheńskie and Gosławskie lakes (tab. 1). Nuclei of the scales, the so-called "primary scales", were observed in 13 mm larvae from Gosławskie Lake, and the first sclerites appeared in 15-16 mm fish from both lakes. Initially they were present only on lateral-oral end of the scale (photo 2). At the caudal end, the first sclerites appeared at body length 18-19 mm. The number of developed lateral sclerites correlated significantly positively with body length (Lc cm), the correlation being a straight-line regression (tab. 2).



Phot. 2. Primary scale of chub fry

Along with the scale growth, beginning from 35 mm of body length, arrangement of the sclerites on the caudal end became blurred, and on the oral end – condensed. Only in the lateral part of the scale, the sclerites were well visible and parallel (photo 3), and their number was related exclusively to chub body length, irrespective of the lake (tab. 3). Thus, the lateral radius (Pl) and number of lateral sclerites were used in assessing chub scale structure. Relationship between these parameters and the other scale dimensions (Pk, Po, nk, no) was similar in all the lakes (tab. 2). The Pl length was slightly lower than Pk, and almost twice higher than Po. On the other hand, numbers of lateral and oral sclerites were equal, but 1.5 times higher than in the caudal part (tab. 3). Pl/Po and nl/nk ratios were always higher in fish from Gośławskie Lake compared to fish from Licheńskie or Ślesieńskie. The highest nl/no ratio was noted in Ślesieńskie Lake, and the lowest – in Gośławskie. Thickness of the lateral sclerites was slightly higher in Licheńskie Lake compared to Gośławskie and Ślesieńskie. Although these differences were not significant, they might have resulted from different time and intensity of lake heating.

DEVELOPMENT OF ANNUAL RINGS

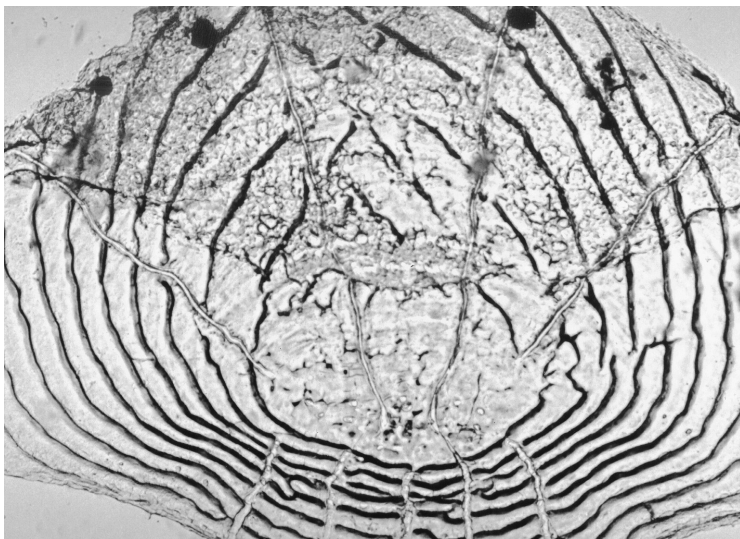
Annual rings developed only in scales of chubs from Ślesięskie Lake (tab. 1). They were present at the scale edge in all the fish harvested in May, in 20-70 mm fry as well as in 1-2 years old fish. In the first year, 10-30 sclerites appeared, in the second – 30-70 (at Lc 83-120 mm), and in the third – 70-110 sclerites (at Lc 120-200 mm) (phot. 4). Such high variability of body length in particular age groups resulted not only from differences of individual growth rate, but also from different hatching time of the cohorts (Wilkońska, Żelepień 1994).

DISCUSSION

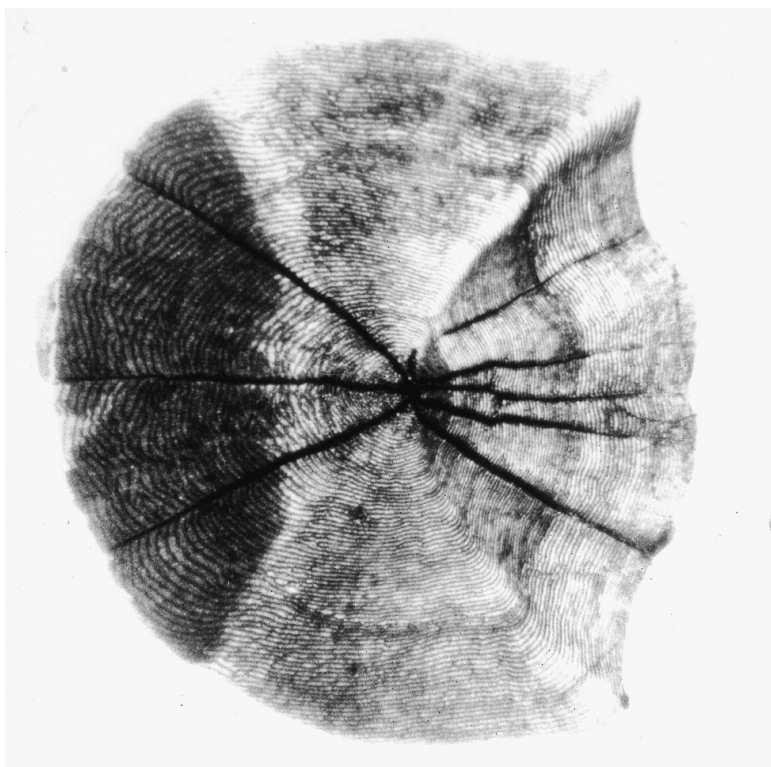
Chub scales start to develop at body length (Lc)13 mm. At first, "primary scale" appears, and then, at Lc 15-16 mm, the first sclerites are formed. Similar results were obtained by Ekonomou et al. (1991). Also in roach and sunbleak (Balon 1956), and in common carp (Mc Crimon, Swee 1967), scale and sclerite formation were observed at similar body length. It is possible that scale formation at such body length is typical for cyprinid fishes. In salmonids, on the other hand, scales appear in 37-42 mm long fish (Bilton 1988). Straight-line relationship between chub body length and number of sclerites was observed (tab. 2), similarly as in other species (Fisher, Pearcy 1990, Kamiński et al. 1996). Exponential relationship was observed only in vimba (Buras, Wolnicki 1996).

Scale structure, described by the relationships between length of radii (Pl, Pk, Po), number of sclerites (nl, nk, no) and their thickness differed slightly among the fish from various lakes (tab. 3). Although the differences were not statistically significant, they might have resulted from different thermal conditions of the lakes. Similar differences of number and thickness of the sclerites were observed also in roach and bream from the same lakes (Wilkońska 1977, Marciak 1977).

Formation of annual rings in May was also observed by other authors in chub from various water bodies: Mann (1976), Prokeš et al. (1978), and Nabiałek (1984). Thus, it seems that new growth season of chub starts in May. It should be added that all these authors observed low variability of body length in fish 1⁰ and 2⁰. Contrary to this, in fish from Konińskie lakes, body length variability was quite distinct, this being probably caused by portioned spawning (Wilkońska, Żelepień 1994) and of the scales, at body length of larvae 15-20 mm (photo 2). Number of sclerites correlated with



Phot. 3. Scale of a chub 35 mm long



Phot. 4. Scale of a chub aged 2+

body length (tab. 2, photo 4). Relationships between the length of lateral, oral and caudal radius, and the number of sclerites were similar for the fish from all lakes (tab. 3). New annual rings appeared always in May, irrespective of body length.

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STRESZCZENIE

STRUKTURA ŁUSEK KLENIA (*Leuciscus cephalus* L.) W PODGRZEWANYCH JEZIORACH KONIŃSKICH

Badano rozwój i strukturę łusek klenia w 3 podgrzewanych jeziorach konińskich (tab. 1, rys. 1). Pierwsze skleryty wokół „łuski pierwotnej” (Nagięć, Murawska 1992) pojawiają się po stronie oralno-lateralnej łuski przy długości larw 15-20 mm (rys. 2, 3). Proporcje między długością promieni lateralnych, oralnego i kaudalnego oraz liczbą odłożonych na nich sklerytów były podobne we wszystkich jeziorach (tab. 2). Liczba sklerytów zależy od długości ciała (tab. 3, rys. 4). Pierścień roczny podobnie jak i następny bez względu na długość kleni był zakładany w maju.

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